A Technology Strategy Analysis for the Deployment of Broadband Connectivity for Economic Development in Emerging Economies: Studying the Case of Kenya Using the CLIOS Process

by

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Submitted to the Engineering Systems Division
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ABSTRACT

The role of Information Communication Technology (ICT) in economic development is increasingly moving to the core of national competitiveness strategies around the world thanks to its revolutionary power as a critical enabler of growth, development and modernization. As a result, many nations in emerging economies have initiated projects with the aim of increasing universal access to communications such as the deployment of broadband internet; one such nation is Kenya.

Kenya recently drafted a national ICT policy (2006) and with the advent of broadband internet through the completion of several submarine (optic fiber) cable projects, the country now faces the challenge of converting this newly deployed infrastructure into a catalyst for sustainable economic growth. Each nation invariably presents a set of unique challenges, characteristics and circumstances that can only be overcome through a comprehensive and integrated technology strategy that appreciates the complexities and dependencies of the sector space and the myriad of interests influencing the policy sphere.

This thesis presents a technology strategy formulation approach that can be effectively used to model and analyze this technology policy problem called the Complex Large Interconnected Open Socio-technical (CLIOS) Process and applies it to the Kenya ICT sector with reference to the deployment of broadband with a goal of achieving sustainable economic growth.

The findings of the thesis encourage the deployment of broadband in a phased manner, beginning with corporations and later to individual clients, from areas of high density population to areas of low density; piloting the deployment using less permanent broadband installation technologies and progressively moving onto more permanent installation technologies backed by sufficient user demand; and finally to have a participative policy and strategy formulation for the achievement of the overall deployment goals.

The thesis concludes by critiquing the effectiveness of the CLIOS process for ICT strategy formulation and mentions the resulting policy recommendations after using the CLIOS Process. It is the hope of the author that this thesis shall offer a framework that will elucidate the ICT policy making space which can later be utilized to analyze further policy decisions.

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CHAPTER 1: INTRODUCTION

1.1 Summary

This thesis examines the policies and strategies associated with the challenges of broadband deployment for socio-economic development with a primary focus on the nation of Kenya. This follows recent investments in fiber optic cables to deliver broadband to Kenya and other countries along the eastern seaboard of Africa, coupled with recent prominence of broadband as an enabler of economic development with capabilities offering significant promise of economic and social benefit.

With the completion of many of these broadband submarine projects, the challenge has now shifted to their strategic and effective deployment that will translate the information and communication technology (ICT) policies into tangible economic benefits – turning the bits and the bytes into nickels and dimes (positive GDP growth). The potential advantages of ICT for development are enormous and national policies need to adequately reflect comprehensive and integrated strategies for harnessing and exploiting this potential. This requires the adoption of a technology strategy that appreciates the complexities and dependencies of the sector space.

This thesis seeks to bring a systems understanding to the question of broadband deployment for economic development that can later be used for quantitative and qualitative analysis of sector performance and the formulation of e-strategies. An important step in policy making is correctly framing the policy question. The systems approach proposed in this thesis seeks to frame the question of broadband deployment and aid policy makers, policy analysts, researchers and investors in understanding the broad question of broadband deployment for economic development. Most specifically, in this thesis the reader will find:

i. A compilation of what may be termed as relevant information for the analysis of the broadband policy question from the perspective of emerging economies , also considering their ICT policy goals and how realistic and achievable they are

ii. Clarity on what exactly are the broadband activities that will generate economic development for emerging economies, their interactions with other components within the broadband system as well as the challenges

iii. Highlights of the policy sensitive areas relating to broadband technology and economic growth in emerging economies

iv. Supportable advice to policy makers with a new way (systems related) for approaching the domain to generate strategies by applying the Complex Large-scale Interconnected Open Socio-technical (CLIOS) Process

v. While applying the CLIOS Process, critiquing the current strategies in place, highlighting key areas that may have been overlooked for achieving broadband deployment success and offering recommendations

vi. Finally, the thesis will show the appropriateness or not of using such a process for the analysis of the question of broadband for economic development in emerging economies

Broadband is often associated with particular facilities or transmission technologies used for its implementation; nevertheless, broadband also covers a convergence of digital streaming (video, audio, text) that can be transmitted across the Internet. This makes broadband Internet a platform that is capable of supporting many different types of applications. Broadband Internet connectivity has therefore been inevitably linked with social and economic benefits.

Nevertheless the deployment of broadband presents a typical "chicken-and-egg" conundrum. A broadband-based application will not be made available unless a given number of subscribers have a broadband connection, with performance high enough to support the application, yet service providers will not invest in high performance broadband until they know that there will be sufficient demand for the service. Investments are therefore dogged with uncertainties about appropriate broadband prices coupled with demand for its capabilities. This thesis aims to elucidate this challenge by offering a systems understanding to the problem.

1.2 Africa's Broadband Infrastructure (Background)

Sub-Saharan Africa is the most digitally isolated region in the world, and also has among the highest connectivity costs in the world. In a journal publication of the American Academy of Arts and Sciences, Prof. Calestous Juma and Elisabeth Moyer (2008), noted that "universities (in Sub-Saharan Africa) pay some 50 times more for bandwidth than do similar institutions in the United States, and connectivity cost per gross domestic product is almost 2,000 times higher than in the United States." The resulting isolation of Africa from the remainder of the world is a therefore a serious impediment to both education and economic development.

Africa is the continent with the lowest internet penetration in the world. In March 2009, the Internet World Statistics noted that Africa had an internet penetration of 5.6%. The penetration corresponds to the percentage of the total population in the continent that uses the Internet. Figure 1.1 shows Africa's Internet penetration compared to the rest of the world.

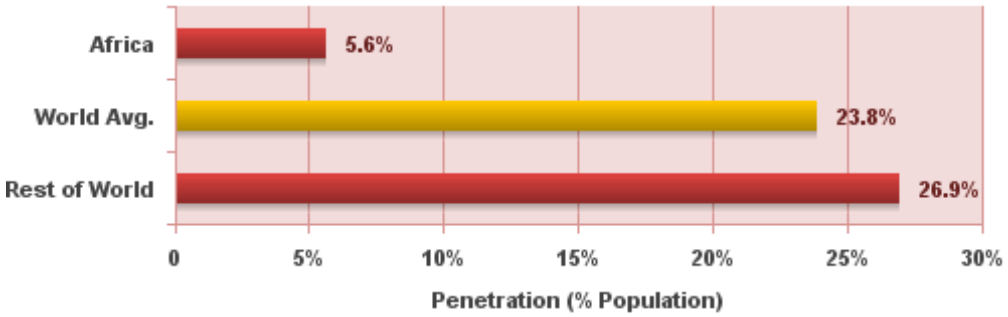


Figure 1.1: Internet Penetration in Africa 2009 Q1 (March 2009)
Source: Internet World Statistics, Accessed 20th July, 2009

The Internet World Statistics also goes on to note that the African continent had approximately 54,171,500 users for the quarter ended March 2009, where an Internet user is defined by the International Telecommunications Union (ITU) as someone aged 2 years old and above who went online in the predefined period of 30 days. Figure 1.2 shows Internet users in Africa compared to the rest of the world and Figure 1.3 shows the national breakdown of the Internet users in Africa.

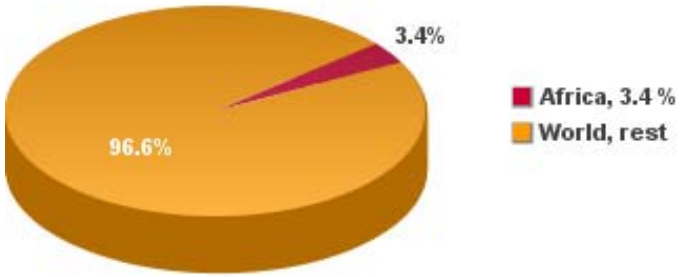


Figure 1.2: Internet Users in Africa Compared to the World 2009 Q1 (March 2009)
Source: Internet World Statistics, Accessed 20th July, 2009

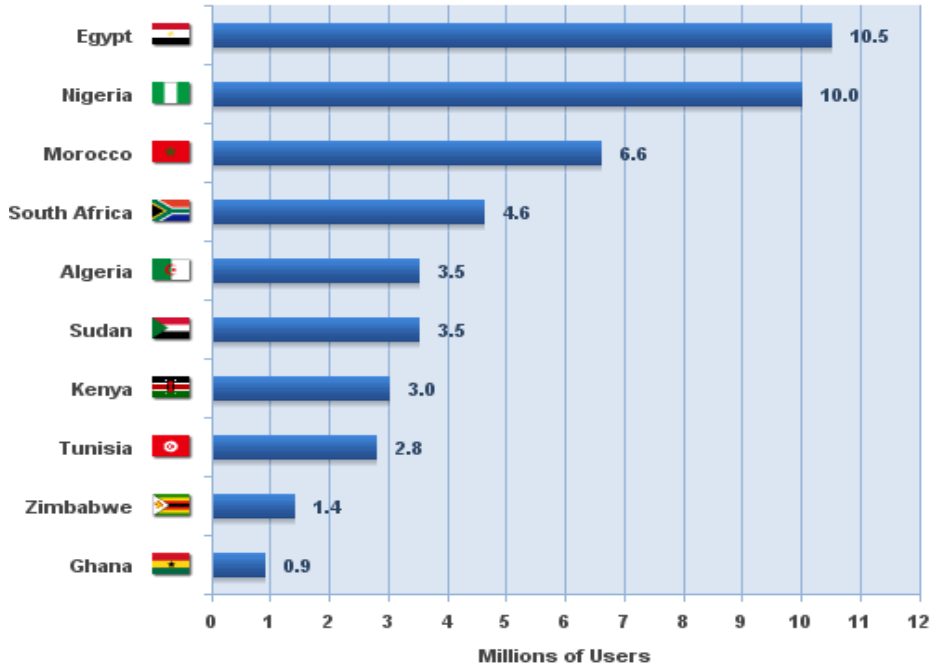


Figure 1.3: National Breakdown of Internet Users in Africa 2009 Q1 (March 2009)
Source: Internet World Statistics, Accessed 20th July, 2009

African nations have recently started undertaking several projects to enhance connectivity and encourage the growth and use of the Internet within the continent. Several fiber optic projects have been proposed, and some of them have been constructed or are under construction with the promise of bringing connectivity to the continent. Many nations have bundled the deployment of broadband Internet with economic and social development, a promise that can only be verified by the test of time and the proper deployment plan and use of the Internet within these nations.

Several attempts have been made to improve connectivity within the continent, the first major one being an attempt at an Africa-wide fiber optic cable dubbed "Africa One" shown in Figure 1.4 by Africa One Ltd owned by Columbia Technologies of New Jersey, USA in 1993. Africa One Ltd. was to develop and own a state-of-the-art undersea fiber optic self-healing loop around Africa. Lucent Technologies were selected as the preferred equipment and software supplier while Global Crossing Ltd. was to provide project management and undersea construction. The network was to provide end-to-end connectivity for the African continent to 19 countries and 185 cities around the world. The project collapsed because the downturn in the telecommunications industry and the subsequent collapse of some of the major partners.

Figure 1.4: The Africa ONE Project
Source: Emeagwali, Accessed 3rd March, 2009

At around the same period, another African submarine project materialized as the Third Southern Africa Telecommunication /West Africa Submarine Cable/ South Africa-Far East Project (SAT3/WASC/SAFE). SAT3/WASC/SAFE connects Portugal to South Africa linking the entire west coast of Africa then crossing the Indian Ocean to East Asia. The fiber cable system is divided into two main subsystems namely SAT3/WASC (the Third Southern Africa - Western Africa Submarine cable), a 15,000km fiber optic cable linking Europe with South Africa and ten countries on the West African coastline. The African countries are Senegal, Nigeria, Ghana, Ivory Coast, Benin, Cameroon, Gabon, Angola and South Africa. Non-African countries who form part of the project are Canary Island, Portugal and Spain. SAT3/WASC and its SAFE (South Africa - Far East) extension continues the connection another 13,800km as far as Malaysia via Reunion and Mauritius, with a landing that brings India into the network. SAT3/WASC/SAFE was launched on May 27, 2002, in Senegal.

However the SAT/WASC/SAFE project has not had the desired major impact in the African countries to which it connects. The project has been criticized by telecommunication experts for not solving the high costs associated with broadband. This was mostly attributed to monopolies that are enjoyed by the SAT3/WASC signatories. This has left great uncertainty as to just how broadband can be used for economic development in the proposed upcoming projects. Nevertheless, the continent stands to learn a lot from these projects that can be utilized in the later deployment of other fiber deployment projects. The planned fiber projects to connect the African continent due for completion in 2011 are shown in Figure 1.5.

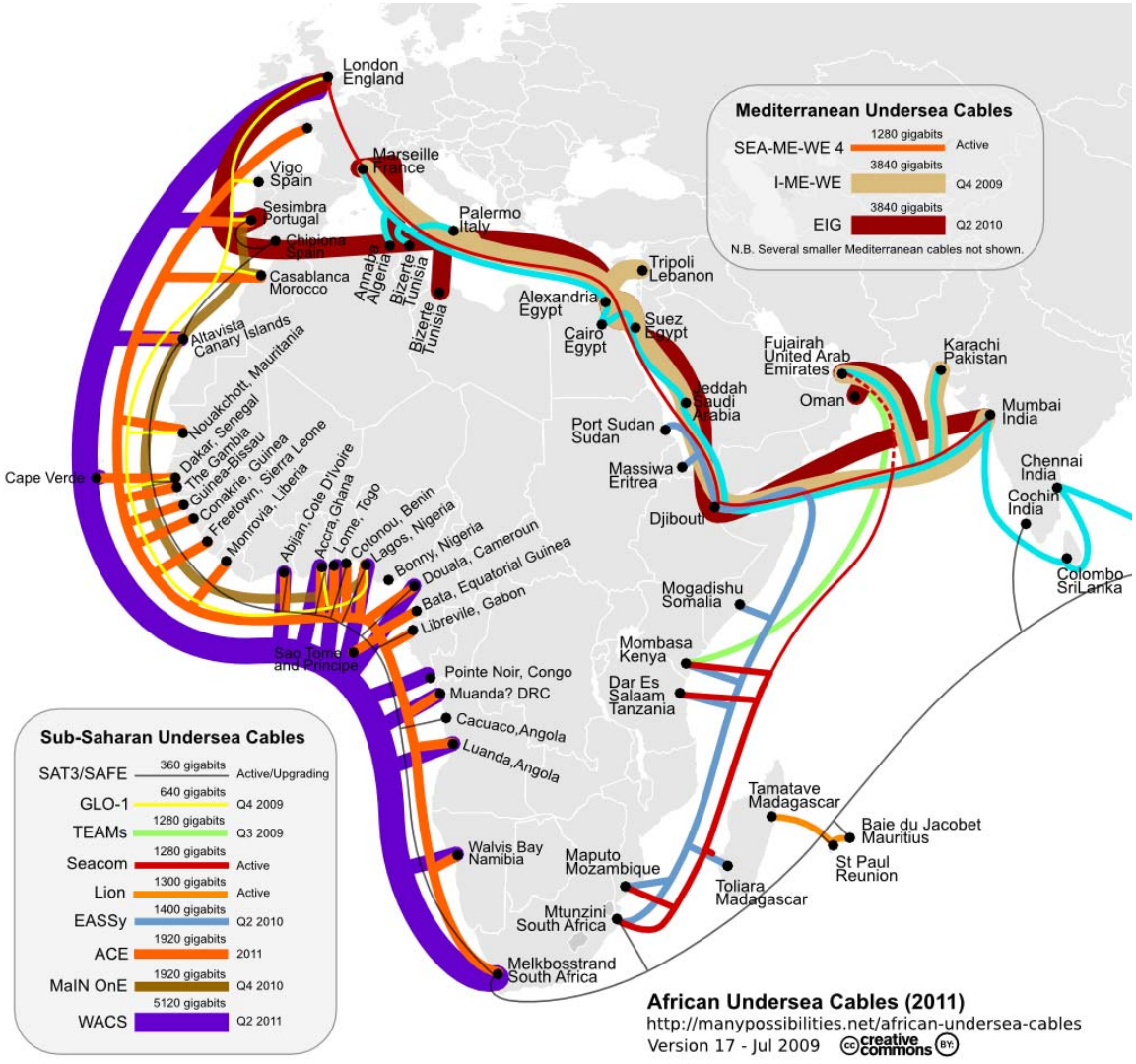


Figure 1.5: Africa Submarine Optic Fiber Cable Projects due for Completion 2011
Source: ShuttleWorth Foundation, Accessed 27th July, 2009

1.3 Broadband Infrastructure in Kenya

From the advent of the Internet to Kenya in the early 1990s, Kenya has relied exclusively on an Internet gateway that was run as a monopoly by the then state owned Telkom Kenya (currently 51% owned by France Telecom), which relied on expensive satellite systems to connect the country to the global Internet. The year 2009 will mark the introduction of high-speed fiber optic cables that will complement and possibly override the prevalent international Internet access mechanisms in the country.

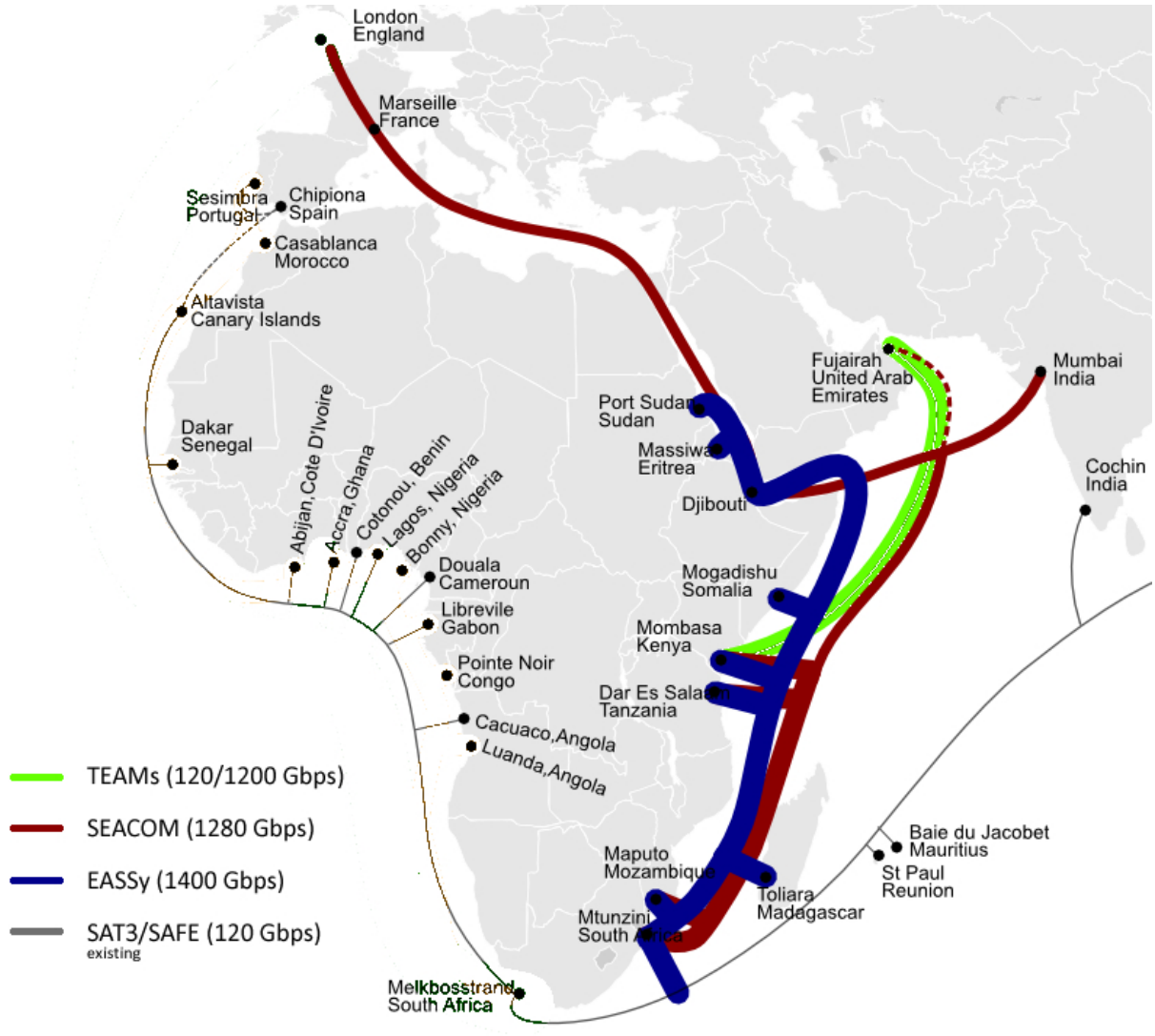


Figure 1.6: East African Seaboard Submarine Fiber Projects to be Completed by 2010
Source: ShuttleWorth Foundation, Accessed 27th July, 2009

Proceeding from an increasing demand for bandwidth and a realization of ICT opportunities for economic development highlighted in the Government of Kenya (2007) Kenya Vision 2030 study, the Kenya government, the private sector and public private partnerships, have invested in submarine fiber optic cable projects to connect the country to the information superhighway as can be seen in Figure 1.6. The notable submarine fiber projects include the East African Submarine System (TEAMS), SEACOM, the Eastern Africa Submarine Cable System (EASSy) and the Kenya Fiber Optic National Network (FONN), a terrestrial backhaul[1] fiber to extend broadband transport infrastructure across the country. This thesis shall analyze the various strategies available to Kenya to translate the deployment of broadband to economic growth.

1.4 Thesis outline

Proceeding from this background on broadband and the broadband projects in Africa, the thesis will go on to build up a more in depth description on the question of ICT for development before focusing on Kenya, the country of choice for the system analysis. It introduces and applies the CLIOS Process to the deployment of broadband in Kenya. The thesis then goes through the results, showing the findings and concludes giving recommendations.

Chapter 2 on ICT for development starts off with a description of ICT and economic growth obtained from various literature sources. This serves as the basis for recognizing what aspects of ICT can be considered as drivers for economic development. This is followed by a specific focus on broadband's contribution in ICT for development. The chapter then proceeds to mention the various ways of measuring ICT for development that offers useful metrics that are considered internationally for measuring ICT. The thesis then proceeds to analyze ICT policy and the effective ICT policy making process that would serve to supplement the analysis process by giving guidelines into the actual policy making process. The chapter then concludes with a look at some case studies where we can learn the effects of adopting some policy practices.

Chapter 3 focuses on Kenya as a country where broadband has gained prominence in the nations' quest for economic development. The chapter seeks to understand the intentions of the Kenyan government by studying the Government of Kenya (2007) Vision 2030 document. The chapter then proceeds to look at the ICT sector in Kenya, laying the background for ICT sector. It looks at how the sector is governed, and touches on the background of Internet use in the country. It also offers a glance on other ICTs particularly mobile telephony within the country. The chapter then proceeds to look through the Government of Kenya (2006) ICT policy and highlights some

[1] **Backhaul** - In a hierarchical telecommunication network the backhaul portion of the network comprises the intermediate links between the core, or backbone, of the network and the small sub-networks at the "edge" of the entire hierarchical network (en.wikipedia.org/wiki/Backhaul_(telecommunications))

of the important challenges mentioned within the policy. The chapter concludes by looking at the broadband infrastructure and broadband projects being undertaken in Kenya.

Chapter 4 acts as an introduction to the CLIOS Process. It outlines the different stages of the CLIOS Process and shows the modeled scenario as a CLIOS System. It touches on other analysis methods and frameworks before engaging in a stakeholder analysis that sets the scope for the analysis. The thesis makes use of the Mitchell (1997) Framework for the stakeholder analysis.

Chapter 5 shows the application of the CLIOS Process following the stages of representation, evaluation and implementation.

Chapter 6 concludes the thesis and goes through the findings, mentioning the effectiveness of the CLIOS Process and makes note of some policy recommendations. It finishes off by suggesting additional topics of study.

1.4 Chapter Conclusion

Within this introduction is the summary of what this thesis sets out to achieve. This chapter covers the overarching problem definition by offering a broad background of the Internet in the African continent and introducing the specific instance of broadband deployment in Kenya. The next chapter will set forth and question a hypothesis of whether ICT does indeed contribute to economic development and how it does so. Later on in Chapter 2, Section 2.5.3, the problem of ICT for development is refined even further with a focus on the specific challenges emerging economies such as Kenya have to face and this will form the backdrop for analysis using the CLIOS Process in chapters 4 and 5.

CHAPTER 2: ICT FOR DEVELOPMENT

Information and Communication Technology (ICT) is defined as a convergence of information technology, computing, telecommunications and multimedia. Labelle (2005) defines ICTs as including "hardware, processes, and systems that are used for storing, managing, communicating and sharing information. These tools can be either manual or computerized (digital). Beyond hardware, i.e., computers, wireless devices, telecommunications equipment, etc. ICTs include computer software and associated systems such as management methods and practices, or the so-called application layer" (p.1).

An emergent form of ICT that has had tremendous impact is the Internet. The Internet is a worldwide network of computers interconnected through a robust digital technology (Internet protocol), permitting efficient routing, transmission and management of data packets between computers.

Through interconnectivity, ICT has enabled fast data sharing and communication and has essentially created an information economy (based on the exchange of knowledge, information and services). The primary question therefore is whether such an information economy has a real and measurable impact on a nation's economic growth. This chapter addresses that question and later touches on effective ICT policy making to maximize ICT economic benefits some of which will be drawn from the analysis of case studies.

2.1 ICT and Economic Growth

The ICT industry can be divided into two broad categories; the applications and service-based software industry and the hardware manufacturing and/or assembly industry. These two categories, in and of themselves, can be developed into sectors that present real economic benefit. We are reminded by Labelle (2005) however, that the primary "agent of change and empowerment is information" (p.2).

The direct economic benefits of ICT can be thought of conceptually as covering two facets: 1) Generation of revenue and 2) reduction in cost. Some of the cost reduction and revenue generating elements of ICT include:

- *Reduction in transaction and distribution costs* – The "digital" and "virtual" nature of many ICT products and services allows for zero or declining marginal costs. Content can be replicated at almost no costs regardless of its volume, and marginal costs for distribution and

communication are near zero. Internetworking drastically reduces geography and distance as a factor of access and participation.

- *Production and process automation* – ICT can be applied to a full range of human production activities, particularly within the services sector. Although the paradigm shift to ICT would often require an immense capital outlay, the net effect is a reduction in production and processes as a result of automation.
- *Collaboration and knowledge sharing* – ICT is a key enabler in the creation of networks. Crowd sourcing and collaboration through open access allows benefits to be reaped from one resource. Such is the case with e-learning. Innovation and product developed are fostered more easily in a knowledge economy facilitated by collaboration made easier by ICT. The availability of more information enhances knowledge and better decision making
- *Market access and efficiency* – ICT enables information distribution that fosters market transparency and access to opportunities. Suppliers have better access to markets with lower barriers of entry and supply chains are better streamlined increasing in efficiency and subsequently reducing costs.
- *ICT sector establishment* – As mentioned earlier, hardware production, software generation, or running ICT based services are employment and revenue generating activities. Subsequent investment within the sector (local and foreign) adds to economic development.

The World Bank (2009) Global Information Technology Report recognizes ICT as a "key enabler of socio-economic progress and development, enhancing productivity and therefore economic growth, reducing poverty and improving living standards in many ways" (p.9). Figure 2.1 further explain how increased productivity can result in economic growth.

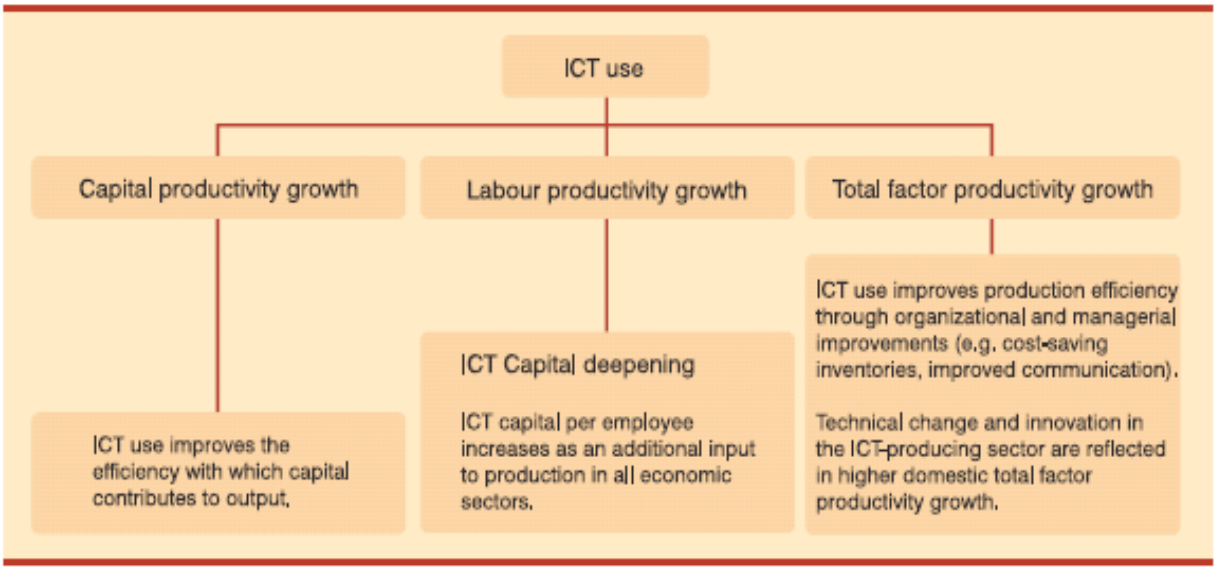


Figure 2.1: Channels through which ICT Contributes to Productivity Growth

Source: UNCTAD Information Economy Report 2007-2008

Although the economic benefits derived from ICT are both tangible and intangible, the Gross Domestic Product (GDP) is a generally accepted proxy for the measurement of economic growth. Therefore the economic growth analysis in this thesis shall center on GDP growth and subsequently the GDP per capita as the measure of personal economic improvement. It should be noted however that although per capita GDP can be personally ascribed, it is not at all a measure of wealth distribution within a nation.

GDP is one of the measures of national income and output for a given country's economy. Sullivan (2003) says that it is "the total value of all final goods and services produced in a particular economy; the dollar value of all goods and services produced within a country's borders in a given year"

According to the United States Bureau of Economic Analysis (2007), GDP can be defined in three ways, all of which are conceptually identical.

- "First, it is equal to the total expenditures for all final goods and services produced within the country in a stipulated year.
- Second, it is equal to the sum of the value added at every stage of production (the intermediate stages) by all the industries within a country, plus taxes less subsidies on products, in the period.
- Third, it is equal to the sum of the income generated by production in the country in the period—that is, compensation of employees, taxes on production and imports less subsidies, and gross operating surplus (or profits)"

While it is clear that knowledge and ideas play essential roles in advancing economic and social welfare, it is important to recognize that the causal relationship is complex, and ICTs are certainly no panacea. Mansell (1999) reminds us that "exclusive emphasis on ICT projects, at the expense of careful analysis and consideration of broader economic, social and political elements that interact to improve the lives of individuals is likely to result in unanticipated failures and wasted resources. This in turn can lead to poorly designed programs and haphazard implementation schemes that do not account for local conditions, resulting in projects which fail to meet their objectives or may even harm the welfare of supposed beneficiaries" (p. 39). Furthermore, investments in ICTs inevitably results in opportunity costs as they divert investment from other developmental needs and priorities.

It is important to note that much of the impact of e-development is anecdotal as there seems to be limited data available on the impact of ICTs at the macroeconomic level. A lot of literature though has highlighted the factors that are needed to derive maximum output from the deployment of ICT and one such proposed framework is represented in Figure 2.2.

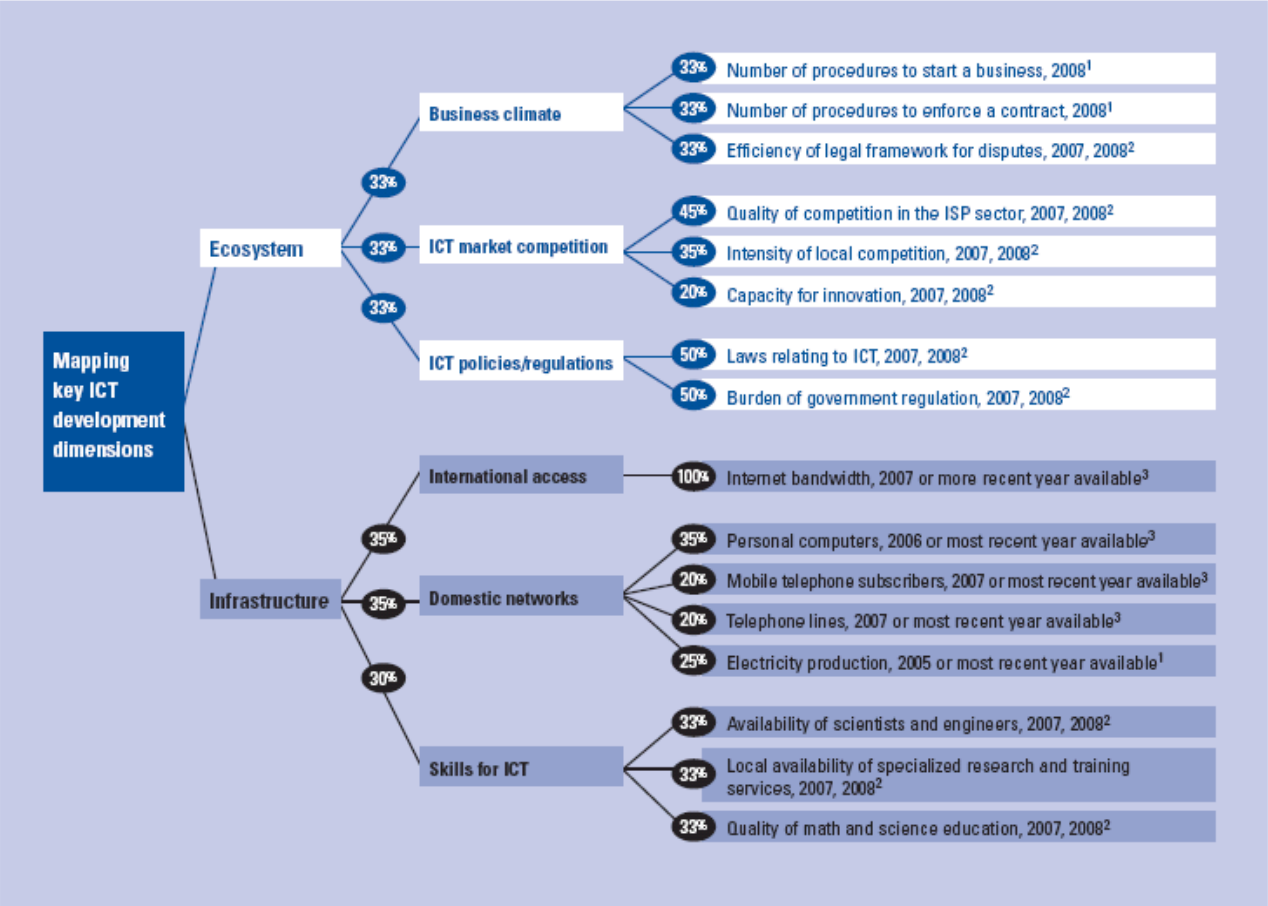


Figure 2.2: ICT Development Map Framework

Source: (1) World Bank 2009; (2) 2-year average, World Economic Forum, Executive Opinion Survey, 2007, 2008; (3) ITU 2008

2.2 Broadband Contribution in ICT for Development

2.2.1 Introduction to Broadband

The definition of 'broadband' varies from country to country, but it is generally accepted as high speed, 'always on' Internet connection. Various organizations like the International Telecommunications Union (ITU), OECD and international regulators specify the minimum download speed of a broadband connection ranging from 128 Kbps to 2 Mbps or higher. The United States Computer Science and Telecommunications Board National Research Council (2002) defined broadband based on following nine attributes: speed, latency and jitter, symmetry between upstream and downstream capacity, always-on, connectivity sharing and home networks, addressability, controls on application and content, network design and architecture. Some of these attributes are elaborated below:

- *Speed* – The mention of broadband is always accompanied by a reference to high speed communication and bandwidth. This bandwidth capacity needs to reflect the end-to-end capacity between sender and receiver through the core network, as well as the loading time on the host computer. The number of nodes presents various bottleneck points. Bandwidth can be thought of as the average throughput of the connection over time.

- *Latency and Jitter* – This refers to real time delivery of information or interaction. Latency refers to the delay in the information packet relay while jitter measures the variation of that latency. Broadband has reduced latency and jitter that can support real time applications such as voice calls and video conferencing

- *Upstream and downstream capacity symmetry* – Broadband has symmetry between upstream and downstream. This means that it is possible for a host computer to adequately be a receiver and a sender of data.

- *"Always-on"* – Broadband should offer an always available connection to the Internet for instant access on demand. The 'Always On' facility as opposed to the 'dial up' means that the user has access to the network as soon as he switches his internet browser on and does not need to dial the service provider number for a connection.

Broadband therefore enhances:

- Browsing related activities
- Messaging
- Fast file downloading
- Speed and response-time sensitive Internet applications
- Online distributed software applications
- Net Storage
- Static image delivery
- Audio delivery – download or streaming (real-time), Voice over Internet Protocol (VoIP) calls, net radio
- Video – download and streaming

As we end the first decade of the 21st century, it is clear that high-speed networks must be considered an integral part of the basic infrastructure of any country. Indeed, broadband networks are the infrastructure foundation of the knowledge economy, primarily through knowledge sharing and collaboration, and the Internet.

The Internet has continued growing worldwide in terms of users and penetration. Although developed economies still account for the majority of Internet users and have the highest Internet

penetration, developing economies are slowly catching up. The GIT Report 2008-2009 highlights that in 2002 Internet penetration in developed economies was ten times higher than in developing economies; in 2006 it was six times higher.

However, wider adoption of ICTs by developing countries is still limited by a lack of awareness of the potential benefits of ICT use, and by investment and implementation costs especially the last mile access. For instance, few enterprises in developing countries have an intranet or extranet, which are often the first steps towards the automated integration of business processes – that is, automatic linking between computer systems to manage orders that have been placed or received and other internal systems. Without these foundational steps the paradigm shift expected with the deployment of broadband in emerging economies can prove to be an extreme challenge.

2.2.2 Broadband and Economic Development

Based on the ability to digitally transmit large amounts of data in various forms, a direct contribution of broadband to economic development can be seen to be through the reduction in transaction and distribution costs and the establishment of a knowledge based economy (KBE) through open access to information and collaboration. A reduction in transaction and distribution costs occurs simply when businesses processes are automated and the impact is often felt at the very moment of the paradigm shift following ICT investment. The KBE on the other hand has a longer term impact on the economy.

McKeon and Weir (2001) defined a KBE as an "economy in which the production, distribution, and use of knowledge is the main driver of growth, wealth creation and employment across all industries" (p. 4). There are four key dimensions:

- an efficient infrastructure, especially in information and communications technology;
- an emphasis on innovation and technological change;
- a business environment stressing innovation and enterprise; and
- a strong commitment to education and human resources development.

2.2.2.1 Innovation and the Knowledge Economy

Technological progress and innovation are the current buzz words when someone mentions long term drivers of economic growth. In the context of a global knowledge economy fueled by the fast pace of technological innovation, it is important for developing countries to lay good foundations for building their capacity to acquire and create knowledge and technology in order

to take advantage of the opportunities offered by globalization, and at the same time, to address emerging global challenges. The challenge is therefore to harness this knowledge and translate it to economic growth – by providing an enabling environment for the production of ideas and innovations, as well as the dissemination and use by different actors, directly or indirectly involved in the production process.

We can therefore assume that the capacity to generate, assimilate, disseminate and effectively use knowledge is crucial for the establishment of a KBE and the eventual generation of economic growth. A KBE therefore is not a direct path to economic growth added to the fact that creating a KBE where no such culture existed before would take a long time.

ICT has profoundly changed the techno-economic paradigm within which innovation takes place today. Whereas in the past innovation revolved around concepts of mass production, economies of scale and corporate-dominated R&D, in the last three decades of the 20th century this was replaced to large extent by an emphasis on economies of scope, exploiting the benefits of interconnected, flexible production facilities, and greater flexibility and decentralization of R&D. Flexibility, interconnectedness and collaboration rely on ICT, which also plays a fundamental role in facilitating research diversification and collaborative, interdisciplinary approaches.

2.2.2.2 Increased Productivity as a Result of Broadband

Broadband access to the Internet can enable or enhance the adoption of certain applications that have an impact on enterprise productivity as discussed in the previous section. The use of ICT and specifically broadband within business processes can also contribute to income generation and increased labor productivity. This reduces the cost of transactions and increases market access.

Broadband increases the capacity of enterprises to benefit from, and deliver through, the Internet, and can enable the adoption of certain applications that have an impact on enterprise productivity. Although broadband particularly enhances multimedia applications and can have evident benefits for the ICT-enabled services and media sectors, it is increasingly being used in non-ICT intensive economic sectors. It is a key enabler of online procurement, which helps enterprises manage their supply chain. Voice over Internet Protocol (VoIP) applications have cost-saving potentials for firms in all economic sectors, while marketing and sales applications have can also be applied to all economic sectors. In general, industries can enhance e-business solutions through broadband.

As is the case with other technologies, ICT contribution is determined by factors such as the role of human capital, externalities and spillovers (notably through learning and complementary innovation) and appropriate policies and institutions supporting innovations. As we have noted

earlier in Section 2.1 on ICT and Economic Growth, the ability to capture the benefits of ICT and specifically broadband requires an interplay of users and technology to achieve what the World Bank (2009) Global Information Technology Report refers to as "*Internet ubiquity*". Once such ubiquity is achieved, the benefits can be more empirically determined and policies need to be formulated with this in mind. It therefore should come as no surprise when initial installation of broadband and internet connectivity are flawed with little or no returns, since much of the underlying structures do not as yet enable the maximum use of such technology to reap the apparent benefits. Take for instance the lack of legal recognition of digital signatures; if a given country has inadequate regulation and cyber laws to protect financial institutions, they will invariably be reluctant to provide their services online. The same applies to internet advertising and purchasing, not to mention innovation. The following steps need to be appreciated for a nation to achieve such ubiquity and harness the ICT benefits, and especially when it comes to the intention of establishing a KBE.

2.2.3 Towards Internet Ubiquity

The World Bank (2009) Global Information Technology Report highlights five stages towards the achievement of Internet ubiquity shown in Figure 2.3. The stages focus specifically on Internet penetration but do not limit themselves to one dimension. They incorporate Internet access, familiarization of use and finally intensive use of Internet-based services. These variables escalate as you move up the stages.

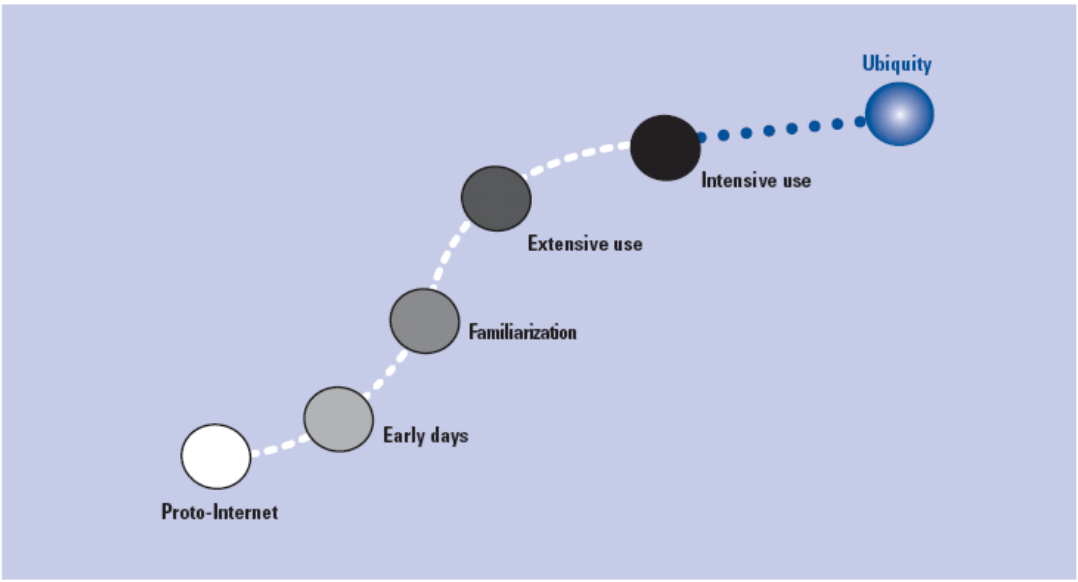


Figure 2.3: The Five Stages to Internet Ubiquity
Source: Global Information Technology Report based on ITU, 2009.

2.3 Measuring ICT for Development

"An understanding of Internet economics is necessary in impact analysis and ICT policy formulation" says Daly (1999). However, cross-country evidence on the impact of the Internet on economic growth is sparse and in many cases, non-existent. According to Gillett and Lehr (2006) studies on the impact of ICT investment in the U.S.A have indicated general positive effects of ICT and broadband adoption on the sector productivity. Grace (2001) is skeptical of ICTs touted benefits reminding us that the relationship between ICTs and productivity is elusive. She goes on to state that there have been instances when the observed correlation between IT investment and productivity has been broadly negative (p.52). However, recent studies have reversed the correlation especially in the case of the manufacturing sector in the United States.

Similar attempts to justify the potential impacts of the Internet on development in Africa have been inhibited by the lack of empirical evidence of observed impact on actual applications. The formulation of effective Internet policy however requires such broad and in-depth analysis of the implications. Previous attempts at impact analysis have tended to be technologically deterministic such as those proposed by Nicholas (2000). Adeya (2001) writing about information technology in Africa reminds us that impact analysis methods "have tended to be based on a prior reasoning about the nature and expected impacts of the technologies and the skills needed to use them effectively. Such shortcomings have resulted in formulation of Internet policy on a generalized and at times inappropriate basis."

The United Nations Development Program (UNDP) (2001) Digital Opportunity Initiative Report argues that since the impact of ICTs depends on, among others, users' attitudes and expectations, institutions' organization and management, impact analysis should be carried-out using generalized and expanded treatments of both qualitative and quantitative techniques, rather than simply quantitative tools. We could add that ICT initiatives must also take account the local situations (especially culture) in individual countries, since blanket development recommendations will often not work.

While conducting Internet impact assessment, it should be noted that adoption of ICTs involves a substantial learning curve and a high level of investment from users, whether they are individuals or organizations. There have been suggestions of a probable lag effect on impact after adoption of ICT due to a need for learning and eventual manifestation of cumulative effects, not to mention the stages of Internet use and ubiquity mentioned in the prior Section.

2.3.1 Development Indices

Several indices have been proposed for the measurement of ICT and ICT for development. Most of these indices revolve around the two major concepts: ICT inclusion and access and ICT opportunities. These are summarized in the Figure 2.4

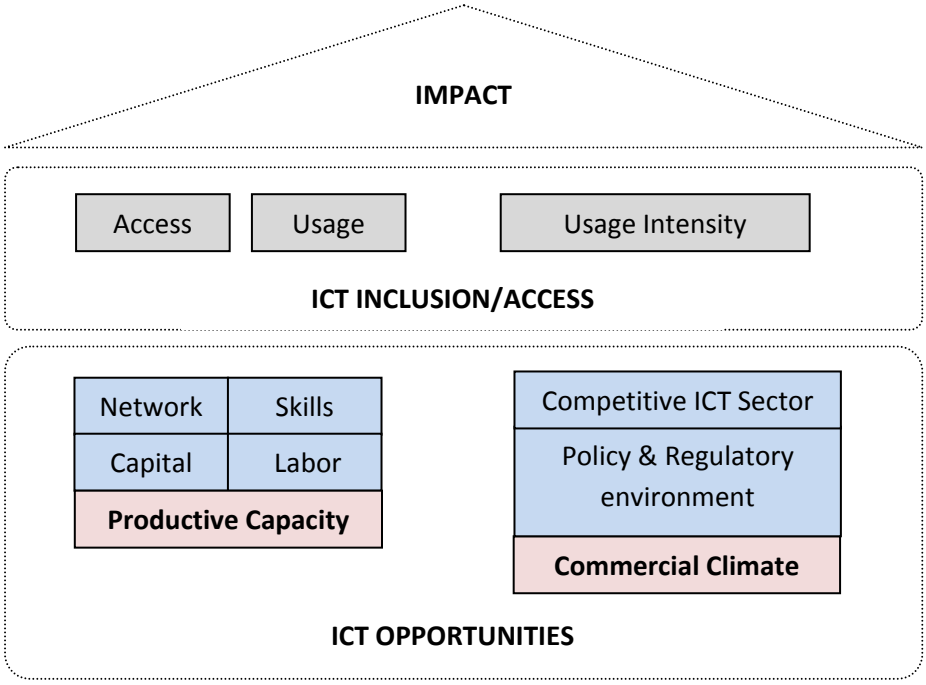


Figure 2.4: Factors Influencing the Impact of ICT on Economic Growth
Source: Author

The most notable document covering these indices is the ITU's *"Measuring the Development Index"* document that includes the indices in the following subsections.

2.3.1.1 The Digital Access/Inclusion Index

In 2003, the ITU developed the "Digital Access Index (DAI)", which was presented at the first phase of the World Summit on the Information Society (WSIS). The main objective of the DAI was to measure the overall ability of individuals in a country to access and use ICTs. It was thus built around five categories: infrastructure, affordability, knowledge, quality and actual usage of ICTs.

2.3.1.2 The ICT Opportunity Index

In 2005, ITU and Orbicom (an international network that links communications leaders from academic, media, corporate and government circles in UNESCO) decided to merge the DAI with another index, the Orbicom "Infostate Index" (also published at WSIS 2003) to create the "ICT Opportunity Index (ICT-OI)". The ICT-OI was particularly designed to monitor the global

digital divide and to track country progress over time and between countries of similar income levels.

Based on the Orbicom Infostate conceptual framework, which is closely linked to economic theory, the ICT-OI distinguished between infodensity (including ICT infrastructure and skills) and info-use (including ICT uptake and intensity of use).

2.3.1.3 The Digital Opportunity Index

Also in 2005, another ITU index, the "Digital Opportunity Index (DOI)" was developed in response to the WSIS Geneva Plan of Action call for an ICT Development (Digital Opportunity) Index. A preliminary version of the DOI was launched at WSIS 2005, and the WSIS Tunis Agenda made reference and acknowledged the DOI as one of the two indices to measure information society progress. A full version of the DOI was published in 2006, and an updated version in 2007. The main objective of the DOI was to measure "digital opportunity" or the potential of countries to benefit from access to ICTs. The DOI was based on three main categories: opportunity, infrastructure and utilization.

The CLIOS Process in Chapter 5 shall later develop performance measures that are more localized to the deployment of broadband within Kenya. Nevertheless, performance in the indices mentioned above would give a more global performance vantage.

2.3.2 Towards an Information society

The indices do reveal a given status of a nations' ICT. It is important though that such information be juxtaposed with the achievement of an information society so as to know just how far a given nation is from achieving an information society.

A useful conceptual framework to describe the process countries are going through in their evolution towards information societies is based on the basic three-stage model:

- **Stage 1:** ICT readiness, reflecting the level of networked infrastructure and access to ICT,
- **Stage 2:** ICT intensity, reflecting the level of use of ICTs in the society, and
- **Stage 3:** ICT impact, reflecting the result of efficient and effective ICT use.

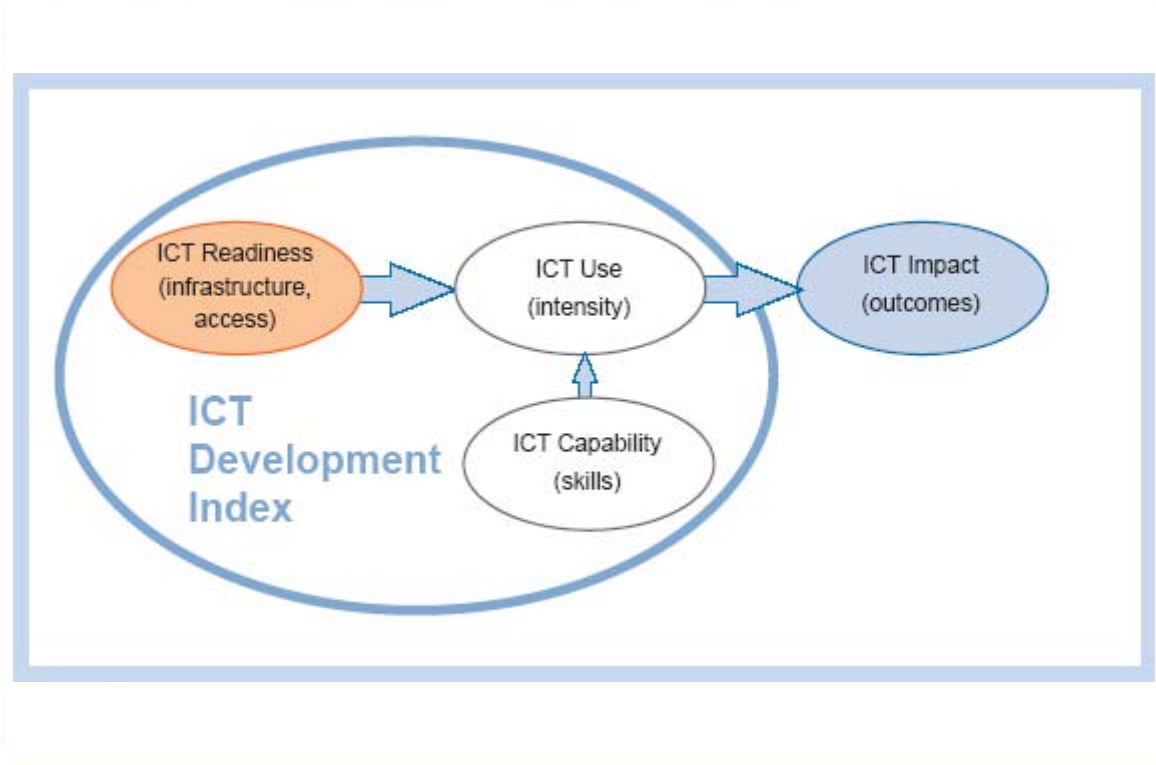


Figure 2.5: Three Stages in the Evolution Towards an Information Society
Source: UNCTAD, Global Information Economy Report 2008

2.3.3 Measuring the Economic Impact of Broadband

Measuring the economic impact of broadband confronts the same types of measurement challenges that led to the so-called productivity paradox of Information Technology (IT), best articulated by economist Robert Solow's famous quip that we see computers everywhere but in the productivity statistics. As had been acknowledged earlier broadband does not act on the economy by itself, but in conjunction with other IT (primarily consisting of computers and software) and associated organizational changes. As with computers, the effects of broadband may be strongest in service industries i.e. non-farm/non-manufacturing, where productivity improvements are typically less well captured by economic data. Broadband does not act on the economy in isolation, but as a complement to other information technologies.

Broadband is a critical enabler for the use of computer-based applications that need to communicate. Adoption of broadband-enabled IT applications can thus affect the economy by changing the behaviors and productivity of both firms and individuals.

According to the United Nations Conference on Trade and Development (UNCTAD) (2008) Information Economy Report, other economists have focused on changes to firm behavior,

finding that these generally lie on a spectrum, with the highest payoffs in enhanced productivity appearing in the firms that commit most intensively to integration of IT into new business processes. They distinguish between IT-using and IT-enhancing firms. The former simply adopt existing Internet applications to make current business processes more productive. The latter develop and integrate more complex e-business applications that can enable whole new business processes and models, such as automated online supply chain management and online sales into geographically distant markets. To the extent that the availability and use of broadband fosters either type of IT adoption and usage by firms, we would expect productivity improvements and other associated economic impacts to follow.

Other studies have focused on the effects of IT on individual workers. IT tends to complement workers that perform non-routine problem-solving and complex communication tasks, but substitutes for workers who perform cognitive and manual tasks that can be accomplished by following explicit rules. While both effects could be expected to increase productivity, the overall effect on employment is ambiguous and would depend on the mix of different types of jobs in the economy.

While much of the IT productivity literature has focused on workplace usage, much of the focus of broadband policy has been on residential deployments. Broadband at home may of course be used for leisure pursuits, but it can also be expected to affect the economy both directly and indirectly. For many knowledge workers, a residential broadband connection is a prerequisite for working at home (enabling productive use of non-traditional working hours, flexible work arrangements, or remote employment), or for establishment of a home-based business.

Less directly, expanded broadband availability at home may raise the quality of the labor force, for example through improved access to educational opportunities via distance education programs, thus making a locale more attractive to potential employers. Similarly, home-based access may improve quality of life, for example by enabling more participation in community and civic activities, making a locale more attractive to potential residents.
Gillet (2006) says that home access may enable online job hunting, thus reducing unemployment by making labor markets more efficient. It may also make workers more productive by reducing the overall time needed for them to fulfill non-work obligations, such as paying bills, shopping, telemedicine, and so forth. As with corporate use of IT, however, the overall effect of home-based broadband usage on local economic indicators is also mixed. While online banking and shopping may make local workers more productive, it is also likely to put competitive pressure on local banks and retail stores, leading to ambiguous effects on the number of local jobs.

2.4 ICT Policy

ICT deployment needs to be accompanied by proper policy and regulation so as to achieve the maximum benefits from its deployment. A policy is a statement of intent envisioning a desired outcome. An administrations' articulated policy can then be used to guide decision making in the presence of different strategic alternatives and varied priorities. Proceeding from the policy, a strategy can be formulated, which is a long-term premeditated plan of action developed through an informed choice derived from the various practical alternatives. What follows is the execution of the action plans.

ICT policies can therefore be formulated for organizational, local, national and international contexts with the distinguishing feature often being their scope of application and level of detail and complexity. Figure 2.6 shows the interaction of the various types of ICT policies.

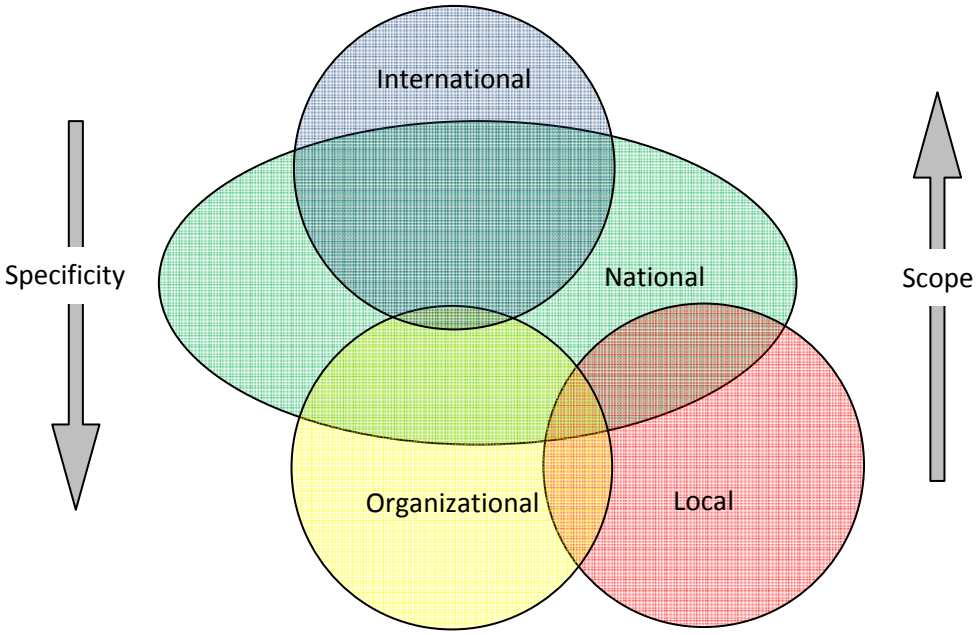


Figure 2.6: Types of Policies
Source: Author

International ICT policies typically concern themselves with the formulation of technology standards for seamless cross boarder interoperability. Such policies are formulated by intergovernmental bodies and organizations such as the Institute of Electronics and Electrical Engineers (IEEE), the International Telecommunications Union (ITU) and the Internet Corporation for Assigning Names and Numbers (ICANN).

Table 2.1: Some International ICT Policy and Standard Formulation Bodies

NAME	TYPE OF ORGANIZATION	AREA OF FOCUS
ITU	Leading United Nations agency for ICT issues	Involved in matters such as the global use of radio spectrum and assigning satellite orbits.
IEEE	Non-profit organization	Standards creation: One of the more notable IEEE standards is the IEEE 802 LAN/MAN group of standards which includes the IEEE 802.3 Ethernet standard and the IEEE 802.11 Wireless Networking standard.
ICANN	Not-for-profit public-benefit corporation	Plays the primary role or coordinating the Internet naming system

Source: Author

Other international policies will concern themselves with some aspect of ICT use such the provision of services, trade and finance. These policies are formulated by international business alliances such as the International Telecommunications Users Group (INTUG) and the World Trade Organization (WTO) which has trade agreements between member countries such as the General Agreement on Trade in Services (which would cover among other issues business process outsourcing) and the Agreement on Basic Telecommunications (which covers among other things, the opening up of national telecoms to foreign investment). Some policies and standards may be formed through general industry practice by large software and hardware manufacturers and multinational corporations. International policies and directives are not mandatory, and only become so when adopted as part of a national law. Nevertheless, they are generally accepted as industry best practices.

National ICT policies would concern themselves with the effective use of ICT to achieve consensual national objectives. These often include equitable access, education, better government administration and service, economic development, etc. The formulation of national ICT policies varies from country to country; typically they are triggered by the government and are put together by a selected government drafting agency in conjunction with various stake holders.

Local ICT policies are more detailed national policies at the sub-national level including specificities to a given regions' needs and priorities. These policies are often in line with national policies and will vary among regions within countries based on issues like level of development,

population, geographical size etc. Organizational policies formulated by executive officers and chief information officers mainly have the objective of supporting organizational business goals by improving operational efficiency and exchange of information so as to maintain and improve competitiveness. They normally adopt national and international standards which may at times restrict organizational operation by national laws and regulations, or or may benefit them through national development incentives, tax breaks, education programs, and so on.

2.4.1 National ICT Policies

"National ICT policies help guide a country or jurisdiction in its use of ICT tools and secure the benefits of the information economy for all its citizens. ICT policies deal with issues related to information dissemination and use as well as issues related to the spread and use of the technology itself" says Labelle (2005).

A strategic approach to the execution and achievement of the policy vision involves a process of analyzing priorities and constraints, such as programs or spending priorities and choosing among them on the basis of the impact they will have regarding the achievement of the policy's goal. The analysis results in a recommendation of political, managerial, financial or administrative mechanisms for courses of action to resolve the given issue.

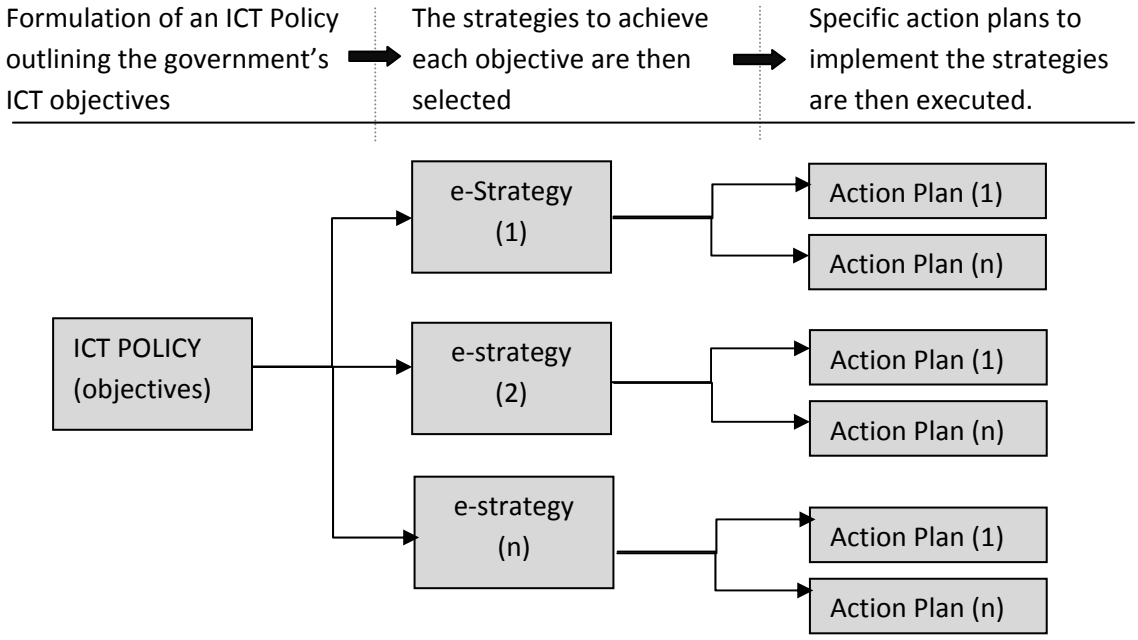


Figure 2.7: National Policies, Strategies and Action Plans
Source: Author

"ICT strategies start with the development goals of the country, taking into consideration local specificities. Individual policies themselves are rather meaningless when they are not based on an underlying national agenda. A strategic framework is necessary to help explain policy decisions and choices and give policies personality and direction. The strategy to deliver ICT policies then has to consider institutional and operational issues. An action plan then details the organization required to implement the strategy" says Labelle (2005).

According to the Adamali et al (2006), a national ICT policy is articulated in a country's *e-strategy* which refers to a plan of action – typically a strategy document written by state leaders – illustrating how ICTs are to be developed and used to achieve the economic, social, and development objectives of a country. E-strategy thus guides and focuses government priorities in ICT development. It explains how institutions interact with one another and how they share resources and responsibilities for ICT development. It specifies a multi-sector activity that involves leaders from government, the private sector, academia, and civil society (p.64).

Thus, governments develop policies part of which may be enshrined into law by legislation resulting in new legal frameworks in the form of telecommunication Acts and cyber-law. Other non-enforceable policies will then be embodied in the National ICT Policy Document. The strategies would then provide a framework for policy implementation.

2.4.2 Current Trends in Policymaking globally

Developed economies seem to be focused on regulations around tariffs, customer service, consumer choice and curbing monopoly power. Developing economies on the other hand are more concerned with critical infrastructure shortages, low-income profiles, skills scarcity, generally poorly-run state operations and the lack of competitive market conditions.

Common themes in the various objectives sited in national ICT policies among the emerging economies include the following:

(a) **e-Commerce/e-Business:** Primarily through the encouragement of Electronic Data Transfer (EDT) increase market efficiencies and reach and reduce costs
(b) **e-Government:** Providing government services and information to citizens and between government agencies using the Internet to increase transparency and accountability and reduce bureaucracy
(c) **Infrastructure:** Constructing physical components, wired or wireless for transmission of information
(d) **ICT Industry:** Creating or expanding the ICT service sector such as business process outsourcing and off-shoring and hardware manufacturing and/or assembly for local and international markets

(e) **Universal Access:** Increase ICT diffusion and provide cheap access to information and communication facilities and the Internet for all without discrimination
(f) **Legal and Regulatory Reform:** For the encouragement of FDI into the sector, increased competition and cyber security
(g) **e-Education:** Using ICT in education to improve teaching and school administration as well as improving e-literacy and improved research and innovation
(h) **ICT Human Resource Development:** Developing local ICT skills to support the ICT industry as well as attract foreign business operations
(i) **Local Content Generation:** The use of ICT for the preservation of culture and heritage as well as the encouragement of the generation locally relevant multimedia
(j) **e-Health:** Using ICT for the administration and provision of health services and information.

The question of effective ICT policy formulation and government involvement will inevitably determine the success of these policies. These issues are discussed hereafter in Section 2.5.

2.5 Effective Policies

An effective policy is simply one that is properly formulated and executed for the attainment of a given goal. These three elements – formulation, execution and goal achievement – need to be considered when coming up with effective policies. Although the achievement of the goal is the end result of the entire policy process, it is the foundation and the beginning of any policy making. The process of policy formulation is guided by a SWOT (Strength, Weaknesses, Opportunities and Threats) analysis followed by the execution of the policy which shall be subject to constant evaluation and realignment for the attainment of the goal.

National ICT Policies that have the ultimate goal of economic development have added complications of scope introduced by the very nature of the technology. This is explained in the latest UNCTAD (2008) Information Economy Report that asserts that "ICT is a general-purpose technology and as such has a pervasive impact on the economy. It introduces a new paradigm to the configuration of economic activities, changing in a radical way the approach of technology for development, because of the importance of spillover effects of ICT economic applications" (p. 1). A lack of recognition and appreciation of the scope and disruptive nature of ICT for development will often result in failed policies primarily due to resistance to change. To avoid this, national ICT policies need participative formulation as well as participative execution.

ICT will therefore be inevitably nested and intertwined with other economic sectors offering various behavioral and evaluative challenges to the ICT policy making process. The policies

therefore need to be integrated with the broad national development concerns and mainstreamed into all aspects of society and of development planning that will be touched upon by the technology. This is the integrated approach which has been found to be most effective in ICT policy making. With an integrated approach, Tipson and Fritelli (2003) say, "the challenge of ICT for development shifts to achieving broad synergistic effects and maximum efficiencies from investments in infrastructure, software and training. Scarce resources and limited human capacity make such efficiencies and synergies a key point of the entire undertaking. Major choices about infrastructure, software, and ICT education and training are best made with the full panoply of priorities in mind" (p. 19). Making ICT an end in itself would result in the country remaining for a long time only as a consumer of ICT as opposed to being a creator and a producer. The big question however is whether one can become an ICT producer without first being a consumer of ICT.

This presupposes leadership from the highest levels of government. Several models of leadership with respect ICT policy making have been tried in various countries, and as Tipson and Fritelli (2003) highlighted there are three basic alternatives; the "ICT Czar" who is a senior government official; the designated minister who would need to rely heavily on persuasion for the assurance of collaboration; or the ICT "champion" with little authority but an abundance of knowledge.

Higher authority and ownership of the policy would effectively reduce the political infighting and potential bureaucratic resistance that can otherwise stall such a major undertaking, nevertheless participative formulation would empower the different actors that will be affected by the policy. Further, an effective policy formulation framework needs to be followed when coming up with any ICT policies. The following Section 2.5.1 lays out an appropriate policy formulation framework.

2.5.1 Policy Formulation Framework

The application of any specialized policy analysis tool such as the CLIOS Process should be based on an appropriate policy formulation framework. As is the epitome of any planning process, an effective policy development framework revolves around these four questions:

1) *Where are we now?* - e-readiness assessment
2) *Where are we going?* - visioning
3) *How will we get there?* - analysis and policy selection
4) *And how will we know when we get there?* - benchmarking, monitoring and evaluation

What follows is an analysis of the above four questions with respect to the national ICT policy making process:

2.5.1.1 E-Readiness Assessment

Policymakers need to obtain the best information and intelligence available about the ICT sector and market in the country. There are various e-readiness assessment methodologies available, some of which are conducted by potential investors, researchers, consulting groups and non-profit making organizations. The policymakers need to adopt a methodology that practically and realistically represents the current status and practices of ICT within their country. Methodologies that are more people-centric and not ones that are merely done for other premeditated prescriptive aims such as those, according to Labelle (2005) that are based on measuring "the conduciveness of a country's ICT sector for Internet based commercial opportunities" (p. 41).

An appropriate methodology would consider issues such as cultural sensitivity and how this would be affected or would affect ICT adoption and diffusion in the nation. Their eventual analysis should broadly cover the current state of the ICT infrastructure, the market, skills (education), regulation, institutions, existing legislation and policies.

The analysis of ICT infrastructure covers the scope of ICT deployment within the country. This can be used to derive an estimate of the intensity as well as type of use and demand for ICT services. This needs to be done in reference to the infrastructure ownership structures. State owned monopolies with vested interests will often cling to obsolete technologies and maintain high cost structures. Research shows that privatization of these monopolies as opposed to competition, would not be a solution for more pervasive and aggressive ICT deployment. Therefore, both the scope of deployment and ownership of telecommunication infrastructure need to be considered.

The market analysis is essential for the formation of realistic and achievable goals to avoid overly ambitious goal setting. Policies need to be based on local needs assessments and on what the market can absorb. Many national strategies will never be implemented because they do not correspond to local, regional and international realities. The analysis should primarily cover the size, the willingness and the ability of the market to pay for ICT services; this would most times determine what appropriate ICT infrastructure variant to deploy.

There needs to be an assessment of how sparsely or centralized ICT and information administration is within the nation and whether there is a strong and independent regulatory regime. ICT jurisdiction is an essential prop to the execution and successful achievement of any ICT policy. Regulatory reviews are often the starting point in the execution of many ICT policies in emerging economies.

The above activities will establish ground for an effective SWOT analysis which then leads on to the visioning. Within this thesis in the use of the CLIOS Process in Chapter 5, the e-readiness

assessment is covered in step 1 where several stakeholder interviews were conducted that resulted in the CLIOS System characteristics and SWOT checklists.

2.5.1.2 Visioning

A national ICT policy sets out the nation's aims, principles and strategies for the delivery of ICT. It is essentially a forerunner to the development of an e-strategy. As a foundational document, it should express its objectives and goals clearly and unambiguously.

As previously stated, policies need to be integrated into national development objectives, they should also be expressed in terms of their development objectives: a value statement expressed in practical terms. Labelle (2005) explains that "ICT policies should be directly related to a development objective. In that way it is easier to explain the intentions of the policies and decisions that accompany policy proposals, if they can be related to the creation of some sort of public good such as greater access to educational opportunities or jobs." (p. 34)

This integrated and pro-development approach, with positive impacts on people, rather than technology deployment, necessitates an open and participatory policy making process. Consultation needs to done widely, not forgetting the marginalized and under-represented communities. Many countries however already have an economic visioning document (such as the Government of Kenya (2007) Kenya Vision 2030, which would simplify the goal setting process by spelling out the long term economic goals. The ICT policy would therefore seek to be as compatible as possible to such a visioning document.

2.5.1.3 Analysis and Policy Selection

Based on sound market data, and well defined goals and objectives, policy makers need to analyze the prevalent best practices, and policies that have been successful in other similar nations in their selection of policies to co-opt. Some of the prevalent areas requiring the establishment of a clear policy are outlined in Table 2.2.

The process of policy selection needs to be participatory and have a holistic approach that recognizes and resolves conflicts, overlaps and gaps. This simply means that even though the goals and objectives are clarified, the ownership and responsibilities resulting from the policy also need to be clarified. This ensures that the policies selected will be actionable.

Table 2.2: Typical Goals Matched with Corresponding Policy Intervention Areas

GOAL	POLICY AREA OF FOCUS
Development of ICT infrastructure	i) Infrastructure development ii) Interoperation of information systems iii) Enhancement of public services iv) Cost savings in service delivery, purchasing, communication, etc. v) Electronic commerce and secure transactions vi) Development of technological standards
Development of skills - Capacity Building	i) Research and development ii) ICT education and training
Development of legislation and policies to correspond to the requirements of new ICT	i) Diffusion of information technology ii) Development of ICT industries iii) Trade policies for ICT-related goods and services iv) Pricing and taxation of electronic services v) Protection of intellectual property vi) Privacy of personal data vii) Protection of cultural and linguistic diversity viii) Protection against illegal and harmful content ix) Adoption of standards
Institutional development and coordination	i) Institutional and regulatory structures ii) National ICT development coordination iii) International interface and cooperation
Access to ICT	i) Access to infrastructure ii) Access to information
Monitoring ICT	i) Monitoring the use of ICT ii) Measurement of the impact of ICT

Source: The UN Economic and Social Commission for Asia and the Pacific

2.5.1.4 Benchmarking, Monitoring and Evaluation

Policies have a higher degree of immutability as opposed to strategies; nevertheless, in such a volatile sector as the ICT industry, policies need to be adaptive, dynamic and scalable. In this day and age of entrepreneurial leadership, policy makers need to factor in uncertainty into their ICT policy, with regular reviews, discussion and perpetual engagement with stakeholders.

The typical pitfalls therefore in ICT policy formulation and some obstacles to effective ICT policy making and execution to watch out for include:

a) *Lack of ownership:* The policy champion needs to be a leader from the highest levels of government
b) *Lack of participation:* Leaving out some stakeholders in the formulation of the policy will often result in its lack of adoption
c) *Lack of communication:* During policy formulation and policy execution
d) *Lack of action planning:* Not considering implementation. This occurs when the document is seen as an end in itself
e) *Lack of progress reporting:* Which results from a lack of regular review and constant national realignment and focus to goal achievement
f) *Lack of accountability:* Each measure, objective, data source and initiative must have an owner
g) *Lack of empowerment:* Implementers of the policy lacking both finance and an enabling legal and regulatory framework

Apart from the role of promoting ICT, governments also need to establish the proper national structures to support and execute the policy, but most of all governments need to be model agents and consumers of ICT.

2.5.3 Unique Policymaking Challenges in Emerging Economies

Large scale infrastructure deployment always poses challenges in whichever setting. The deployment of large scale infrastructure and in particular ICT for development in emerging economies offers some unique challenges not only to the project pioneers but also the policymakers and strategists. The challenges of enhancing socio-economic development through ICT are similar to those of many varied development projects that have been run in the developing countries for many years now. Some of the specific challenges that need to be addressed by policymakers with regard to ICT strategy include:

1. **Cost and Financial Challenges**
   Deploying ICT and broadband requires specialized equipment most of which is quite costly to acquire. Many developing countries do not have ICT manufacturing or assembly industries and therefore need to import most of this equipment.

   These costs inevitably reflect themselves onto the prices charged for a broadband Internet connection. Investors seeking returns on investment will often charge exorbitant costs to

recoup their investment outlays. Tariff regulation is therefore an important matter than needs to be addressed in developing countries.

2. **Political Challenges**

   The local political context in many emerging economies can be very confusing. The structures and chains of command are easily misunderstood. This would result in inadequate participation which spawns further resistance down the line.

   One primary means of addressing the political challenge is to have ICT for development initiatives championed with individuals with the highest political power possible.

3. **Coordination and Compatibility Challenges**

   The multiplicity of development projects from a wide range of development actors can result in a lack of coordination and possible duplicity of effort. When it comes to a ubiquitous technology such as ICT that whose benefits dwell heavily on networking, a lack of coordination can result in technical incompatibilities that would later require a lot of investment to patch together. A lack of coordination can also result in the inability to exploit synergies.

   Although infrastructure planning has its own challenges in developing countries, a possible solution to the coordination problem can be the development of a master plan by the ICT regulator and the issuing of licenses only along the lines of the master plan and not for financial gain.

4. **Development and Planning Challenge**

   The development challenge comes up when the question of what needs to be done is presented. Many actors will present their opinions, and a myriad or technology solutions will present themselves. Even after a plan has been etched and agreed upon, it is very common to have such plans shelved resulting in anarchy. A visit to the Nairobi Central Business District and the City Council's planning office can attest to that.

   This happens to be a problem of leadership and institutions, one that has been prevalent in many of these countries for quite a long time. But a new age of leaders and respect for institutions is slowly taking over most of these countries.

5. **Access Challenge**

   This would be by far the biggest challenge faced by all the players within the sector. A number of things contribute to making access a challenge and some of these obstacles include:

a. *Physical Obstacles to Access:* Many areas in developing countries are pretty remote, and intentions of universal access often come across last mile deployment challenges due to the topology and the lack other necessary complementary resources such as electricity.
b. *Educational Obstacles to Access:* Although basic levels of literacy are rising in many of these nations, operation and working with ICT's is never really as simple as it is cut out to be. A given critical mass of engineers is necessary to maintain and sustain these systems and accessing these few engineers available in the developing countries can be quite a problem.
c. *Economic Obstacles to Access:* Large scale infrastructure projects may be funded by the government through various means. This might be thought of as the end of the economic barrier to infrastructure deployment, while the true obstacle is the purchasing power of the end users which for the most part for a majority of the population in developing countries is very dire.
d. *Cultural Obstacles to Access:* Gender inequality happens to be a very big problem in many developing countries. A good amount of these inequality problems stem from cultural related issues that discriminate on the girl child. These cultural issues may pose a problem to universal access.

6. Challenges on use

A lack of relevant local content and local applications and services are a deterrent to how successful the deployment of ICT for development will be. Most developing countries have very little relevant information online, with would partially explain why internet traffic in the entire African continent is extremely low. Once the infrastructure is in place, a key challenge is to make sure that is used for the intended purpose; economic and social empowerment. There also needs to be clear demand for these services because if they only are a duplication of something that has since been running all too well differently, the infrastructure deployment may be just but a waste.

7. Sustainability Challenge

The challenge of sustainability is often a conglomeration of all of the above. Poor planning, unrealistic timeframes, insufficient training, inappropriate technologies, lack of participation, monitoring and feedback are common causes of project failure, but most of all eventual ownership and maintenance of the infrastructure determines survival. Most projects die within a few years after they are handed over to the locals. A good way to avoid this would not only involve addressing all the above, but also keeping a high level of simplicity within the project to ensure it eventual local sustainability.

2.5.3 From Policy to Strategy

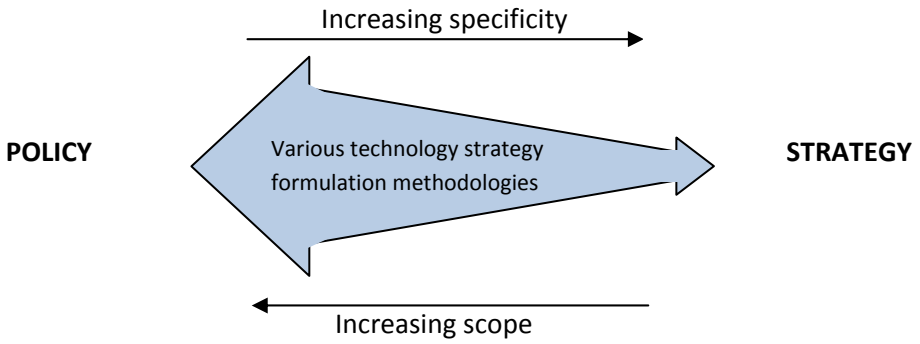


Figure 2.8: Policies and Strategies
Source: Author

Strategy making is the exercise of attaching a mission to the vision. Analysis and selection of various strategic alternatives result in more specific action plans. Several methodologies and processes exist for the formulation of an e-strategy. Figure 2.8 summarizes the shift from policies to strategies. The concern of this thesis includes analyzing the effectiveness of one such process, the CLIOS Process.

2.6 Relevant Case Study References

The United Nations Conference on Trade and Development (UNCTAD) (2007) noted that, "although the number of Internet users in Africa continues to grow strongly, penetration continues to be extremely low. Four out of the 53 countries (Nigeria, Morocco, Egypt and South Africa) account for almost 60 per cent of Internet users in the continent." (p. 25) They proceeded on to say that, "African countries still have much work to do in order to improve Internet penetration, but several are strenuously pursuing ICT diffusion and are slowly but surely improving the situation through a combination of ICT for development policies to improve ICT access and skills, regulatory reforms to increase the offer of services and competition and the fostering of investments in infrastructure in the ICT sector" (p. 25).

Based on this backdrop, the state of connectivity and Internet within the continent is dire. Nevertheless there are two countries that are seemingly performing well with respect to ICT for development – Egypt and South Africa. Among the highest ranked African countries in the

network readiness index worldwide released by the World Economic Forum 2008-2009, are Egypt which is ranked 76 and South Africa which is ranked 52, while Kenya comes in at a paltry 97 in an analysis of 134 countries globally. According to the 2007 ITU's Digital Opportunities Index, Egypt is ranked 91; South Africa is 86 while Kenya is ranked 153 in an analysis of 181 countries.

It is no surprise therefore that when the nations of Africa realized the necessity and benefits of having its own regional Internet registry, AfriNic was launched in 2005; the operations center was established in South Africa with back up facilities in Egypt. These two countries, Egypt and South Africa shall therefore be used as case study references with respect to the appropriate ICT for development policies in emerging economies.

2.6.1 Egypt

According to the Egypt State Information Service website, Egypt is a North African country with the Sinai Peninsula forming a land bridge to Western Asia as shown in figure 2.9. Covering an area of about 1,010,000 square kilometers (390,000 sq mi), Egypt is bordered by the Mediterranean Sea to the north, the Gaza Strip and Israel to the northeast, the Red Sea to the east, Sudan to the south and Libya to the west.

According to Egypt's government online portal the following were the prevalent facts as at the latest census conducted in 2006. Egypt was one of the most populous countries in Africa and the Middle East. The great majority of its estimated 76 million population lived near the banks of the Nile River, in an area of about 40,000 square kilometers (15,000 sq mi), where the only arable agricultural land is found. The large areas of the Sahara Desert are sparsely inhabited and about half of Egypt's residents live in urban areas, with the majority spread across the densely-populated centers of greater Cairo, Alexandria and other major cities in the Nile Delta.

The State Information service highlights that Egypt's economy depends mainly on agriculture, petroleum exports, and tourism. The completion of the Aswan High Dam in 1970 and the resultant Lake Nasser have altered the time-honored place of the Nile River in the agriculture and ecology of Egypt. A rapidly-growing population, limited arable land, and dependence on the Nile all continue to overtax resources and stress the economy. The government prepared the economy for the new millennium through economic reform and massive investments in communications and physical infrastructure. Its main revenues however come from tourism as well as traffic that goes through the Suez Canal.

Fiber Optic Connections

- I-ME-WE
- SEA-ME-WE-2
- SEA-ME-WE-3
- SEA-ME-WE-4
- FLAG (FEA)
- FALCON
- TGN-EA
- SEACOM
- EIG
- TE NORTH
- MAIN ONE

Figure 2.9: Egypt's Fiber Optic Connections
Source: TATA Communications, Accessed June 15, 2009

Due to its convenient location at the North Eastern tip of the African continent with a connection through the Suez Canal to the Middle East, Egypt acts as a conduit and perhaps the most convenient default landing station for submarine cables connecting Europe and the West to Asia and the Indian subcontinent. Egypt has access to close to 10 submarine optic fiber cables connected to it. Some of the submarine fiber optic connections are highlighted in table 2.3.

Table 2.3: Optic Fiber Cables Landing in Egypt

NAME	COUNTRIES	OWNER (OPERATOR)	DISTANCE	YEAR (COMPLETED)	CAPACITY
South East Asia–Middle East–Western Europe (SEA ME WE) 2	Egypt, Tunisia, Italy, Algeria, France, Cyprus, Turkey	AT&T and Alcatel – USA	3,660 km	1993	2 x 560 Mb/s
Fiber-Optic Link Around the Globe (FLAG)	USA, UK, Spain, Italy, Egypt, Saudi Arabia, UAE, India, Malaysia, Thailand, China, Korea, Japan	FLAG Telecom (NYNEX) – USA	26,000 km	1997	2 x 5 Gb/s
ALETAR	Egypt, Syria	Arab Republic of Egypt National Telecom Organization (ARENTO) – Egypt	787 km	1997	5 Gb/s
SE ME WE 3	Egypt, Turkey, Greece, Italy, Morocco, Portugal,	British Telecom (BT) – UK, Deutsche Telekom AG (DTAG) – Germany and Tele Danmark – Denmark	40,000 km	1999	4 x 2.5 Gb/s
SE ME WE 4	France, Singapore, Malaysia, Thailand, India, Bangladesh, Pakistan, UAE, Egypt, Tunisia, Sri Lanka, Algeria, UK	Singtel - Singapore, Telekom Malaysia, CAT Telecom – Thailand, Barti Infotel Ltd. – India, VSNL – India, Bangladesh T&T, Sri Lanka Telecom Ltd, Pakistan Telecoms, ETISALAT – UAE, Saudi Telecom, ARENTO, Tunisie Telecom, Algerie Telecom, Telecom Italia, France Telecom, MCI – UK	20,000 km	2005	1.28 Tb/s
FLAG Alcatel-Lucent Optical Network (FALCON)	Egypt, Gulf States, India	FLAG Telecom (NYNEX) – USA	10,000 km	2005	3.84 Tb/s?
SEACOM	South Africa, Mozambique, Madagascar, Tanzania, Kenya, UAE, India, Egypt, Italy	Neotel - SEACOM	13,000 km	Due for completion 2009	1.28 Tb/s
Middle East North Africa (MENA)	Italy, Greece, Egypt, Saudi Arabia, Oman, and India	Oman Telecommunications Company Omantel – Oman, and MENA Co. – Egypt	8,000 km	Due for completion 2009	5.8 Tb/s
Tyco Global Network – Eurasia (TGN EA)	Egypt, India, France, UK	VSNL – India	9,000 km	Due for completion 2009	1.28 Tb/s
India-Middle East-Western Europe (I ME WE)	India, Yemen, Saudi Arabia, Pakistan, UAE	Bharti Airtel, VSNL – India, PTCL – Pakistan, ETISALAT – UAE, STC - Saudi Arabia, Ogero – Lebanon, TE – Egypt, Telecom	14,000 km	Due for completion 2009	3.84 Tb/s

		Italia, France Telecom			
Europe India Gateway (EIG)	UK, Portugal, Gibraltar, Morocco, France, Libya, Egypt, Saudi Arabia, Djibouti, Oman, UAE, India	AT&T, Bharti Airtel, BT, C&W, Djibouti Telecom, Gibtelcom, IAM, Libya PTT, MTN Group, Omantel, UAE PT, Saudi Telecom, TE, Telkom SA, Verizon Business	15,000 km	Due for completion 2010	3.84 Tb/s
Telecom Egypt North (TE N)	Egypt, France	Telecom Egypt, France Telecom	3,100km		
MAIN ONE	South Africa, Portugal, Ghana, Nigeria, Angola	Main Street Technologies – USA		Due for completion May 2010	1.28 Tb/s

Sources: Atlantic Cable, Wikipedia Accessed June 15, 2009.

2.6.1.1 Egypt's ICT Sector

Egypt has managed to achieve some key milestones of their e-strategy with regard to becoming a business process outsourcing destination. According to the Egypt's Ministry of Communications and Information Technology, Egypt won the first place for the best outsourcing destination for the year 2008 from the National British Society for Outsourcing Services, and Egypt's capital, Cairo, was in the top ten of the world's emerging outsourcing cities for the first time, according to the latest Global Services - Tholons Study.

The history of the Internet in Egypt starts in 1993 and as recounted by Hassanin (2003), the first use of the Internet in the country was through a link to the Egyptian University Network connecting to France. By the end of that year Egypt had 2,000 Internet users who were mainly within the academic community. According to the World Bank (2009) Global Information Technology Report Egypt currently has 10,532,400 Internet users as of December 2008, 12.9% of the population. From one local Internet Service Provider (ISP) in 1993 to 12 in 1996, Egypt now has more than 200 ISPs serving Egypt's population of roughly 80 million as of the beginning of 2009.

Access to digital communications has grown since it was first made publicly available to the public in 1996, but widespread poverty and poor infrastructure, particularly in rural areas, remain barriers to access. According to government statistics, 0.58 percent of the population used the internet regularly in 1999. By 2008, the figure had grown to 14 percent.

The disparity of broadband Internet between the rich and the poor still seems to be a challenge though and this may be partially due to the disproportionate distribution of the population density between rural and urban areas. The Freedom House (2009a) Global Assessment of Internet and Digital Media report on Egypt makes the observation that "broadband Internet remains

prohibitively expensive for most of Egypt's population, 40 percent of which lives on $2 or less a day. In 2008, just over 1 percent of the population had a broadband connection at home, but internet cafes offering such connections are common, even in urban slums and small villages. In December 2008, an average of 200,000 people a week used these cafes." (p. 53)

In the Global Information Systems Watch, Hassanin (2007) offers a background to Egypt's ICT sector. In 1998, the Ministry of Communication and Information Technology (MCIT) was established as an entity independent from the former Ministry of Transportation and Telecommunication. MCIT was then charged with the responsibility of developing the ICT infrastructure, stimulating the national knowledge economy, forging an e-government strategy and developing a legal framework that is in line with international digital requirements. The MCIT facilitated the drafting of several telecommunications related laws and facilitated privatization and subsequent sector liberalization. They also undertook to deregulate the sector. They facilitated the establishment of the National Telecommunications Regulatory Authority (NTRA) in 2003 charged with all regulatory functions as an independent regulatory authority.

After setting up the requisite administrative, regulatory and judicial structures, the MCIT then embarked on formulating the national ICT policy and e-strategy in conjunction with the Information Technology Industry Development Agency (ITIDA). The primary goal of the policy is summarized in UNCTAD's (2008) Information Economy Report as, "transforming their economy into a regional hub of ICT production and service provision" (p. 102). In the World Bank (2009) Global Information Technology Report, Shenawi and Lanvin (2009) quote Dr. Tarek Kamel, Egypt's Minister of Communications and Information Technology, who echoes the service provision component of the policy by saying that "Egypt's strategy is based on the development of outsourcing capability with the objective of competing efficiently worldwide and maximizing the revenues generated by the investments in the outsourcing industry." (p. 113)

Egypt's goal of becoming a leader in the outsourcing industry was broken down into several sub-goals outlined by Shenawi and Lanvin (2009) in the World Bank (2009) Global Information Technology Report. "The national strategy established for the development of the BPO (Business Process Outsourcing) market in Egypt is defined by the ITIDA's strategy grid, which includes the following pillars:

- Ensure that all requirements (human resources, infrastructure, legislative matters, etc.) are ready and available.
- Enhance the volume and quality of the local talent pool, particularly through the training of 4,500 university students (this is expected to scale up to 40,000 students within three years)
- Promote Egypt as a BPO destination using the services of a world-class public relations company.

- Offer ready-made incentive packages tailored to suit all investors in accordance with the numbers of positions to be deployed in Egypt, training and telecommunications costs, and so on.
- Encourage local companies to cooperate with foreign investors.
- Provide single-window clearance, thanks to full cooperation from relevant governmental agencies and authorities." (p.114)

Shenawi and Lavin (2009) highlight the sources of Egypt's advantage and success in the BPO industry as the setting of attractive costs, possession of a competitive pool of human resources, a stable macroeconomic environment, a strategic geographical location, government support, telecommunications infrastructure, and an improved business environment. Each of these has a concurrent strategy that has resulted in various action plans. The success of these action plans shall be included in the subsequent analysis of the Government of Kenya (2006a) Kenya ICT Strategy particularly in reference to BPO.

Egypt's efforts to build itself as a first-class competitor in the area of outsourcing have led to measurable success based on the careful formulation and execution of a strategy. They also offer a basis for further efforts and ambitions in this area. The way in which Egypt has chosen to pursue this path can be a source of reference and even inspiration for other emerging economies.

2.6.2 South Africa

The Republic of South Africa is a country located at the southern tip of the continent of Africa. It is a country better known for its mineral endowments of gold and diamonds and its turbulent history marred with an apartheid regime that lasted for 44 years beginning 1950. Nevertheless, South Africa is easily recognized as the most developed African. The South African coast stretches 2,798 kilometres (1,739 mi) and borders both the Atlantic and Indian oceans. To the north of South Africa lie Namibia, Botswana and Zimbabwe, to the east are Mozambique and Swaziland, while the Kingdom of Lesotho is an independent enclave surrounded by South African territory.

The brand South Africa campaign mentions on its website that South Africa is known for its diversity in cultures, languages, and religious beliefs. Statistics South Africa, states that eleven official languages are recognized in the constitution. English is the most commonly spoken language in official and commercial public life; however, it is only the fifth most-spoken home language. South Africa is ethnically diverse, with the largest Caucasian, Indian, and racially mixed communities in Africa. Midyear 2007, the South African population was estimated at 47.9 million. About a quarter of the population lives on less than US$ 1.25 a day.

By UN classification, South Africa is a middle-income country with an abundant supply of resources, well-developed financial, legal, communications, energy, and transport sectors, a stock exchange (the JSE Limited), that ranks among the top twenty in the world, and a modern infrastructure supporting an efficient distribution of goods to major urban centers throughout the entire region. South Africa was ranked 25th in the world in terms of GDP as of 2007. According to the 2008 UN Human Development Indices Report, South Africa's advanced development is significantly localized around four areas: Cape Town, Port Elizabeth, Durban, and Pretoria/Johannesburg. Beyond these four economic centers, development is marginal and poverty is still prevalent. The report goes on to mention that South Africa has one of the highest rates of income inequality in the world. A decade of continual economic growth has helped to lower unemployment, but daunting economic and social problems still remain persistent.

South Africa has a large agricultural sector and is a net exporter of farming products especially to the rest of the Sub-Saharan African countries. South Africa is also the largest energy producer and consumer on the continent and is a popular tourist destination, with a substantial amount of revenue from tourism. It was recently selected to host the 2010 soccer World Cup, which would be a major boost to the country's economy.

With respect to the Internet and broadband, the Freedom House (2009b) Global Assessment of Internet and Digital Media report on South Africa says that "South Africa's broadband penetration rate currently sits at around 1 percent something that has been achieved over 4 years. In South Africa around half of all broadband connections are wireless which is mainly due to the high cost and poor service offerings in the fixed line space" (p. 93). This may have partially been caused by the fact that the long standing submarine cable, Sub Atlantic (SAT)-3, landing station was exclusively owned by the state-run South Africa Telkom. It has therefore been extracting monopoly rents with little regulation, making bandwidth costs extremely high.

South Africa's ICT Sector policy history lies in contrast to that of Egypt. They have experienced generally lower levels of success in the execution of their e-strategy and not until recently did the country pay renewed focus to the sector with the particular intention of reformulating its e-strategy, which is currently underway. Nevertheless South Africa offers a good case study on the possible challenges that most Sub-Saharan countries will experience in the formulation and execution of their ICT policies and e-strategies.

Due to its location at the southern tip of the African continent, as shown in Figure 2.10, South Africa has benefited by acting as a landing station to submarine cables going round the continent connecting the United States to the Indian sub continent. The government owned South Africa Telekom was also a part investor on a submarine fiber cable running from Portugal down the West African coast. These are just but a few of the submarine fiber optic cables currently in

place; there are several other projects underway. Some of the submarine fiber optic connections are highlighted in table 2.4.

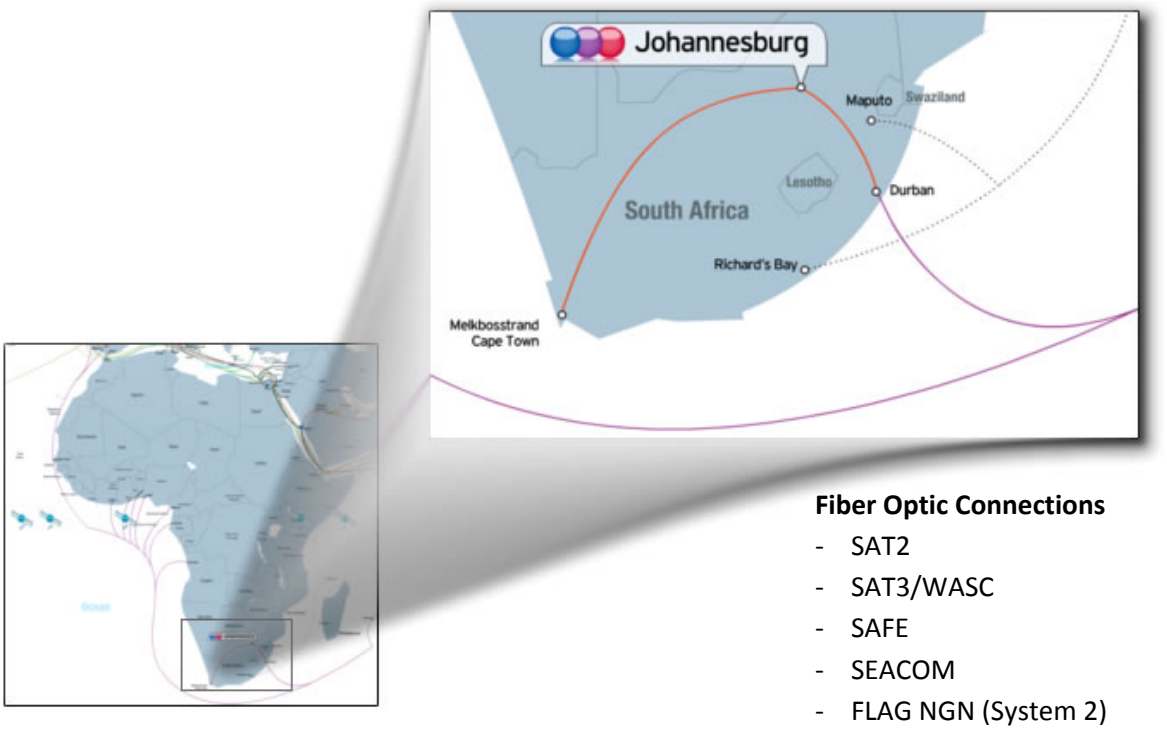


Figure 2.10: South Africa's Fiber Optic Connections
Source: TATA Communications, Accessed June 15, 2009

Table 2.4: Optic Fiber Cables Landing in South Africa

NAME	COUNTRIES	OWNER (OPERATOR)	DISTANCE	YEAR (COMPLETED)	CAPACITY
South Atlantic (SAT) 2	South Africa, Tenerife, Portugal	Telkom SA, Telefonica, Marconi	9,500 km	1993	2 x 560 Mb/s
SAT 3/WASC	South Africa, Angola, Gabon, Cameroon, Nigeria, Benin, Ghana, Ivory Coast, Senegal, Gran Canaria, Spain, Portugal	Telkom SA, Telefonica, Angola Telekom, Ghana Telecom, Nitel, Gabon PT, Benin PT, Marconi, Sonatel, Camtel, CIT	14,350 km	2002	Phase 1: 20 Gb/s Phase 2: 40 Gb/s Maximum 120 Gb/s

South Africa Far East (SAFE)	South Africa, Reunion, Mauritius, India, Malaysia	VSNL, France Telecom, Telkom SA	13,500 km	2002	Phase 1: 20 Gb/s Phase 2: 40 Gb/s Maximum 120 Gb/s
SEACOM	South Africa, Mozambique, Madagascar, Tanzania, Kenya, UAE, India, Egypt, Italy	Neotel - SEACOM	13,000 km	Due for completion 2009	1.28 Tb/s
FLAG NGN (Next Generation Network) -System 2	South Africa, India, Kenya, Tanzania, Kenya, Mozambique, Madagascar, Mauritius	FLAG TELECOM	10,000 km	Due for completion 2010	
EASSy	South Africa, Sudan, Eritrea, Djibouti, Somalia, Kenya, Tanzania, Zanzibar, Madagascar, Mozambique, South Africa, Comoros	WIOCC: West Indian Ocean Cable Company which consists of the telecoms companies in the following countries: Djibouti, Kenya, Somalia, Uganda, Zanzibar, Burundi, Nigeria, Botswana, Mozambique, Lesotho. Other partners are Mauritius Telecom, Comoros Telecom, Sudatel,- Sudan, MTN Group, Neotel, Telkom, South Africa, Telecom Malagasy, Tanzania Telecoms, Zambia Telecoms, BT, France Telecom, Etisalat, Bharthi AerTel – India, Saudi Telecom	10,500km	Due for completion 1st half of 2010	3 x 10 Gb/s upgradable to 32 x 10 Gb/s
MAIN ONE	South Africa, Portugal, Ghana, Nigeria, Angola	Main Street Technologies – USA	14,000 km	Due for completion May 2010	1.28 Tb/s
Africa Coast to Europe (ACE)	France, Spain, Portugal, Morocco, Spain, Mauritania, Senegal, Gambia, Guinea-Bissau, Guinea, Sierra Leone, Liberia, Côte d'Ivoire, Ghana, Togo, Benin, Nigeria, Cameroon, Sao Tome and Principe, Equatorial Guinea, Gabon, Congo, Angola, Namibia, South Africa	Benin Telecoms SA, Camtel, Companhia Santomense de Telecomunica, Côte d'Ivoire Telecom, France Telecom, Gamtel, Maroc Telecom, Mauritania Telecom, Tunisia Telecom, Orange Bissau, Orange Cameroun, Orange Guinée, Orange Mali, Orange Niger, Orange Spain, Portugal Telecom, Sonatel and Togo Telecom	14,000 km	Due for completion 2011	1.92 Tb/s

Sources: Atlantic Cable, Wikipedia, Accessed June 15, 2009.

2.6.1.1 South Africa's ICT Sector

South Africa's challenge after the first democratic transition following the apartheid regime was to balance sustainable economic growth with social empowerment. This is the challenge addressed by several related ICT initiatives including the South Africa ICT Strategy Project – how to make South Africa regionally and globally competitive and, at the same time, use ICT as an enabler of social equity.

According to the International Telecommunications Union (ITU), access to the internet has steadily improved in South Africa despite the obstacles that remain. It is estimated that about 8 percent of the population – 4 million people – have access (broadband access 1%), one of the highest rates in Sub-Saharan Africa. However prices are still beyond the reach of the majority of the population.

The Global Assessment of Internet and Digital Media report on South Africa (2009b) by the Freedom House, qualifies this broadband access, stating that, "the country is in the exceptional position of having more people accessing the internet from their mobile telephones than from their computers. Nevertheless, the majority of the population is unable to benefit from internet access due to high costs and the fact that most content is in English, an obstacle for those who speak only local dialects" (p. 93). Their survey also showed that, "most of those with access, especially broadband access, are concentrated in urban areas. After years of stifled competition, the market is slowly opening up, and it is expected that costs will drop with the arrival of the Seacom undersea fiber-optic cable in 2009 and the increasing use of updated mobile-phone technology. Telkom SA, a partly stated-owned company, retains a near monopoly in providing broadband access via ADSL, though the recent licensing of a second national operator, Neotel, should increase competition" (p. 94).

The United Nations Economic Commission for Africa noted that the South Africa IT Strategy Project (SAITIS) was developed by the Department of Trade and Industry and the Department of Communication, in consultation with the private sector and other stakeholders. In the design of the SAITIS strategy, it was recognized that the development of the local market could act as a powerful stimulus to the ICT sector and, at the same time, could have substantial socio-economic benefits for other sectors. To achieve this, the extension of ICT usage was viewed as needing to take place in four areas—local market development, applications development, information infrastructure development, and achieving ubiquity of access. Until now, as stated earlier, access has been heavily concentrated in the urban commercial areas and among higher socio-economic groups.

The UNDP (2001) Report of the Digital Opportunity Initiative highlighted that an important objective of the South African 1996 Telecommunications Act was the promotion of universal service and affordable provision of telecommunication services. In addition, the government

created International and National Task Forces for ICT, as well as a Local Content and Production National Task Force within the media and broadcasting industry which would focus on the implementation of the ICT strategies generated by the taskforces.

The report by the UNDP (2001) observed that "there is a shortage of IT-literate staff to use and maintain ICT Systems in South Africa. It is not clear whether the development focus of the South African strategy has been fully translated into action on the ground. Slow progress may be due to skills, access and regulatory constraints. Approximately 25 percent of ICT skilled workers leave the country each year; meanwhile demand is growing at 40 percent per annum. The cost of access is still high by international standards and many areas are without access at all. There is not yet a transparent regulatory regime which could facilitate the development of the telecommunications sector. Potentially differing priorities among stakeholders also present a challenge. The multi-stakeholder taskforces are an important step in this regard, but consultation also needs to be extended to the implementation stage to ensure that initiatives are demand-driven and sustainable" (p. 25).

Some of the reasons for the dismal performance of the sector are explained by Esselaar and Gillwald (2007) where they maintain that, "while the absence of improvement in South African competitiveness and e-readiness are concerning, they are not surprising considering the absence of change to the fundamental market structure and institutional arrangements that failed to deliver on policy objectives in the first two reform rounds – the first round starting in 1996 with the Telecommunications Act, and the second starting in 2001. The market remains structured around vertically integrated incumbents (a number significantly owned by the state), and ineffectually regulated in several critical areas, partially as a result of structural conflicts of interest in the institutional arrangements of the state, particularly the Ministry of Communications – which has responsibility both for protecting and growing state assets in the sector and, paradoxically, for developing the competitive policy framework. The combined effect is a sector committed in principle to reaping the benefits of competition through use of the market to efficiently allocate resources, but which in practice is not characterized by effective market operations and is in fact currently marked by increased concentration of state ownership, market distortion and indeed, significant limitations on competitive entry" (p. 9)

Nevertheless, the South African government continues to emphasize the importance of ICTs and their contribution to the country's economic growth. There is still a glimmer of hope in salvaging the situation and Esselar and Gilwald (2007) note this when they recognize the newly set up Accelerated and Shared Growth Initiative of South Africa (ASGISA) in 2005, whose action plan includes the goal of bringing down the cost of ICT by developing high-speed national and international broadband capacity.

2.7 Chapter Conclusion

In Chapter 2 the thesis begun by covering the question of ICT for development, where the generally accepted drivers of the ICT for economic development were highlighted. The challenges associated with each driver were also mentioned within the discussion. Subsequent analysis of the Kenya ICT Policy (2006) and their intentions to deploy ICT for economic development shall be based on this discussion. This was followed by a discussion on the specific deployment of broadband focusing on the challenges of developing a knowledge based economy, a process that would take several steps resulting in Internet ubiquity within the emerging economy.

The chapter also discussed the various indices used to measure ICT for development which would be useful for consideration in the evaluation of ICT deployment projects. These measures will also be useful in guiding the CLIOS Process steps of setting measurable goals.

The sections in the chapter covering policy making, set the background and framework within which any policy analysis tool such as the CLIOS Process should operate. The chapter also mentions the unique policy making challenges for emerging economies, and concludes by looking at two case study references where different policies were adopted and their subsequent effects.

Proceeding from Chapter 2, the next chapter shall focus on the specific case of Kenya highlighting the various projects and policy challenges of its ICT sector.

CHAPTER 3: THE CASE OF KENYA

Kenya is one nation among the emerging economies that has taken particular focus on the deployment of broadband with an aim of achieving economic growth. This intention has presented the complexities of proceeding from simple broadband technology deployment to the use and application of this technology in ways that will result in the achievement of economic growth. This chapter will take an in depth look at Kenya, its current economic activity and performance before focusing on the ICT sector, its governance, policies and current projects.

3.1 Introduction

The Republic of Kenya is a country in Eastern Africa. As shown in Figure 3.1, Kenya is bordered by Ethiopia to the north, Somalia to the east, Tanzania to the south, Uganda to the west, and Sudan to the northwest, with the Indian Ocean running along the southeast border.

Basic Facts:

- *Population Estimate:* 37,953,838 (2008)
- *Area:* 582,646 sq km
- *Urban population:* 22% of total
- (2008)
- *Literacy:* 85.1%
- *GDP - real growth rate:* 2.2% (2008 est.)
- *GDP - per capita (PPP):* $1,600 (2008)
- ***GDP - composition by sector:***
  Agriculture: 23.8%
  Industry: 16.7%
- *Services:* 59.5% (2007 est.)
- *Unemployment rate:* 40% (2008 est.)
- *Population below poverty line: 46*% (2006 est.)

Figure 3.1: Map of Kenya
Source: CIA World Fact Book and Bliss Sites, Accessed Jul 1, 2009

Kenya is ranked 148th out of 177 countries in the Human Development Index Report published by the United Nations Development Program (2007-2008), with a Gini coefficient[2] score of 0.425. There is an incredible lack of wealth distribution, among the population. That can be evidenced in the capital city, Nairobi, with sprawling suburbs but it is also home to the largest slum in Africa, Kibera.

Nevertheless, Kenya is the economic leader in the East African region and Nairobi continues to be the primary communication and financial hub of East Africa. It enjoys the region's best transportation linkages, communications infrastructure, and trained personnel, although these advantages are less prominent than in past years.

Before the general elections in December 2007, the Kenyan economy enjoyed a broad-based expansion touching all sectors of the economy. According to Kenya's Ministry of Finance, real GDP grew by 7.0 percent in 2007, up from 6.4 percent in 2006 and 0.5 percent in 2002. The broad-based growth was driven mainly by agriculture, manufacturing, tourism, construction, and transport and communication. As a result, growth in per capita income rose from minus 1.7 percent in 2002 to 4.1 percent in 2007. This has had a significant positive impact on poverty reduction, which declined from 57 percent in 2000 to 46 percent in 2007 based on the most recent poverty statistics from Kenya National Bureau of Statistics (KNBS).

In the recent past, following the negative effects of the post election disturbances and the global financial recession, the projected 6.3 percent real GDP growth by the World Bank was overly optimistic when the Kenyan finance minister announced a modest 2.4 percent growth in the year 2008. This together with the historical performance of Kenya's economy are shown in Figure 3.2 that shows Kenya's actual and projected GDP real growth for the period 2000-2008 and in Figure 3.3 which shows the GDP purchasing power parity for the same period.

[2] The **Gini coefficient** is a measure of statistical dispersion most prominently used as a measure of inequality of income distribution or inequality of wealth distribution. It is defined as a ratio with values between 0 and 1: A low Gini coefficient indicates more equal income or wealth distribution, while a high Gini coefficient indicates more unequal distribution. 0 corresponds to perfect equality (everyone having exactly the same income) and 1 corresponds to perfect inequality (where one person has all the income, while everyone else has zero income). The Gini coefficient requires that no one have a negative net income or wealth. Worldwide, Gini coefficients range from approximately 0.232 in Denmark to 0.707 in Namibia although not every country has been assessed. (source: Economics Dictionary and Research Guide)

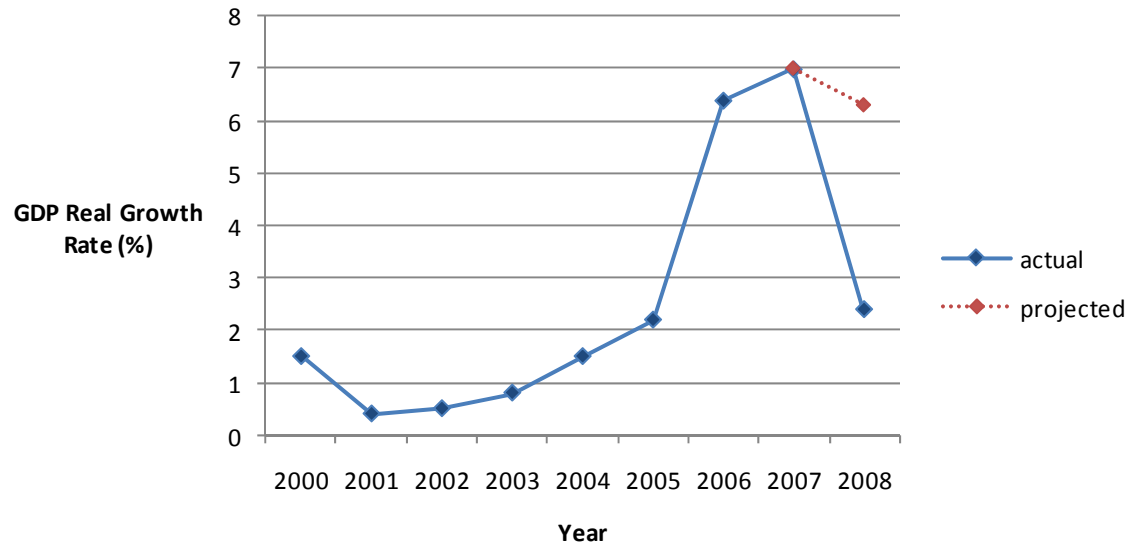


Figure 3.2: Kenya GDP Real Growth 2000-2008

Source: World Economic Outlook Database, International Monetary Fund (IMF) and Kenya Ministry of Finance Budget Outlook paper 2009/10-2011/12

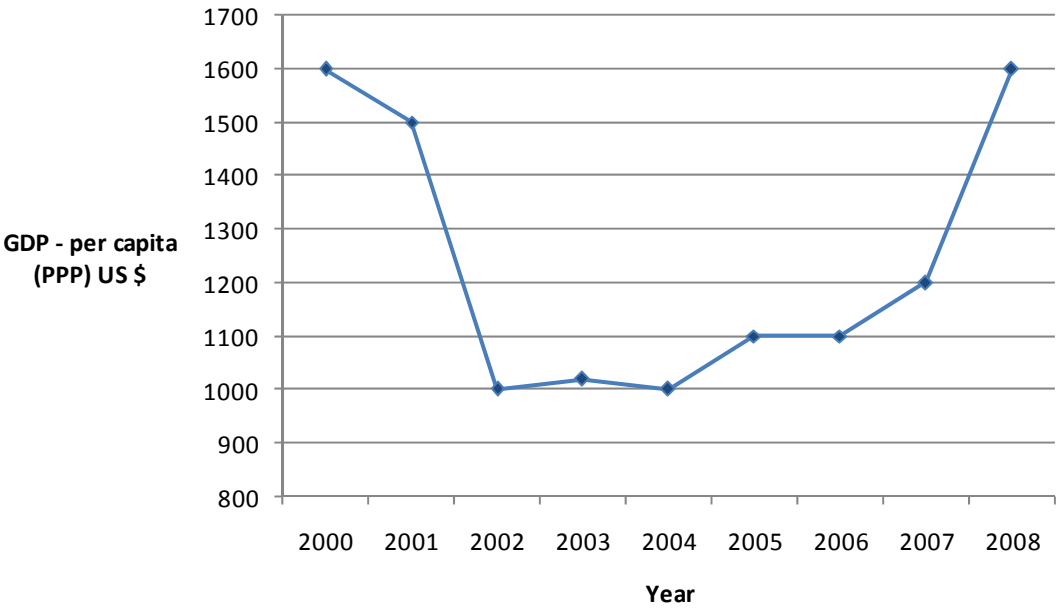


Figure 3.3: Kenya GDP per capita (Purchasing Power Parity)

Source: World Economic Outlook Database, International Monetary Fund (IMF)

3.2 Kenya Vision 2030

As a necessary step in policy making, visioning seeks to understand and elaborate the intentions giving direction to the deployment of ICTs. In the case of Kenya, the broad vision is set by the Government of Kenya (2007) Vision 2030 document discussed below.

In 2007 the Kenya government unveiled a visioning document which would help "transform Kenya into a newly industrializing middle-income country providing a high quality life to all its citizens by the year 2030" (Government of Kenya (2007) Vision 2030, p.1). The document was the government's ambitious economic blueprint which, if implemented in its entirety, would have the potential of putting the country in the same league as the Asian Economic Tigers.

The document was a national level SWOT analysis that primarily highlighted opportunities and sectors where the country possessed an economic competitive advantage. According to the authors of the document, the assessment approach involved two critical components; the potential of the sectors to have a wide economic impact and the feasibility of unlocking such potential. The document was mutually agreed upon and developed using a consultative approach that involved members of the public service, the private sector, civil society and non-governmental organizations. The synthesis of the findings were done by a core team comprised of technical officers drawn from the Kenyan government, Kenya research institutions, international consultants (McKinsey Consulting Company) and the private sector under a national visioning steering committee.

The vision was based upon the economic, social and political pillars as shown in Figure 3.3. Economic development was aimed at improving the prosperity of the nation with a goal of achieving an average GDP growth rate of 10% per annum beginning in 2012. This economic projection now hangs in the balance following the political uncertainty occasioned by the aftermath of the 2007 disputed Presidential elections, which left the country both politically and economically dented. The social development vision aims at enhancing nationalism with social equity in a clean and secure environment. This comes with a backdrop of a large Gini coefficient, and a very unfavorable rating in the Paying Taxes (2009) Global report where Kenya dropped from rank 154 to 158 out of 181 economies this year. The political development vision aims to realize an issue based democratic political system respecting the rule of law and protecting the rights and freedoms of every individual in Kenya, although the events that took place during the Presidential elections in 2007 led to questions about Kenya's political maturity.

These three pillars were founded on:

- Macroeconomic stability for long-term development
- Continuity in governance reforms to create a better environment for business

- Enhanced equity and wealth creation opportunities for the poor
- Improved infrastructure for commercial and social amenities
- Improved energy in terms of availability and cost
- An intensified application of science, technology and innovation
- Land reforms including property rights and administration
- Human resource development that is internationally competitive
- Security with a particular focus on internal security to create a conducive commercial environment
- A more citizen focused and results oriented public service

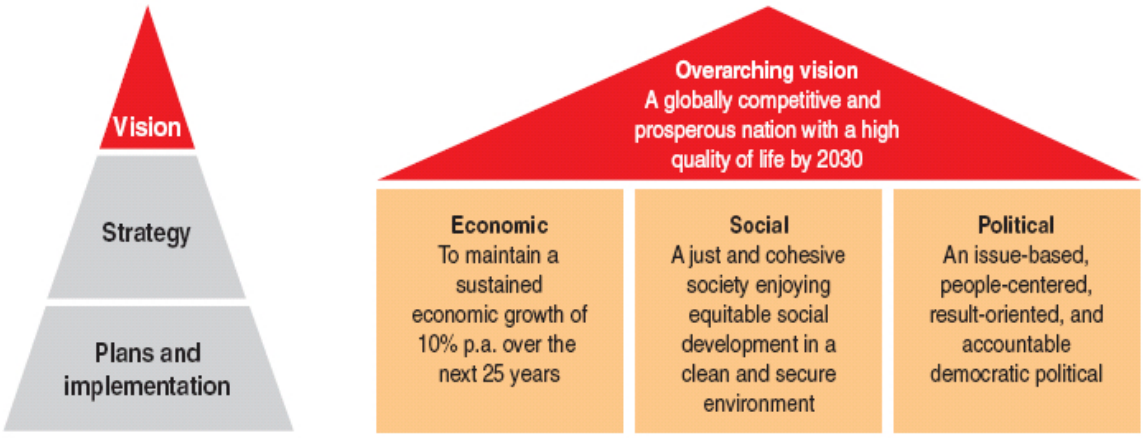


Figure 3.3: Thematic Overview of Kenya Vision 2030

Source: Kenya Vision 2030, the popular version.

The economic vision and strategy focused on the achievement of a sustainable 10% GDP growth rate. Figure 3.4 shows just how much of a challenge this economic growth achievement is in relation to other countries in the world. The economic vision highlighted the following products and services as the focus for economic growth:

1) "Tourism which would be the leading sector to achieve the goals of the vision
2) Increasing value in agriculture which has for a long time been the major economic activity
3) A better and more inclusive wholesale and retail trade sector to lower costs
4) Manufacturing for the regional market of Eastern and Central Africa
5) Business process outsourcing (BPO) and off-shoring to provide business services via the internet to companies and organizations in the developed world
6) To create a globally competitive financial sector with services conducive for investment"

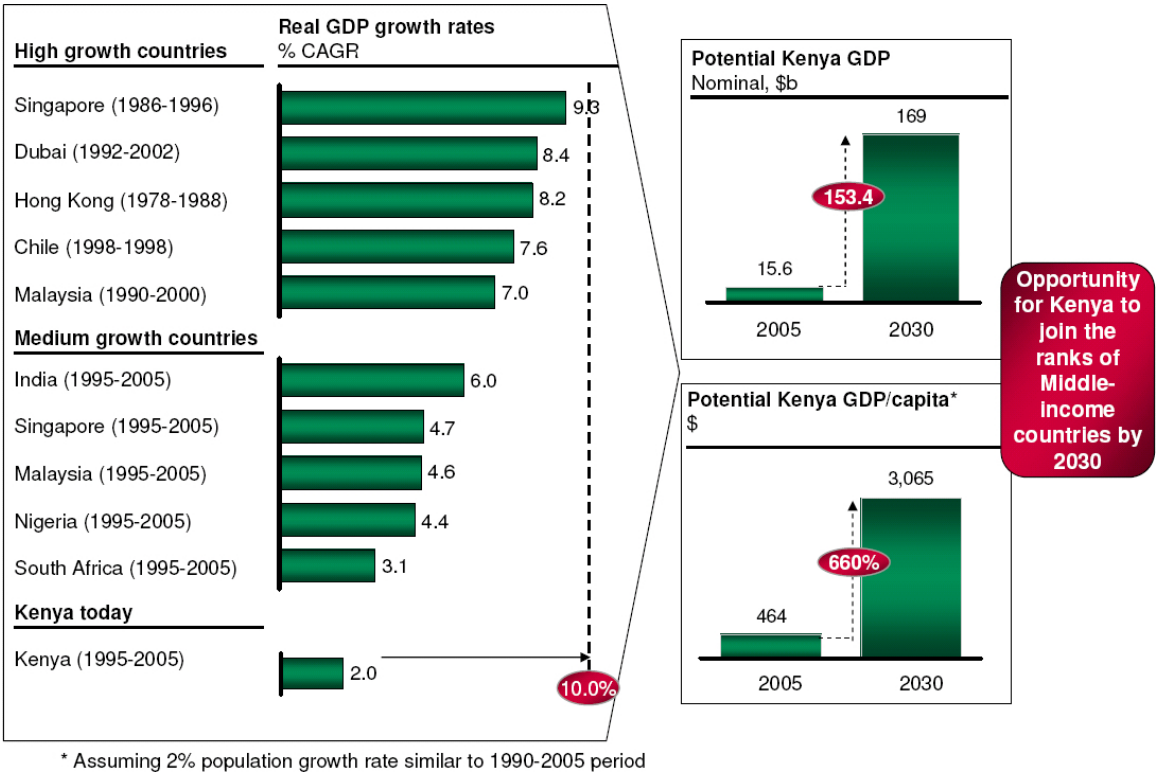


Figure 3.4: Size Comparison of Achieving Economic Vision
Source: McKinsey; Global Insight

The social vision and strategy focused on the following to enhance the livelihood and well being of the Kenyan populace:

1) "Education and training: Providing globally competitive quality education
2) Improving the health sector: Providing an efficient and high quality health care system
3) The environment: Provide a clean secure and sustainable environment
4) Housing and urbanization: Become a predominantly urban country and have a controlled rural to urban migration
5) Water and sanitation: Involving water conservation
6) Gender, youth and vulnerable groups: To obtain more empowerment
7) Equity and poverty elimination: Equality of opportunity and an equitable distribution of resources"

The political vision and strategy focused on the rule of law, a proper implementation of an electoral and political process, a democratic government with a focus for public service delivery, increased transparency and accountability and better security, peace and conflict management.

3.3 The Kenya ICT Sector

In order to understand the e-readiness of Kenya both from a technological and a policy perspective, a look at the current ICT sector and sector background follows in this subsection.

The ICT sector in Kenya has undergone rapid growth in the last decade. There has been a massive leap in the teledensity within the country; increased numbers of mobile telephone subscriptions that were approximately 100,000 at the turn of the millennium currently lie close to 13 million. There is an increased number of computers, internet service providers, broadcasting stations and internet users. The government as well has established an ICT policy, created a specialized ministry to govern the sector and has highlighted it as one of the economic pillars for the achievement of the Kenya Vision 2030.

Table 3.1: Some Facts on Telecommunications in Kenya

ICT Property	Measure
Fixed telephone lines per 100 inhabitants	0.65
Computers per 100 inhabitants (2005)	1.44
Internet users per 100 inhabitants	8.71
Broadband Internet subscribers per 100 inhabitants (2007)	0.05
International Internet bandwidth (Mbps)	1,421
Cyber cafes (2007)	1,000
Radio sets per 100 inhabitants (2002)	21.83
FM Radio Stations (2007)	48
% population with access to radio (2007)	90
TV sets per 100 inhabitants (2003)	4.64
% population with access to TV (2007)	80%
TV sets per 100 inhabitants (2003)	4.64
Mobile cellular subscribers per 100 inhabitants	42.11
% population covered by mobile signal (2007)	77.00

Source: ITU and Communications Commission of Kenya (CCK), Accessed 30th June, 2009

3.3.1 Sector Governance Background

The ICT sector in Kenya is currently governed by the Ministry of Information and Communications, regulated by the Communications Commission of Kenya (CCK) and has the National Communications Secretariat as its policymaker.

The 2008 ICT sector report touches on the history of the sector since the nation's independence in 1963 to date. Prior to 2004 when the Ministry of Information and Communication was formed, ICT fell under various dockets, whose lack of coordination often caused a stunted growth to the sector.

Immediately after the country's independence in 1963, ICT fell under the newly formed Ministry of Information, Broadcasting and Tourism which during the years of the East African Community (Kenya, Uganda and Tanzania) spawned a jointly managed East African Post and Telecommunications Agency. In 1977, following the dissolution of the East African Community, the Kenyan government established the Kenya Posts and Telecommunications Corporation (KP&TC) to run the ICT sector, which then covered telecommunications, postal services, broadcasting and information technology services.

In 1997, the government issued a telecommunications policy statement paving way to the enactment of the Kenya Communications Act of 1998. The statement separated the functions and management of the sector and clearly defined the policy, regulatory and operational responsibilities. This resulted in the establishment of the wholly government owned Telkom Kenya which took up the operational responsibilities for the ICT infrastructure in the country. The CCK was established as the telecommunications, radio and postal sector regulator. The Postal Corporation of Kenya took up the operational responsibilities of the Kenyan Postal System. The Communications Act 1998 provided for the creation of a National Communications Secretariat to be established within the Ministry of Information, Transport and Communications to advice the government on communications policy. The Act also made provisions for an Appeals Tribunal to serve as the independent arbitrator.

In 1999 there was a series of structural changes to the government after which ICT was placed in the Transport and Communications Ministry up until 2004 when the Ministry of Information and Communication was formed. Telkom Kenya was later privatized in 2007 with the government, the public and a strategic investor (France Telecom) holding stocks.

The tumultuous past of the sector was attested to by the current Head of Google – East Africa and former chairman of the Telecommunications Service Providers Association of Kenya (TESPOK), Mr. Joseph Mucheru during a research interview where he said, "there is currently a ministry of information and communication when before there were seven different ministries that dealt with the sector" when he was speaking in reference to receiving government approval to start an ICT service provision company.

Nevertheless, the Kenyan government currently carries a massive intent of mainstreaming ICT into government operations. They are investing in adequate ICT education and training, running

a 1 million shilling (approx. 15,000 USD) annual ICT program to each high school locally, implementing tax incentives on both computer software and hardware, reviewing the legal framework to encourage adoption and use of e-commerce and have developed a master plan for e-government.

Jurisprudence governing ICT in Kenya has been developing gradually over time. The first such embodiment of what may be termed as cyber law was in the 1977 Science and Technology Act. This was supplemented by the Kenya Broadcasting Corporation Act of 1998, which for all intents and purposes actually referred to the government run broadcasting service. The Kenya Communications Act 1998 was by far the most comprehensive embodiment of cyber law in the country since independence as well as several clauses in the Evidence Act that were amended to introduce provisions for dealing with computer outputs and documents from computer systems. To increase its scope to handle among other issues the question of technology convergence, the Communications Act was reviewed and amended in 2008 amidst uproar from the private sector and lobby groups. Muliaro and Wanjohi (2005)summarize the major contents of the reviewed sections as "intended to facilitate the use of electronic transactions in the country; promote business and community confidence in the use of information technology; and enable businesses and individuals to use electronic communications in their dealings with government" (p. 143). Other provisions of the Act allowed for recognition of digital signatures, electronic transactions and increased retention of data and its use as evidence in court.

An issue of contention with the media for instance was where the Act gave CCK and not the independent and professional Media Council of Kenya the responsibility for regulating both traditional and online media as well as giving the Minister of Internal Security the power to raid, seize and confiscate broadcasting equipment during a state of emergency to preserve national security. In light of Kenya's recent history, including the banning of live television coverage by the government following the 2007 elections, reservations have been raised regarding the implications for free online speech should this Act come into effect. The Communications Amendment Act was nevertheless passed in December despite significant opposition from local media houses.

Although the independence of a regulatory body (CCK) is technically enshrined in the Communications Act as well, most of the commissioners are government appointees and their independence may seem to be limited in practice. During the interview, Mr. Gicheru was quick to point out that "there is definitely a problem of vested interest where there has been an intention of gaining unfair advantage and wanting to prolong certain already existing advantages. Telekom Kenya for instance, has been involved in the formulation of policies and in many instances has interpreted them to its own advantage." CCK however has made several reforms and is currently very receptive and professional in the execution of its duties.

3.3.2 Internet Background

The Internet first became available in Kenya in 1993. The African Regional Centre for Computing (ARCC), a non-governmental organization based in Nairobi, became the first provider of web-based Internet service. The first commercial Internet Service Provider (ISP), Formnet began operating in 1995 and was rapidly followed by Africa Online an ISP formed by three young Kenyan entrepreneurs, in Cambridge, Massachusetts in early 1995. Soon competition increased with the entry of more ISPs which currently roughly counts to 51. Figure 3.5 gives a historical trend of ISP licensing over the past seven years in Kenya.

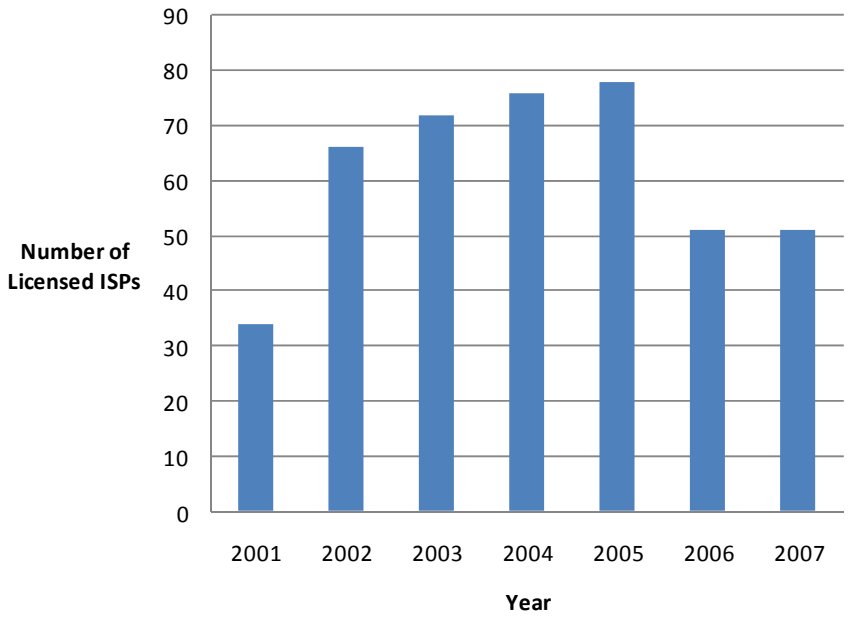


Figure 3.5: Licensed ISPs in Kenya
Source: CCK, Accessed 10th July, 2009

All the ISPs would lease analogue or digital data lines from Kenya to the United States to access the Internet. With the increasing number of ISPs and Internet users, an Internet backbone run by KP&TC called Jambonet was introduced in 1998. It was registered as a subsidiary to Telkom Kenya and was granted exclusivity as the monopoly Internet gateway to the Kenyan market for five years. Jambonet would handle all the internet traffic to and from Kenya and was the upstream provider that offered connectivity to other ISPs. Internet bandwidth and leased line tariffs largely remained high and unchanged with Telkom Kenya exerting its monopolistic advantage. The situation only changed after Telkom Kenya's exclusivity period came to an end in 2004 which coincided with a hearing at the communications tribunal brought by TESPOK, in an effort to ensure the monopoly was not renewed and liberalize the market. The tribunal concluded that Jambonet's monopoly was indeed illegal and the market was liberalized to allow

for competitors. The CCK licensed new operators (currently listed as 8) to compete in both the Internet gateway and domestic leased line services.

Table 3.2: Top Visited Websites in Kenya (2009)

	Top 10 visited sites in Kenya
1	Yahoo!
2	Google.co.ke
3	Google.com
4	Facebook
5	Windows live
6	Microsoft Network (MSN)
7	Youtube
8	Blogger.com
9	Wikipedia
10	BBC Newsline

	Top 10 local sites visited	Rank among all sites visited
1	Nation newspaper	12
2	East African Standard	15
3	Kenyaonetours	27
4	Haiya.co.ke	33
5	Capitalfm.co.ke	40
6	Kenya revenue authority	42
7	Butterfly.co.ke	50
8	Intokenya	53
9	Rich.co.ke	57
10	Best jobs Kenya	59

Source: Alexa, Accessed 10th July, 2009

With continued maturity of the Internet in Kenya and the prevalent high costs, a local Kenya Internet Exchange Point (KIXP), was eventually licensed and launched. The KIXP reduced the amount of international traffic considerably, saving costs and opening up the much demanded capacity for international bandwidth. In 2001, the Kenya Network Information Center (KENIC) was formed with representative board members from the government and Internet community. It took over the administration of the ".ke" country code top level domain (ccTLD). This has since been superseded by the amended Communications Act 2008 that assigned the administration of the ccTLD to the local regulator CCK. Table 3.2 juxtaposes local ".ke" websites to international websites that were accessed in Kenya for the first half of year 2009.

3.3.3 Current Status of the Internet

Although there has been a rather tumultuous past among the Kenyan Internet community, the regulator and the government, there has been a steady growth of Internet use within the country. According to CCK, in the year 2002 there were about 200,000 Internet users in Kenya, with an estimated monthly growth of 300 new subscribers each month. The latest estimate of Internet users for Kenya from the ITU is 2,770,296 people in 2007, corresponding to a penetration rate of 3.1%. This trend can be seen in Figure 3.6.

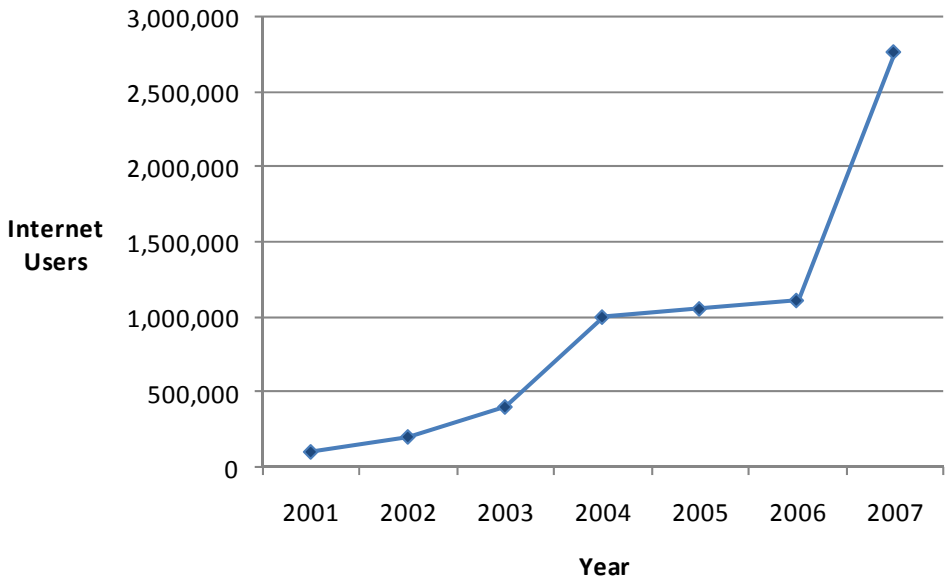


Figure 3.6: Internet Users in Kenya by ITU Estimates
Source: Internet World Statistics, Accessed 10th Jul 2009

Poor telecommunications infrastructure and a lack of electricity particularly in rural areas have resulted in a disproportionately high concentration of internet subscriptions in two of Kenya's largest cities, Nairobi and Mombasa. Since many people in Kenya do not have fixed phone lines, computers, or electricity, internet shops known as cyber cafes, provide access to internet, mainly in the major towns although the mobile phone carriers are having a very successful 3G campaign in the local market. The cost of internet access is still prohibitive and exorbitant and therefore internet access in Kenya has so far only been a preserve of the rich.

Apart from the cost and access challenges, the internet in Kenya has had very little local content to invoke demand as can be seen from Table 3.2, where local sites performed rather poorly compared to foreign sites. The ISPs on the other hand have focused on Internet access rather than Internet services and applications, and the licensing framework has not been in line with the convergence of technologies and interconnection processes take long.

As of 2008, Kenya relied on expensive satellite systems to connect the country's infrastructure with the global internet, but 2009 will mark the introduction of high-speed fiber optic cables to replace this. As a result, costs are expected to drop and connection speeds should rise dramatically, making the technology affordable and accessible to larger segments of the population.

3.3.4 Mobile Telephony

One cannot speak about ICT in developing countries without mentioning mobile phones. In Kenya as well as in most developing countries, mobile-phone penetration is significantly higher than internet penetration rates. In a space of about 7 years, Kenya has managed to grow its mobile phone subscriptions from close to nothing to the CCK estimated 13 million in 2008. The trend of mobile phone subscriptions can be seen in figure 3.7. Four mobile operators have rolled out their networks in Kenya using the Global System for Mobile (GSM) communication technology. These are highlighted in Table 3 below.

Table 3.3: Mobile Phone GSM Operators in Kenya

Rank	Operator	Subscribers (in millions)	Ownership
1	Safaricom	11.956 *(Sept 2008)*	Vodafone (35%), Public (65%)
2	Zain	3.079 *(Dec 2008)*	Zain (80%)
3	Orange Kenya	0.360 *(Dec 2008)*	Telkom Kenya, France Telecom
4	Yu (Econet)	*Not Yet Available*	Essar Group

Source: Wikipedia, Accessed 10th Jul, 2009

There were 2 CDMA providers who started operating in 2006, Flashcom and Popote Wireless. They were primarily focused on data rather than voice technologies. It seems they either could not compete against the GSM providers or Telkom Kenya that also rolled out its CDMA service that very same year or simply because of the predominantly high cost of connectivity that hampered the market from taking up their service. Flashcom went on to invest in one of the submarine fiber optic projects.

According to the network world website, mobile-phone coverage extended to 92 percent (up from the estimated 77 percent by the ITU in 2007) within the Kenyan nation. The availability of internet access via mobile phones increased in 2008, as Safaricom and Zain, launched internet services in Nairobi in mid 2008.

Dearbhla McHenry, an analyst at Pyramid Research in her Africa and the Middle East market perspective and forecast report noted that the mobile penetration rate in Kenya currently stands at 39 percent (compared to the Internet's 3.1 percent) and the subscriber base was expected to rise to 29.28 million, or 66.7 percent penetration, by year-end 2013.

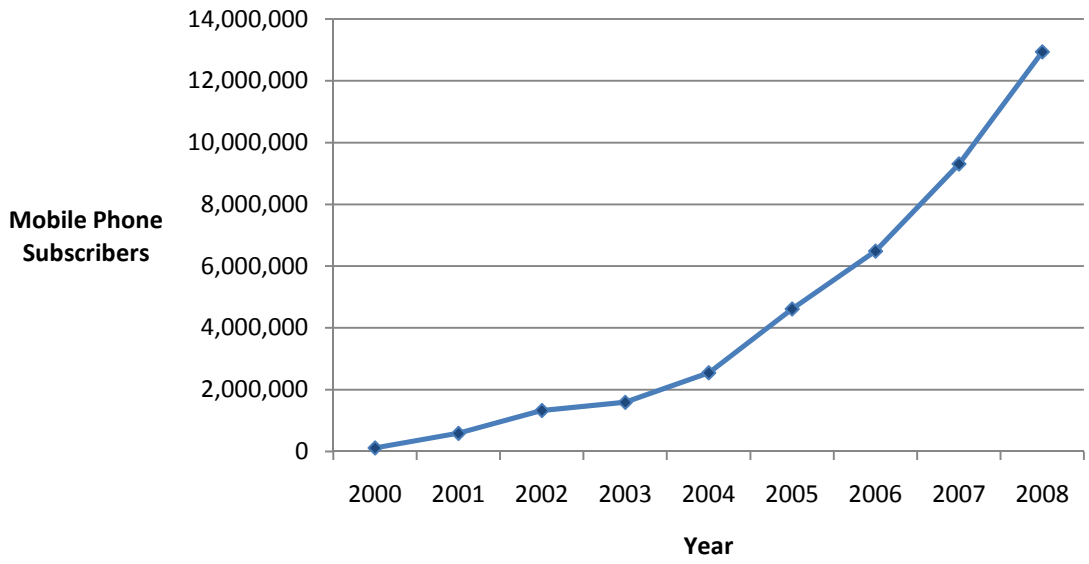


Figure 3.7: Mobile Phone Subscribers in Kenya
Source: CCK, Accessed 10th Jul 2009

McHenry went on to say that "Total revenue of Kenya's telecom market is forecast to grow by 42 percent from $1.39 billion in 2008 to $1.98 billion by 2013, with 78 percent of the total revenue to be generated by the mobile sector. Mobile data will be the telecom sector's fastest-growing revenue stream, increasing in revenue from $62 million in 2008 to $224 million in 2013, partly due to the launch of 3G services but also to the explosive growth of low-tech, low-margin mobile data services, particularly mobile money transfers (with the notable Safaricom mobile banking service – mpesa)"

The cost of making mobile phone calls has generally been high partly due to the duopoly enjoyed by Safaricom and Celtel (currently Zain). There is currently very vibrant competition and intense price wars that have increased the demand of mobile phones following the entry of the other two GSM providers.

The cost of buying a mobile phone in Kenya on the other hand dropped sharply after the government waived the import duty on mobile phones. Kenya's Finance Minister Uhuru Kenyatta cut the 16% VAT on new phone handsets in the government's 2009 June budget statement. Although the government made this bold and encouraging step, a recent report from the GSM Association had earlier stated that mobile subscribers across East Africa are taxed at some of the highest levels world-wide. Kenya, Uganda and Tanzania impose mobile-specific taxes which when added to VAT can result in their respective consumers facing taxes as high as 30% in Uganda and Tanzania, and 27% in Kenya, considerably the highest rates in Africa (and the among the highest across the world as a whole).

3.3.5 Other ICT Related Technologies

There is one fixed line national operator, Telkom Kenya, although there have been plans for quite a while to put in place a second national carrier. According to the CCK website, a license has been issued to Bell Western Ltd as a regional telecom operator, there's uncertainty as to whether they have started operations. The 2008 ICT sector report notes the decline in fixed lines from 320,000 in 2002 to 280,000 in 2006.

The problem of commercializing the fixed line operating space may be due to the fact that CCK has not provided adequate incentive for a new entrant. CCK has also for a long time seemed to lack independence and has favored the government owned Telkom Kenya by giving it monopoly status either directly or indirectly. A problem could also be the lack of review of the licensing model used by the regulator that that lacks consideration for convergence of technology.

Finally the CCK has licensed 16 television stations (2005) and 48 FM radio stations (2007).

3.4 The Kenya ICT Policy

The government of Kenya, through its Ministry of Information and Communication issued an official National ICT Policy document in 2004. The document generated much discussion, criticism and acclaim. The writing process was participatory to an extent and several stakeholders were involved through workshops to contribute to its content, and an official version was released in 2006. Below is a brief discussion of the policy and the policymaking process.

3.4.1 Background of the ICT Policy making process

There have been many attempts to write a National ICT Policy in Kenya that can be traced back to the 1980s. The varied incarnations of the research and technology arm of the Kenya government have attempted over time to embody some kind of ICT master plan with varied levels of success and completion. But as is the case with many other committees and governmental structures that attempted to develop some kind of information or information technology master plan, the documents were either not finalized, or where stored and left to gather dust in some government office or archive.

The words of the Head of Google East Africa's operation, Mr. Mucheru during a research interview cannot be truer; "it is interesting to note that up until 4 years ago, Kenya actually had

no (ICT) policy, though it had connectivity. The policymakers have basically been playing catch up all the while."

The most considerably formal participatory information policy consideration group was the National Y2K (Year 2000) Steering Committee established in October 1998 by the Kenya Minister for Finance that was to work closely with the key operators in strategic sectors of the Kenyan economy to oversee and coordinate initiatives to address the millennium bug problem and ensure the least disruptions prior to and during roll-over to the year 2000. Many other such structures that included parties from the private sector, such as the team which was supposed to collaboratively turn the economy of the country around, either received very little governmental cooperation or had their funding and their contracts abruptly and summarily terminated. Nevertheless, the National Communications Secretariat (NCS), the governmental ICT policy advisory organ, did come up with policy documents that involved little or no outside contribution.

In 2002 though, both local and international pressure necessitated the formulation of an ICT policy to guide the country's ICT sector. Prof. Timothy Waema (2005), writing about the ICT policy making process in East Africa notes that, "the move to develop a national ICT policy was triggered off by three key and mutually reinforcing factors. The first factor was the fast and haphazard growth of information technology that lacked direction and regulation. The second was a desire by the Permanent Secretary (PS) in the Ministry of Research, Technical Training and Technology (MRTTT) to develop national policy guidelines that would steer the development of ICTs in the country in order to address the disorder. The third factor was the readiness of UNESCO to fund the process." (p.26)

In 2002, the National Communications Secretariat in the Ministry of Information, Transport and Communications started the preparation of a national ICT policy. They invited several stakeholders although a glimpse at the list of conference participants suggests they were almost exclusively drawn from the public sector. The publishing of the document underwent several delays but was nevertheless completed in 2004.

When in June 2004 the new Ministry of Information and Communications was created, following the re-organization of some ministries, the new Minister, rejected the draft national ICT policy. He also rejected the draft national broadcasting policy and the draft broadcasting bill.

In the meantime, in March 2004, the government released the e-government strategy that had been developed in the Office of the President adding further confusion, and exhibiting the ad hoc approach the government had on ICT and ICT policy making since the function of e-government would have logically fallen under the Government Information Technology Services (GITS) in the Ministry of Finance or the new Ministry of Information and Communications.

By October 2004, the draft national ICT policy was ready in the new Ministry of Information and Communications. The document appeared to be not much different from the June 2004 version though. The document was unveiled to the public by the Ministry of Information and Communications in November 2004 during a national ICT visioning workshop.

3.4.2 The Policy Specifics

In the proper spirit of visioning, the Kenya ICT Policy document states its vision as developing "a prosperous ICT-driven Kenyan society" and its mission as "improving the livelihoods of Kenyans by ensuring accessible, efficient, reliable and affordable ICT services."

Possibly obtained from the results of an e-readiness and a SWOT analysis, the ICT Policy document proceeds to highlight the current prevalent challenges of ICT in country's national development. Since these challenges will translate to action plans that will be resource intensive, it is important that they possess certain clarity of necessity and demand for efficient resource allocation. The following were the highlighted challenges, each followed with a commentary about its necessity to be addressed and the real or potential demand by the market:

a) *Policy, legal and regulatory framework*
   As can be derived from the prior Section 2.5 on effective policy making and the specific Kenyan ICT sector background, jurisprudence and regulation are a necessary complement for the running of the sector. It is encouraging to note that the policy highlights this as the first challenge. This drove the government to amend the 1998 Communications Act, which was mostly beneficial with of course the usual problems relating to resistance to change. It is yet to be seen whether some of the changes proposed by the Act shall be beneficial or detrimental to the sector.

b) *Infrastructure of ICT*
   One cannot speak of ICT if such infrastructure does not exist. Current fiber optic projects attest to the commitment of the Kenyan government to deliver infrastructure. Nevertheless, ICT infrastructure depends on a number of complimentary sectors, particularly the electricity sector. Interestingly, the energy (electricity) sector was not highlighted in the Government of Kenya (2007) Kenya Vision 2030 document with a specific sector target, possibly because the country is not particularly advantaged with natural resource and technologies to harness electricity. Nevertheless, it was recognized and mentioned as a fundamental grounding for the attainment of the social, economic and political goals.

c) *Development of Human Resource*

With an estimated 85.1 percent literacy level and an extremely successful free primary (elementary) school government project, the Kenyan population still possesses a fairly low level of skilled ICT human resource. There are many tertiary and advanced institutions of learning offering specialized training, but the demand for such training far exceeds the supply. This has resulted in the haphazard blooming of institutions offering uncertified training which, in the words of Hon. Dr. Kilemi Mwiria, the Assistant Minister in the Kenya Ministry of Higher Education Science and Technology, "are taking advantage of the ignorance, desperation and education thirst of Kenyans looking for any opportunity by offering them bogus and inadequate training and certification."

d) *e-Learning*

One key quality of ICT and especially the new age of Web 2.0 is collaboration. It is proper that the policy has highlighted e-Learning as an area of focus, but an issue of key importance would be the generation of relevant local educational content and the encouragement of educational institutions to publish most of their material online. The Massachusetts Institute of Technology's open courseware is a good example and is possibly one of the factors that bolstered the institution to be the top ranked web publishing university in the world's webometric ranking. Kenya's top entrant was Strathmore University, a private institution, coming in 12th in the African continent and 2,404th in the world. Nairobi University, the leading public university in Kenya came in 22nd in Africa. These ratings need major improvements.

e) *Universal Access*

As earlier mentioned, there is an incredibly disproportionate distribution of ICT access in Kenya. Infrastructure will address the question of coverage and availability, nevertheless access is determined not only by physical availability of the resource, but also with the economic ability to make use of such services/resources. The Ministry of Information and Communication has several tele-center projects in place. According to the Permanent Secretary in the Ministry, Dr. Bitange Ndemo, the government is using the well established post office network to set up these tele-centers. The question of universal access shall need to be addressed concurrently with the poverty inequality question, and/or government policy mechanisms that will ensure the poor have equal opportunities as the rich. Later strategies make mention of Poverty Reduction Strategy Papers (PRSP).

f) *Public-Private Partnerships (PPP)*

For a long time, the private sector has been dormant in the policy making space of the country most probably due to the reluctance of the previous regime, that rarely considered input from the private sector. With the regime change, things have definitely been getting more and more positive, notably with the joint PPP investment on the East African Marine

System (TEAMS) fiber optic cable that is jointly funded by the government and the private sector.

g) *e-Government*

The release of the e-Government strategy paper was from the office of the President – directorate of e-government. It was much needed since the varied government organs had started purchasing ICT systems haphazardly and in an ad hoc manner. The set up of standards of both hardware and software required the formulation of and e-Government strategy apriori, since a lot of the current ICT investment is going into patching up of the existing systems.

h) *e-commerce*

Undertaking the development of electronic commerce will be a massive project. The first steps have been achieved by the amendment of the Kenya Communications Act (2008) to recognize digital signatures among several other clauses that will facilitate e-commerce. Nevertheless, the uptake of e-commerce is a total paradigm shift of how business is generally conducted within the country. Although email happens to currently be the most prevalent e-commerce application for the transfer of business documents, integration of payment systems and enterprise resource programs the ultimate running or organizations as e-organizations remain the challenge. The government though can encourage businesses to take up e-commerce for instance through the newly developed Kenya Revenue Authority website that allows for the submission of tax returns online. This top-down approach may not be sufficient though and other market incentive tools such as subsidies on business software programs for small and middle scale enterprises (SME's) need to be considered.

i) *Relevant Local Content Development*

Relevant local content is a project that will definitely be ongoing for a long time. It is a way of developing demand for the ICT infrastructure. Local businesses and services also need to be encouraged to obtain a web presence and more transparency of the services they offer online.

j) *ICT Leadership*

The need for an ICT champion from the highest possible levels of government can not be stressed enough. The current President, Hon. Mwai Kibaki seems to be in tune with what is going on within the sector.

k) *Gender and ICT*

Culturally the girl child has been discriminated upon in many Kenyan communities particularly when it comes to education. This has changed considerably although the representation of women in Kenya's work force is still low.

l) The Youth and ICT

The policy mentions that the youth have the largest representation in the population. They will definitely be the group that determines just how beneficial ICT will be, and a move to have them embrace ICT early will give good results in future. The challenge therefore is how exactly to engage them so that their eventual use of the technology is productive.

To ensure that a proper strategy is formulated, it is of imperative importance to have measurable goals. The goals are often derived from objectives which proceed from the visioning process. The Kenya ICT Policy document rightly proceeds to state the broad policy objectives with respective strategies on Information Technology (IT), broadcasting, telecommunications, radio frequency access and universal access. The key objectives of Kenya's ICT Policy (2006) were stated as:

- "To promote the deployment and exploitation of information, knowledge and technology within the economy and society as key drivers for socio-economic development. This will be supported through the modernization and expansion of Kenya's ICT infrastructure and services to improve universal access and service as well as quality of service.
- To transform Kenya into an attractive destination for ICT-related Foreign Direct Investment (FDI) with the potential to become a competitive regional/international ICT and business hub. This involves the development and promotion of a globally competitive local ICT industry for the development, production and sale of information, knowledge, and technology products and services;
- To develop a highly competitive ICT-led value-added and export-orientated services sector driven by a dynamic ICT services subsector and manufacturing. This points to the need to promote and facilitate the development of the private sector to serve as a key driver for the development of the economy;
- To create a dynamic knowledge-based, technology-driven light modern industrial sector which is export-led and globally competitive;
- To improve both the national human resource development capacity and the research and development capacity to meet the demands and requirements for developing the country's information and knowledge-based economy; and
- To modernize Kenya's educational system using ICTs to improve and expand access to education, training and research resources and facilities, as well as to improve the quality of education and training and make the educational system responsive to the needs and requirements of the economy and society with specific reference to the development of the information and knowledge based economy and society."

The Kenya ICT Policy then makes mention of the institutional framework for policy implementation which would included development partners, civil society, investors, operators, consumers, professional bodies and government institutions such as the ICT policy advisory secretariat (National Communications Secretariat), the regulator (Communications Commission of Kenya) and the appellate tribunal (Communications Appeal Tribunal).

The Government of Kenya (2006a) Kenya ICT Strategy document broadly states that its strategic framework and action plan will focus on seven key areas which are intended to produce roll-over effects in driving the country's economic recovery. These will be highlighted within the strategy analysis section in the following chapter. The key elements of the framework include: "new development opportunities; education and training; marketing, networking and promotions; recruitment and retention; industrial incubation; market intelligence and research; and business support investment." The framework is intended to serve as a guide in the design and implementation of more strategic approaches to the use of ICT for development.

3.5 Broadband Infrastructure in Kenya

From the advent of the Internet in the early 1990s, Kenya has relied exclusively on an Internet gateway that was run as a monopoly by the then state owned Telkom Kenya (currently 51% owned by France Telecom), which relied on expensive satellite systems to connect the country to the global Internet. The year 2009 will mark the introduction of high-speed fiber optic cables that will complement and possibly override the prevalent international Internet access mechanisms in the country.

Proceeding from an increasing demand for bandwidth and a realization of ICT opportunities in the Government of Kenya (2007) Kenya Vision 2030, the Kenya Government, the private sector and public private partnerships, have invested in submarine fiber optic cable projects to connect the country to the information superhighway. Some of these projects are shown in Figure 3.8. The notable submarine fiber projects include the East African Submarine System (TEAMS), SEACOM, the Eastern Africa Submarine Cable System (EASSy) and the Kenya Fiber Optic National Network (FONN), a terrestrial backhaul fiber to extend broadband transport infrastructure across the country. Some of the consortium run projects were marred by confusion, political bureaucracy and other delays. Nonetheless, below are some of the projects that have waded through the intense negotiation phases and have either begun, been completed or are soon to be complete.

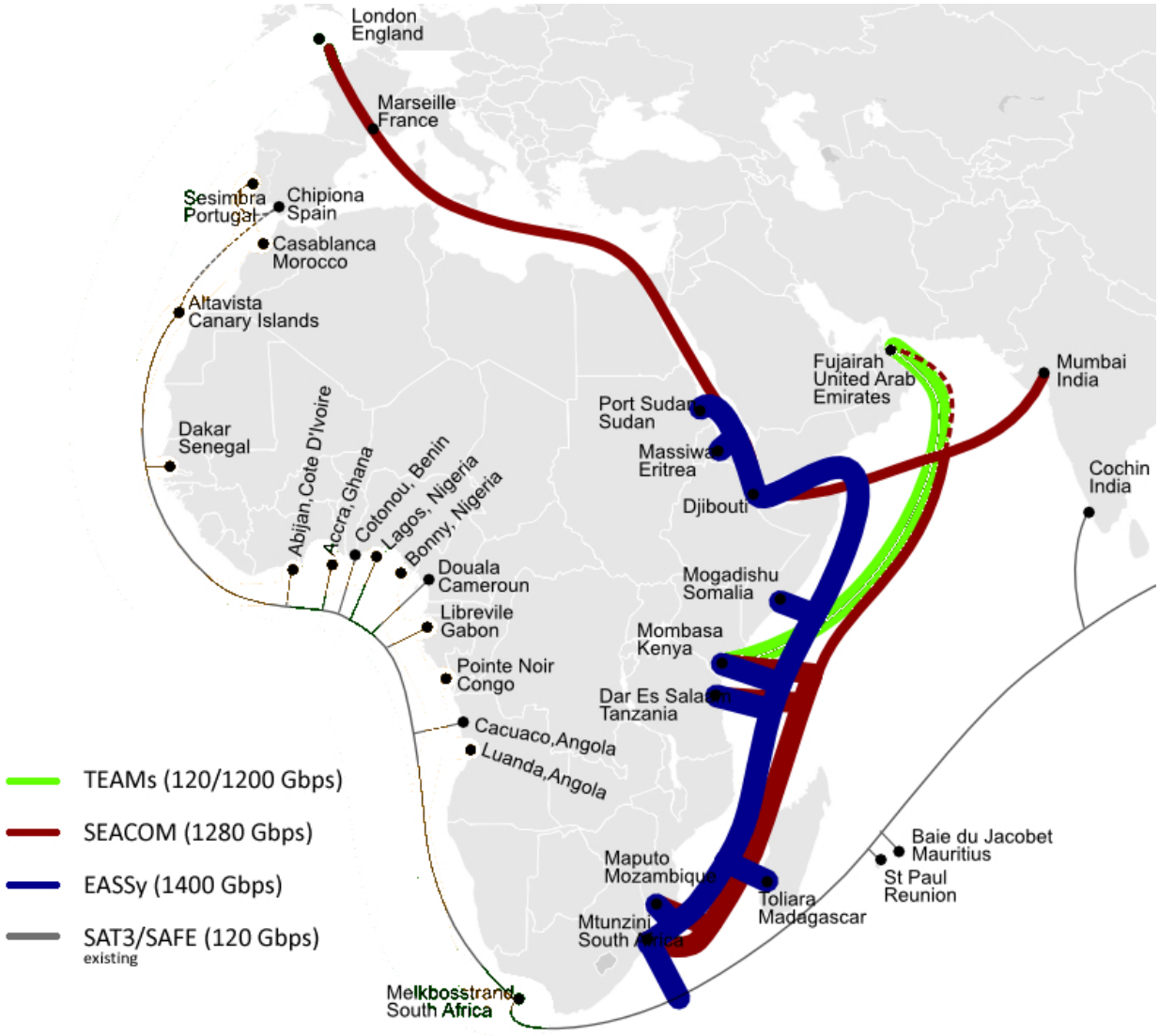


Figure 3.8: East African Seaboard Submarine Fiber Projects to be Completed by 2010
Source: ShuttleWorth Foundation, Accessed 27th July, 2009

A specific discussion covering the ownership and magnitude of the various projects follows in the sections below.

3.5.1 The East African Marine System (TEAMS)

The TEAMS project costing $82 million connects the Kenyan coastal city of Mombasa to the Fujairah port in the United Arab Emirates. The TEAMS project was first proposed as an alternative to EASSy, in 2006 by the Communications Commission of Kenya (CCK). It has an initial capacity of 40 Gbps which can be upgraded to 640 Gbps. The supply contract was awarded to Alcatel-Lucent.

Under the Teams agreement, the structure of ownership has Etisalat holding 15% and a consortium of "TEAMS Kenya" holding the other 85%. This is comprised of the Kenya Government (through the Ministry of Finance) holding 20%, Safaricom 20%, Telkom Kenya 20%, Kenya Data Networks Ltd 10%, Econet/Essar Telecom Ltd, 10%, Wananchi Group 5%, Jamii Telecom Ltd 3.75% and Broadband Access/Access Kenya Ltd, Africa Fibernet (Uganda) Ltd, InHand Ltd, iQuip Ltd and Flashcom Ltd each holding 1.25%.

Construction of the cable started in January 2008 on the Emirates' side and the cable landed in Mombasa on June 12th 2009 after several delays among them a rerouting of the cable to include some extra 90 km of cable skirting around Somali's territorial waters (possibly to avoid vandalism) so as to run the cable in international waters as it makes its way from the Arabian Peninsula. The cable is scheduled to start operations in September 2009.

3.5.2 SEACOM

The SEACOM cable was the first to complete construction on the East African sea board. SEACOM is a Mauritanian registered company which is a privately funded venture, 75% of which is owned by African investors. The SEACOM cable runs from South Africa to Europe and India with landing stations in Mozambique, Madagascar, Tanzania and Kenya as is shown in Figure 3.9. The cable construction cost approximately $650 million with financing arranged by Nedbank and Investec. The supply contract was granted to Tyco.

The cable is expected to be operational in 2009 in anticipation for the 2010 soccer World Cup taking place in South Africa. SEACOM landed at the Kenyan coastal town of Mombasa in March 2009 and was commissioned and started operations on the 23rd of July 2009. The cable has a total capacity of 1.2 Tbps.

Figure 3.9: SEACOM Submarine Fiber Cable and Landing Sites
Source: SEACOM, Accessed 15th July, 2009

The cables ownership is segmented to comply with local ownership regulations in the different countries. According to the SEACOM website, the cable backbone along the east coast of Africa to India and Europe is owned by SEACOM. The segments connecting to individual countries are either 100% (South Africa, Mozambique, Madagascar, India, France) or 35% (Tanzania, Kenya) locally owned. SEACOM has also procured fiber capacity from Marseilles to London as part of the SEACOM network. The actual structure of ownership is shown in figure 3.10.

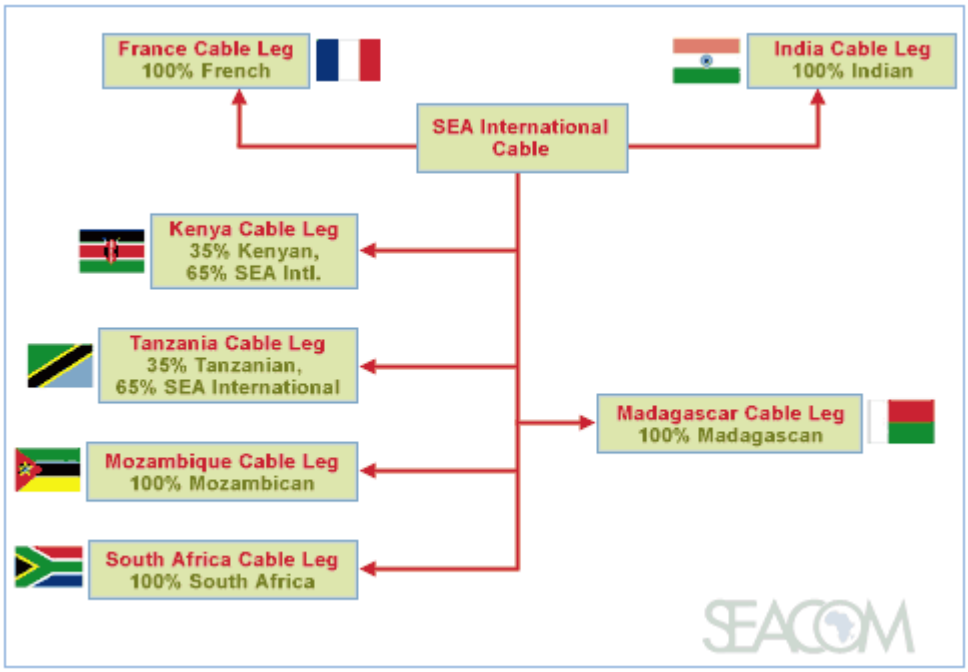


Figure 3.10: SEACOM Cable Ownership Structure
Source: SEACOM, Accessed 15th July, 2009

3.5.3 The Eastern Africa Submarine Cable System (EASSy)

After the collapse of the "Africa One" project (discussed in Section 1.2 previously) in the late 1990s, the Eastern Africa Submarine Cable System (EASSy) was the first initiative proposed to connect countries of eastern Africa through a high bandwidth fiber optic cable system to the rest of the world. The project, funded by the World Bank and the Development Bank of Southern Africa, was initiated in January 2003, when a handful of companies investigated its feasibility.

EASSy was planned to connect nine coastal countries and island nations to the rest of the world. It would run from South Africa to Port Sudan, covering over 9,000 km, connecting Djibouti, Kenya, Madagascar, Mozambique, Somalia, South Africa, Sudan and Tanzania (including Zanzibar). Terrestrial backbone networks were also to be built in separate developments to link all capitals and major cities in Eastern and Southern Africa to the EASSy cable and the international backbone system. Thirty-two leading telecommunications operators from East and Southern Africa signed a Memorandum of Understanding (MOU) in December 2003 to carry out the construction and maintenance of EASSy.

Figure 3.11: EASSy Submarine Cable
Source: EASSy, Accessed 15th July, 2009

The New Partnership for Africa's Development (NEPAD) under the encouragement of the World Bank and the International Finance Corporation (IFC) who were to partially fund the project, hosted the project discussions. In a decision document prepared jointly by the ICT ministers of the member countries, NEPAD proposed recommendations for the EASSy project that included open access, non-discrimination, harmonization of policy, legal and regulatory frameworks, harmonization timeframe, licensing, bandwidth charges, currency and participation. These directives seemed to be the onset of many of the problems the project was soon to experience.

The EASSy project was soon dogged by controversy such as the involvement of NEPAD and whether they should take the overall leadership of the project or the leadership should be led by the private sector. Added to this, was the fact that EASSy was a joint venture of more than 20 largely monopolistic governmental telecommunication bureaucracies. Telkom South Africa, for instance, a major EASSy stakeholder, said it may withdraw from the project, as it may be forced to reduce the fees it charges rival operators to use its bandwidth on SAT-3, a cable connecting Portugal and Spain to South Africa, which is co-owned by Telkom South Africa. Simply put, Telkom South Africa wanted to extend its monopolistic tendencies to EASSy. In 2007, NEPAD

decided to go its separate way after the unresolved disagreements regarding the best approach to delivering much-needed international telecommunications links to countries in Eastern and Southern Africa.

In 2006, the Kenyan government, after growing frustrated with the ownership model favored by South Africa, the time the project was taking and what it perceived as an attempt by South Africa to control the cable, decided to partner with the Emirates Telecommunication Establishment (Etisalat) to build its own fiber optic cable – The East African Marine Systems (TEAMS) described above.

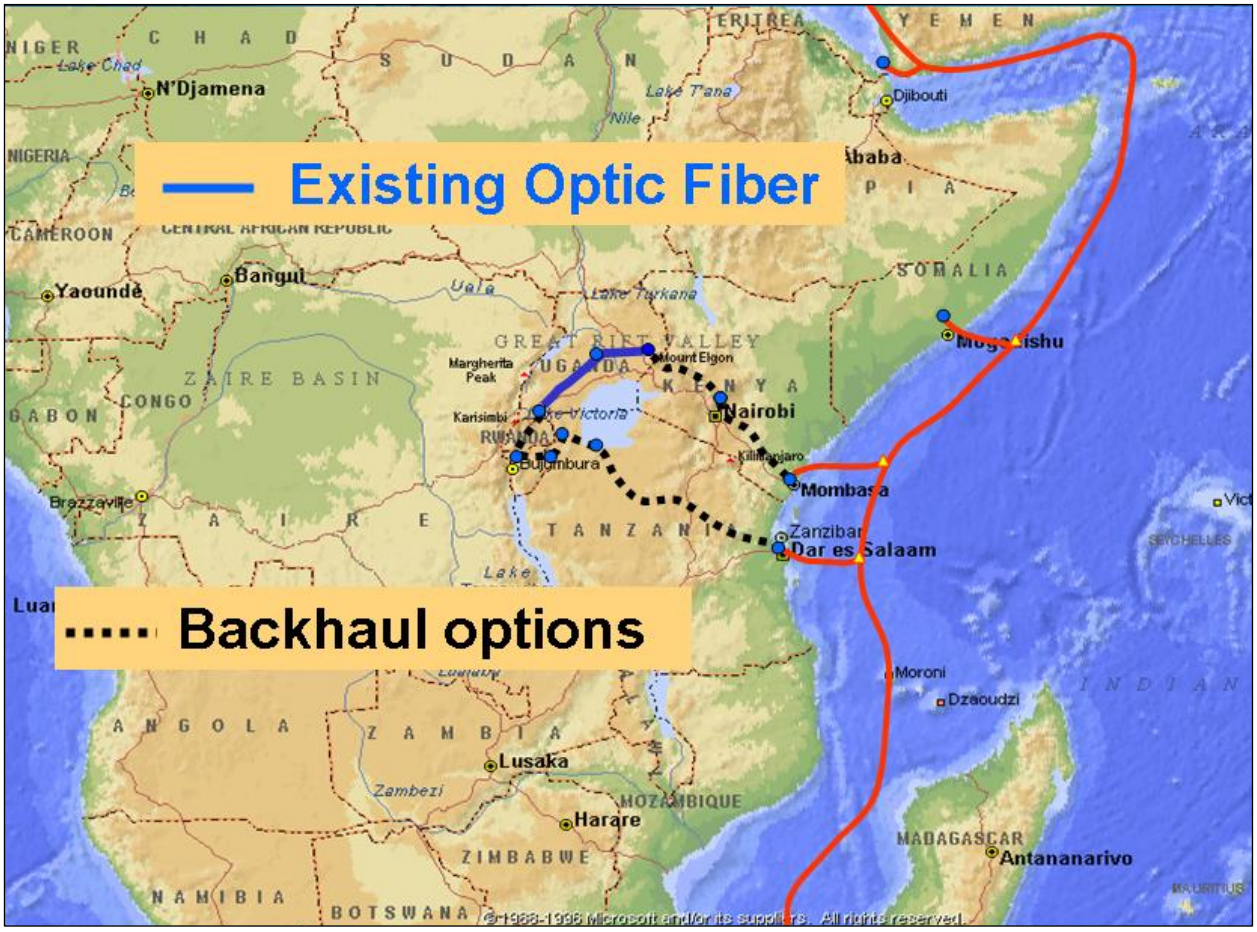


Figure 3.12: EASSy East African Region Backhaul Connectivity
Source: EASSy, Accessed 15th July, 2009

Construction of the EASSy cable did not start until March 2008 and the project is now slated for completion and commercial service in the second half of 2010 – three years behind schedule. EASSy, is now backed by the consortium of 25 telecom companies including 19 from the East and Southern Africa region. The supply contract was awarded to Alcatel-Lucent. The project is

estimated to cost over US$ 200 million and will benefit from an injection of up to US $18.2 million from the IFC. Other major funding to the tune of US $70.7 million will come from other Development Financial Institutions including the European Investment Bank (EIB), the African Development Bank, and the German owned KfW. The rest will be provided by the EASSy consortium members.

3.5.4 NEPAD Broadband Infrastructure Network (NBIN)

Following the fall out with the EASSy project, NEPAD which had always planned to facilitate the construction of an elaborate massive backhaul network through Eastern and Southern Africa initiated its own NEPAD Broadband Infrastructure Network (NBIN) project to complement and compete with the EASSy submarine cable. NBIN was conceived by Africa's ICT ministers in 2007 under the auspices of NEPAD with the sole purpose of constructing and laying an undersea cable around Africa connecting every country on the continent with the internet backbones in Europe, Asia and North America.

The NBIN project has two parts to it: a submarine part called UHURUNET which will encircle the entire continent of Africa, with connections to Europe, Brazil, India and the Middle East and which, according to FiberforAfrica website seeks to connect coastal countries in Eastern and Southern Africa to other global submarine cable systems: SAFE in the South Africa and SEA-ME-WE 4 (and potentially others) in the North and a terrestrial part UMOJANET. NEPAD recently signed an MoU with P-5 Holdings, a US company to construct UHURUNET. The cable is expected to cost about US$ 1.4 billion and will run for 50,000km and have a capacity of 3.84 Tbs. It is scheduled to be in place by 2010.

According to the NEPAD website, the cable is to be funded by governments and by telecom companies in countries which are signatories to the NEPAD broadband protocol, which governs how the networks will be controlled and managed. The Holding Company of the Submarine cable is named, BAHARICOM and the ownership structure of UhuruNet is broken down in NEPAD's eAfrica commission website as follows; "a NEPAD special purpose vehicle 30%; African telcos and other investors 45% and international investors 25%. The 12 countries that signed on at the inception of the project get to choose and pick which investors hop on the special purpose vehicle ownership with a government representative from each country holding 'golden shares', giving veto powers when a two-thirds quorum is met to check activities and actions of the company."

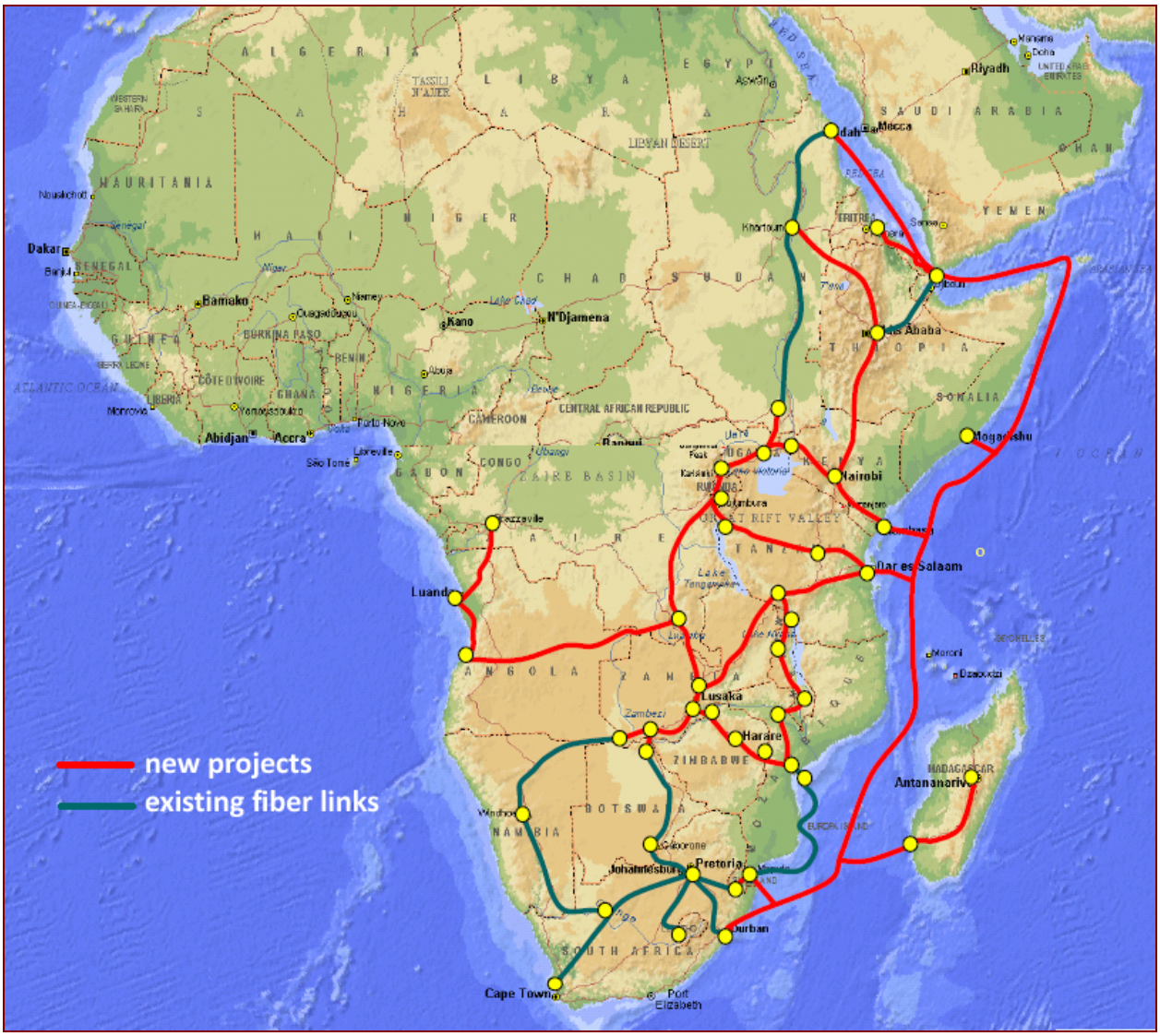


Figure 3.13: UMOJANET Backhaul Network for Eastern and Southern Africa
Source: NEPAD e-Africa Commission, Accessed 20th July 2009

Figure 3.14: Uhurunet Submarine Cable Project
Source: NEPAD e-Africa Commission, Accessed 20th July 2009

3.5.5 FLAG Telecom's fiber project and Kenya Data Network (KDN)

In 2007, KDN signed a contract with FLAG (Fiber Optic Link Around the Globe) an Indian owned fiber project to construct a cable that would link Mombasa and terminate in an undersea junction in international waters off the coast of Yemen. The contract included both discounted capacity and the landing station but FLAG would own and operate the cable as a private provider.

The fiberforafrica website stated that KDN paid FLAG US$110 million to start work on the project on August 2008 and to enable traffic from Mombasa in September 2009.

3.5.6 LION

Little is known about the LION project since its announcement in March 2008. Lion is a cable project proposed by France Telecom and Orange to link Madagascar to the South Africa Far East (SAFE) cable via Reunion and Mauritius. It proposed a link to Lamu, an island town off the coast.

3.5.7 Local Terrestrial backhaul Broadband Fiber projects

3.5.7.1 Fiber Optic National Network (FONN)

FONN also referred to as National Optic Fiber Backhaul Infrastructure (NOFBI) Project is a twin project to the Kenyan Government's TEAMS project. The Government through the Ministry of Information and Communications deemed it fit to invest in a terrestrial national optic fiber backhaul network. FONN is intended to ensure maximum utilization of capacity provided by TEAMS and add connectivity in all districts within the country.

The 'brandkenya' website, a government run campaign promoting investment in Kenya says that the Kenya Government has contracted three companies to construct the FONN cable in three regions. They include a French company-Sagem that will cover 1,800Kms running through North Eastern and the Coastal regions, while two other Chinese companies - Huawei and ZTN , will construct 1,100KM through Central Kenya and 1,400KM covering Nairobi, Isebania, Eldoret and Lokichogio respectively.

3.5.7.2 Telkom Kenya's Fiber Optic Projects

Telkom Kenya has been installing digital fiber-optic trunk lines primarily to connect its various telephone exchanges over the course of the past few years. At the moment these connect major market centers like Nairobi, Mombasa, Nakuru and Eldoret.

In 2006 Telkom Kenya simultaneously launched its optic fiber cable and its wireless broadband product named Kenstream Wireless. The 500km fiber optic cable has 13 add and drop points in Kenya along the Nairobi-Mombasa route, where traffic can be introduced to or removed from the fiber link. Plans to extend the fiber optic cable to Malaba, connecting with Uganda, are also under way. The fiber cable operates at 2.5 Gbps.

3.5.7.3 Kenya Data Networks (KDN)

Kenya Data Networks in conjunction with Altech Stream East Africa—a unit of Altech comprising Infocom Uganda and Altech Stream Rwanda—completed a fiber-optic line running from Mombasa (Kenya) via Nairobi to Kampala (Uganda). The 1,500 km cable has a capacity of 10 Gbps.

KDN has also had a 3,800-kilometre, long-haul, fiber-optic network in operation in Kenya since February 2009, including 950 km of metropolitan area network in Nairobi, Mombasa, Kisumu and Eldoret. KDN has also invested in both the SEACOM and TEAMS submarine cables.

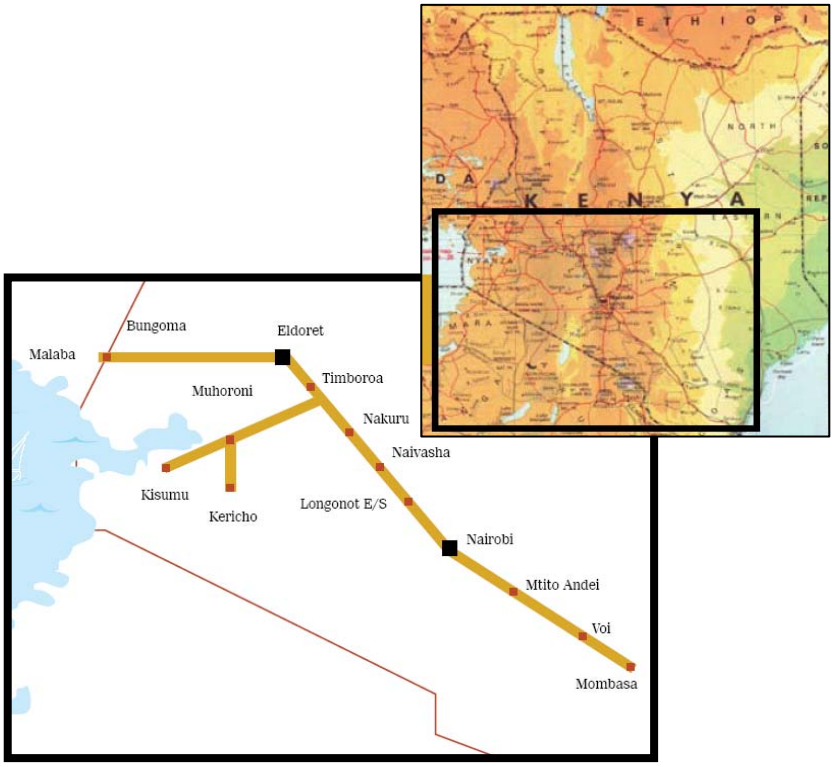


Figure 3.15: Telkom Kenya Terrestrial Fiber Cable
Source: Kenya ICT Investor guide 2006

3.5.7.4 Other local fiber projects

More operators particularly utility companies such as Kenya Power and Lighting Co (KPLC) Ltd and Kenya Oil Pipeline Ltd are gearing to build fiber bundled with their primary business infrastructure. Jamii Telecommunications has signed an agreement with KPLC to sell its fiber capacity in Nairobi and Mombasa.

3.6 Chapter Conclusion

This chapter has covered the useful background necessary to understand the Kenyan ICT sector, its goals and the sector's policy domain. It has also covered the various broadband projects underway in Kenya analyzing their ownership and the competitive landscape in broadband provision. Competition is essential to avoid a case of monopoly that would cause the soaring of Internet prices as was the case in South Africa, presented in Section 2.6 of this thesis.

With this understanding, the thesis proceeds to introduce the CLIOS Process, which will be used in analyzing and presenting a technology strategy.

CHAPTER 4: PRELIMINARY ANALYSIS

Before embarking on an analysis of the deployment of broadband deployment in Kenya, the thesis shall outline the particular CLIOS Process, justifying its applicability to the specific problem, as well as mention other available policy analysis frameworks.

This chapter shall conclude by performing a stakeholder analysis that shall determine the scope of the policy analysis determining the influence and relationships between the various players within the sector.

4.1 Introduction – the CLIOS Process

As outlined in the CLIOS User Guide (2009), complex, large-scale, interconnected, open, socio-technical (CLIOS) systems, refers to the class of engineering systems exhibiting complexity, are generally deployed on a large scale and therefore having wide reaching impact. They are internally or externally interconnected with other systems and finally have a socio-technical impact. The formulation of the CLIOS Process by Joseph Sussman (2009) et al was aimed at helping to organize and understand the CLIOS System's "underlying structure and behavior, identifying and deploying strategic alternatives for improving the systems performance and monitoring the performance of those strategic alternatives" (p. 4).

The CLIOS Process strives to elucidate the nested complexities which result from physical domain and institutional sphere interactions. The CLIOS Process consists of 3 stages (phases) covered in 12 steps:

i. *Representation:* which is primarily a graphical illustration of the CLIOS System
ii. *Design, evaluation and selection:* which analyses and prescribes alternative strategies
iii. *Implementation:* of the strategies followed by monitoring and evaluation

The CLIOS Process is an iterative process and Figure 4.1 shows the twelve steps and the 3 stages of the CLIOS Process.

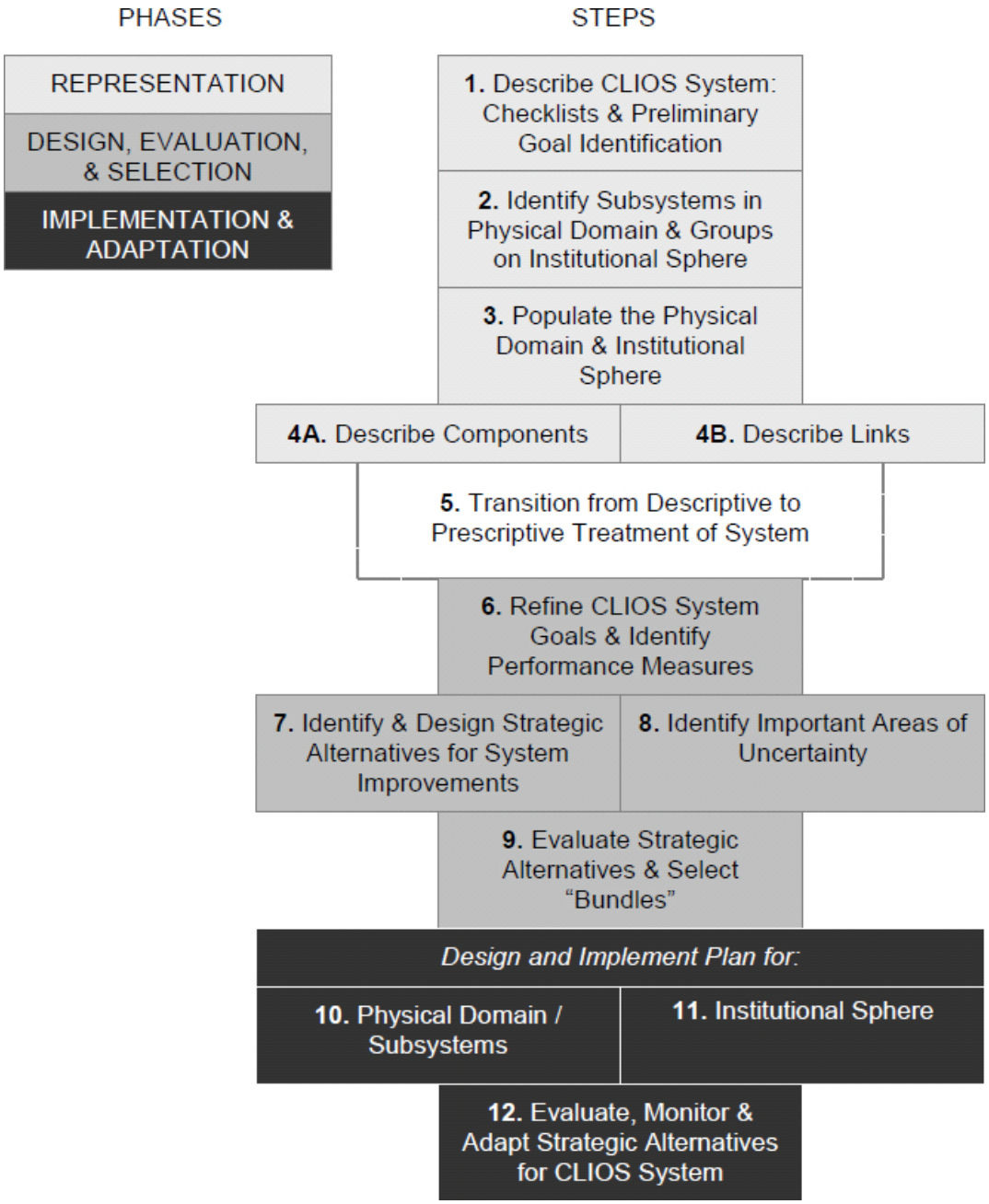


Figure 4.1: The Twelve Steps of the CLIOS Process

Source: CLIOS User Guide, Sussman, et al.

4.2 Broadband as a CLIOS System

Broadband can be thought of as a transportation infrastructure with the distinction that it involves itself with the movement of data and services in the form of information unlike the movement of people and goods.

The primary medium carried by broadband infrastructure is information. Unlike other transportation systems' medium such as aero-based or motor vehicle based transportation systems, information has unique qualities such as an almost zero cost of replication, lack of depreciation, and little or no localization constraints. This adds simplicity to the design and deployment of broadband systems but increases the evaluative and monitoring complexity.

The broadband system is a CLIOS System because it possesses these primary CLIOS System characteristics:

i. *Complexity*

Sussman (2009) stated that a "system is complex when it is composed of a group of interrelated components and subsystems for which the degree and nature of relationship is imperfectly known, with varying directionality, magnitude and timescales of interaction" (p.9)

The broadband system interacts with many other systems for successful deployment and maintenance. Examples include the electricity subsystem used to run broadband equipment and skilled manpower needed to operate broadband facilities. More specific complexities include:

- *Structured Complexity* – Also combinatorial or detail complexity is exhibited within a system having a large number of interconnected parts. The broadband system as highlighted in Section 2.2 of Chapter 2, is a system dependant on several other systems for effective operation.

- *Behavioral Complexity* – Behavioral complexity is complexity derived from the uncertainty about the emergent behavior of the system. As mentioned in the earlier Section 2.1 of Chapter 2 on ICT and economic growth, deployment of broadband for economic development cannot be taken as a guarantee. The behavior of the broadband system is dependent on many factors which are a mix of policy, market forces and other social forces.

- *Nested Complexity* – Nested complexity refers to the embedding of the physical subsystems within an institutional system. The broadband system, by the very nature of being pervasive, is subject to several institutional and regulatory interactions.

- *Evaluative Complexity* – This is primarily exhibited by the various goals stakeholders within the system seek to achieve. Broadband systems will have several stakeholders wishing to make use of broadband to achieve varied goals. These goals may be concurrent or divergent and this presents some evaluative complexity on the system goals.

ii. *Large-Scale*
The broadband deployment in question is intended to have a nationwide extent and international reach.

iii. *Interconnected*
Broadband is connected to other socio-technical systems such as education and national security and administration for the proper achievement of its goals

iv. *Open*
Broadband is an open system in that it includes social, political and economic aspects

v. *Socio-technical*
Broadband not only cover technical aspects in running the system, but also involves itself with issues of a socio-technical nature and the achievement of social and economic goals

4.3 Other Broadband Technology Analysis Methods

There are several methods that may be used to analyze broadband deployment. Some notable examples include the net strategy framework outlined in the World Bank (2009) Global Information Technology Report, the object oriented program planning and the logical framework analysis outlined by Labelle (2005) in ICT Policy Formulation and e-Strategy Development.

Some of these methods are particularly effective, especially when deploying broadband at a smaller scale. The net strategy which is proposed for national level planning is touched upon below.

4.3.1 The Net Strategy Framework

The Net Strategy framework proposes 6 keystones which represent a foundation necessary to reach the intensive use stage of broadband and ICT. These six keystones can be characterized through a series of questions and by examining lessons from best practice. The keystones are:

i. *Market/Competition* – This involves questions about market share, barriers of entry and number of players in the sector and competition
ii. *Policies and regulations* – This involves itself with the currency of regulation and its applicability to broadband as well as institutional structures in place to execute such regulation
iii. *Applications and content* – This involves itself with the innovative environment and a business entrepreneurial business environment.
iv. *Government budgets* – This primarily involves itself with e-government and the government involvement in promoting and using broadband
v. *Skills for IT* – Involving itself with the skill levels of ICT users and professionals
vi. *Infrastructure investment* – Which involves itself with the ease or investing in broadband

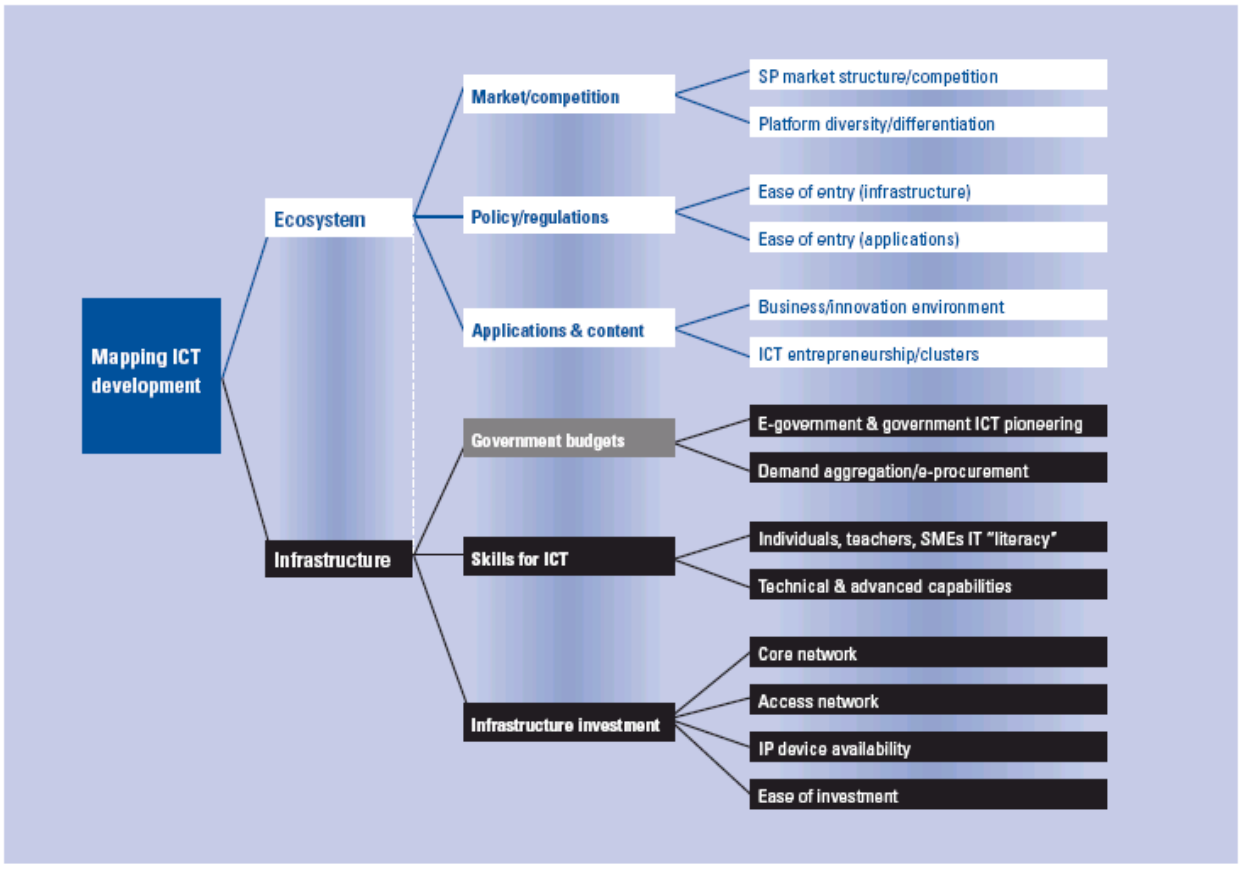


Figure 4.2: A Net Strategy Framework
Source: Global Information Technology Report, 2009

Although this framework covers many of the critical issues affecting broadband, it does not include issues such as directionality and magnitude of the interconnections; it leaves out a number of critical subsystems such as the electricity subsystem that will strongly influence the expanse of broadband deployment.

It nevertheless outlines very effective performance measures that can be used to evaluate and monitor success of broadband deployment.

4.4 Stakeholder Analysis

As a preliminary step to the broadband CLIOS System analysis, an understanding of the stakeholders would be useful in defining the scope of the analysis.

A stakeholder with respect to broadband deployment can be defined as “any group or individual who can affect or is affected by the outcome” of such an objective. This definition is adapted from a more generic definition of stakeholders as seminally proposed by Edward Freeman (1984). The concept of a stakeholder therefore covers both the individuals who can affect the decision making process of policy formulation and also groups that are eventually affected by those policies.

With respect to Kenya, we can divide the broadband stakeholders into three broad categories, namely; broadband service providers, broadband administrators and broadband users. With respect to the primary goal of stimulating economic growth, service providers can be thought of as those entities that invest in both broadband infrastructure and other data products and services that will be available on broadband Internet for the purpose of generating revenue. The administrators perform the function of policy formulation, articulation and execution as well as sector regulation to ensure the smooth running of the broadband sector while the users are represented by a wide array of entities from the government, to corporations and individuals within the civil society who make use of the services available through broadband.

The stakeholder analysis will be divided into two parts, the first being the identification of the stakeholders using the Freeman (1984) stakeholder definition, which will then be followed by an analysis of their *salience* or *importance* to the broadband project design and deployment process based on a framework developed by Mitchell et al (1997).

The Mitchell (1997) framework classifies the stakeholders according to the attributes of power, legitimacy and urgency, which in the context of broadband deployment can be defined as:

- *Power: The ability to affect the design, operation, or outcome of broadband deployment*
- *Legitimacy: The degree to which the broadband deployment affects the stakeholder*
- *Urgency: The need perceived by a stakeholder to change the broadband sector and deployment*

According to Mitchell's research, for an entity to be considered a stakeholder, it needs to possess at least one of these attributes. The more attributes possessed by a given stakeholder, the more salient that stakeholder would be and the greater consideration that stakeholder should be given. It therefore follows that the most salient stakeholder would be the one with a legitimate and urgent need to influence the broadband deployment and has the power to do so. The Venn diagram in Figure 4.3 shows the eight possible classifications into which the stakeholders can be catalogued.

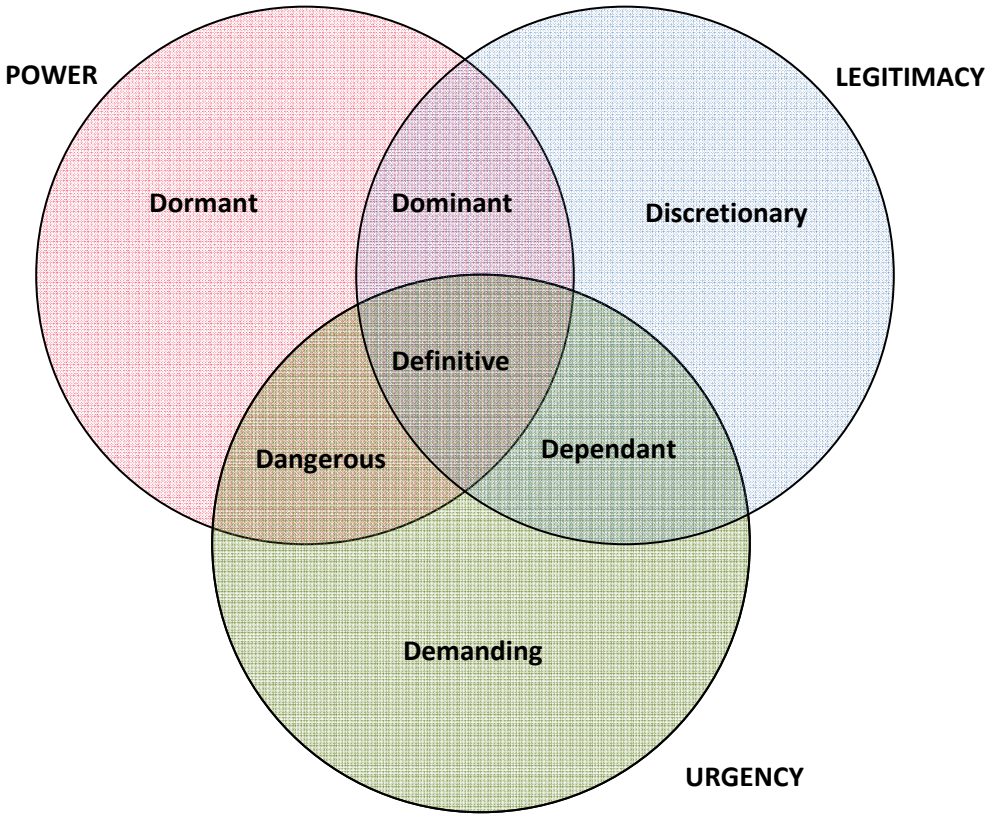


Figure 4.3: Stakeholder Classifications
Source: Mitchell et al. (1997)

4.4.1 Stakeholder Identification

The three broad categories (service providers, administrators and consumers) can be broken down into organizations that are shown in figure 4.2.

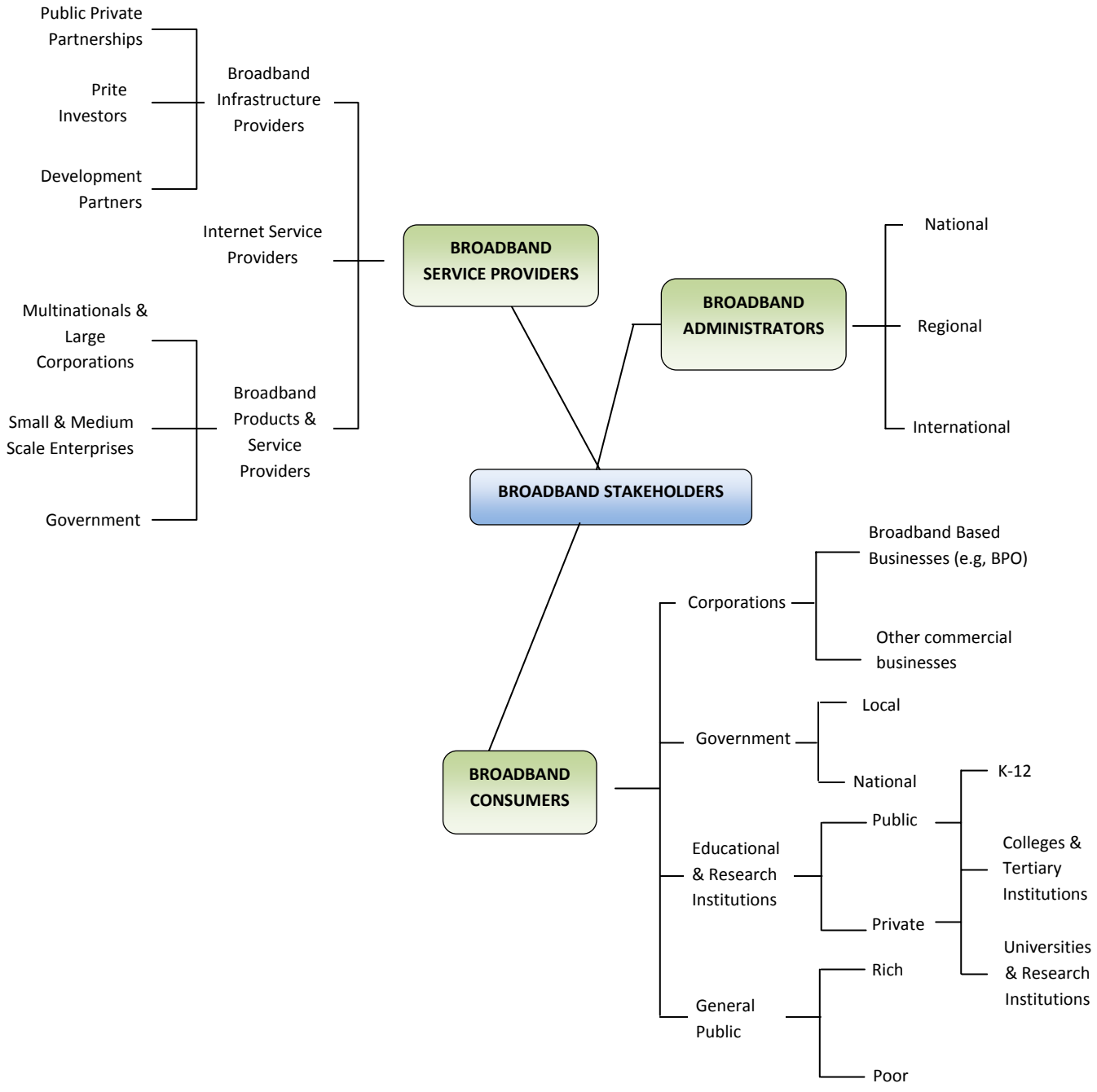


Figure 4.4: Taxonomy of the Various Broadband Stakeholders
Source: Author

4.4.1.1 Broadband Service Providers

1) Broadband Infrastructure Providers

These are organizations that have invested in building broadband infrastructure such as the deployment of submarine and terrestrial fiber optic cables as well as other technologies that provide broadband connectivity. They include:

(a) Public Private Partnerships

A public private partnership (PPP) refers to a venture funded and operated through a partnership between the government and one or more private sector companies. The East African Marine System (TEAMS) project described under Section 3.5.1 of this thesis is one such PPP.

(b) Private Investors

These are wholly privately owned commercial corporations that have invested in broadband infrastructure. The SEACOM project and Kenya Data Network fiber deployments described in Sections 3.5.2 and 3.5.5 respectively are privately run infrastructure providers.

(c) Development Partners

Some projects such as the EASSy project described in Section 3.5.3 of this thesis are supported by development partners like the World Bank and the IMF. These projects, in contrast to the privately invested projects usually are not for profit. Included under this category shall also be all other ICT for development projects that are for social rather than commercial benefit.

2) Internet Service Providers

These are value added resellers that package and deliver broadband connectivity to the consumers. They will ordinarily buy the broadband bandwidth in bulk from the infrastructure providers and resell it to the eventual consumers.

3) Broadband Products and Service Providers

These are organizations that provide products or services utilizing broadband. The products or services include hardware, software production and streaming of data among others. These corporations can be divided into:

(a) **Multinationals and Large Corporations**

Multinational companies such as Google, Microsoft, IBM and Cisco are constantly competing for global supremacy in the information technology sector. This competition shall inevitably intensify in Kenya with the increased deployment of broadband and the

growth of the potential market. The issues that dogged the growth of these companies in developed countries such as anti-trust, competition and monopoly policy can potentially impact the sector in Kenya albeit at a smaller scale. Other large corporations that are homegrown such as the large mobile service providers and the partly government owned Telecom companies are included in this category.

(b) **Small and Medium Scale Enterprises**

These are the entrepreneurial ventures that generally have limited capital and that have not been in existence for a long time. They would usually offer services that are particularly geared to the local market.

(c) **Government**

The government wishes to offer e-Government services through broadband. For purposes of this analysis it will be assumed that the services provided will not be undertaken for profit.

4.4.1.2 Broadband Administrators

1) National

With respect to the Republic of Kenya, the following entities within the government formulate, articulate and execute policies, which with regard to broadband, have the purpose of achieving economic growth and enhancing social and political development.

There is only one mandated ICT policy formulating entity within the government, the Ministry of Information and Communication. There are two policy drafting and articulation entities. These are the National Communications Secretariat (NCS) and the Kenya Institute for Public Policy Research and Analysis (KIPPRA). Ideally these entities should not have any vested interests in a given policy and should simply express the intent of the mandated ministry through relevant policy instruments offering advice on the most effective way of articulating a policy or how such policies would be wholly compatible with other pre-existing policies. The NCS is the ICT sector specific policy analyst while KIPPRA is the over-arching policy advisor for the entire government. The policy executing entities are charged with specific industry tasks, regulation or resolving disputes. The primary industry regulator is the Communications Commission of Kenya (CCK). Other government corporations are tasked with some specific ICT related issue. They include the Kenya ICT Board and those that are only called upon in the event of dispute resolution which include the Communications Tribunal and the Judiciary.

(a) Ministry of Information and Communication (MOIC)

The ministry was constituted in June 2004, with a mission to facilitate ICT development in Kenya. According to the Ministry's website, the Ministry is mandated to cover information policy, communication policy, film development policy, dissemination of public information, development of national communications capacity, development of the film industry, public relation services, the Kenya Broadcasting Corporation, the Kenya Institute of Mass Communication, the Kenya Film Censorship Board, the Kenya Film Commission, the Communications Commission of Kenya, the Postal Corporation of Kenya, the National Communications Secretariat, the Communications Appeal Tribunal, Telkom Kenya Limited, the Kenya College of Communications Technology and the Gilgil Telecommunications Industries.

Like most other ministries it is run by a presidentially appointed Minister and 2 Assistant Ministers who have to be members of the National Assembly (legislature) and a technocrat Permanent Secretary who runs the day to day business of the Ministry.

(b) National Communication Secretariat (NCS)

The NCS was also formed under the Kenya Communications Act, 1998 to serve as the policy advisory arm of the government on all matters pertaining to the info-communications sector. Its mandate included advising on policies, carrying out specialized research and conducting continuous review of development under the information and communications sector. The Secretariat is overseen by the Ministry of Information and Communication

(c) Kenya Institute for Public Policy Research and Analysis (KIPPRA)

KIPPRA is an autonomous public institute created by the State Corporations Act with a primary mission of conducting research and analysis to providing public policy advice to the government of Kenya and to the private sector in order to contribute to achievement of national development goals. KIPPRA is therefore the central source of information and advice on a wide range of policy issues for the Kenya government and the private sector.

(d) Communications Commission of Kenya

The Communications Commission of Kenya (CCK) was established by the Kenya Communications Act, 1998 and given the responsibility to license and regulate telecommunications, radio communication and postal services in Kenya.

According to the Commissions website, the commission performs the following functions: "Licensing of operators, regulating tariffs for monopoly areas, establishing interconnection principles, type-approving communications equipment, managing the radio frequency spectrum, formulating telecommunication numbering schemes and

assigning them to network operators; and implementing universal service obligation for both postal and telecommunication services."

(e) The Kenya ICT Board

The Kenya ICT Board was established as a state corporation under the State Corporations Act in February 2007. The Kenya ICT Board has four mandates. The first is marketing and promoting Kenya as an ICT destination, especially with regard to Business Process Outsourcing (BPO) and Off-shoring. The second is to advise the government on all relevant matters pertaining to the development and promotion of the ICT industries in the country. The third is capacity building and finally the fourth is project management.

2) Regional

Regional regulation takes place through the East Africa Regulatory, Postal and Telecommunications Organization (EARPTO). Other regional regulation issues would include trade agreements that would affect the exporting of broadband products and services within the region.

(a) East Africa Regulatory, Postal and Telecommunications Organization

The East Africa Regulatory, Postal and Telecommunications Organization (EARPTO) is an organization whose membership is drawn from regulatory, postal and telecommunications organizations/companies within the East Africa region. EARPTO draws its mandate under the new MoU, in recognition of the East African Community Treaty signed by the Heads of States and Governments of the Republic of Kenya, the United Republic of Tanzania and the Republic of Uganda.

3) International

Notable international regulation bodies are the United Nations leading agency for ICT which is the International Telecommunications Union. Also relevant are the Institute of Electronics and Electrical Engineers (IEEE), and the Internet Corporation for Assigning Names and Numbers (ICANN) (for more see Table 2.1). Other forms of policy influences that need to be considered come through government signed declarations, treatises and agreements such as the World Summit on the Information Society (WSIS) Convention.

4.4.1.3 Broadband Consumers

1) Corporations

Corporations would ordinarily use broadband services to increase their productivity. Some corporations would run businesses whose processes will be heavily dependent on a broadband connection, while others would simply use it to streamline their processes and reduce transaction costs.

(a) Broadband Based Businesses

This refers primarily to businesses whose core business process is dependent on a broadband connection. Such businesses include call centers handling business process outsourcing (BPO) and off-shoring tasks.

(b) Other Commercial Businesses

Under this category are all other commercial businesses that would primarily benefit through e-Commerce facilitated by broadband.

2) Government

The government will definitely be a very large consumer of broadband both at the local and national level, not only for running its own internal administration processes but also for the provision of e-Government services.

3) Educational and Research Institutions

Educational institutions primarily institutions of higher learning (universities and colleges) will utilize broadband for collaboration and research. Other education applications include e-Learning that will be beneficial to K-12 institutions (primary & secondary) and tertiary institutions.

4) General Public

The general public refers to consumers of broadband for use at home or at work. They will utilize their connections to receive various broadband based products and services from e-Learning to e-Government to entertainment. Nevertheless a distinction needs to be made between the rich and the poor since a primary question of broadband consumption is the willingness and ability to pay.

In Kenya some of these stakeholder groups have organized themselves into representative associations. Some examples of these associations appear in Table 4.1.

Table 4.1: Examples of Stakeholder Associations in Kenya

Name	Description	Representative Group
Kenya Education Network Trust (KENET) http://www.kenet.or.ke/,	National research and education network that promotes the use of ICT in teaching, learning and research in higher education institutions in Kenya.	Educational and Research Institutions (Consumers)
Kenya ICT Federation (KIF) http://www.kif.or.ke/	Represents the ICT industry with Government and with private sector bodies.	All private sector broadband service providers
Telecommunications Service Providers of Kenya (TESPOK) http://www.tespok.or.ke/	A professional, non-profit organization representing the interests of Telecommunication service providers in Kenya	Internet service providers (Service providers)
Computer Society of Kenya (CSK) http://www.cskonline.org/	Serves the individual IT professionals, corporate IT members, corporate IT users, and IT accredited training members providing an industry identity and forum and leading in public policy advocacy.	General public (Consumers)
Kenya Business Process Outsourcing and Contact Centre Society (KBPOCCS)	A private sector association representing the needs of the Contact Centre and Business Process Outsourcing industry in Kenya	Broadband based corporations (Consumers)
Network for Initiatives in Computer Education (NICE) Kenya	A consortium of the organizations in the civil and private societies working in different areas to improve delivery of educational ICT services to various sectors in the community	Educational and Research Institutions (Consumers)
The Kenya WSIS Civil Society Caucus	Kenyan chapter of the Youth Caucus for the World Summit on the Information Society (WSIS). It is a grouping of youth and youth-serving organizations interested in the WSIS process and the related ICT for Development issues.	General public (Consumers)

Source: Author

From the taxonomy, we can distinguish six broad representative groups that would encompass all the smaller sub-groups. These are shown in Table 4.2. All stakeholders identified in the taxonomy are included in one of these six groups so as to facilitate and simplify stakeholder analysis at a higher level of organization capturing those stakeholders with the most salience.

Table 4.2: The Six Broadband Deployment Stakeholder Groups

Stakeholder group	Definition
Government	The executive arm of the government that appoints the broadband administrators
Broadband Administrators	Represents the entities within government that formulate, articulate and execute policy. They also oversee and regulate the ICT industry
Broadband Value Added Services and Products Providers	Represents a collection of entities that would use broadband to deliver products and services to consumers
Broadband Infrastructure Owners	Represents the actual owners of the broadband infrastructure
Broadband Consumers	Represents all ICT consumers making use of broadband services
Civil Society	The general public

Source: Author

The groups were formulated based on the level and type of interest they have on the policy making process. The level of interest refers to the priority of importance that the stakeholder attaches to the given policy formulation process. This level of interest is supplemented by the type of interest often derived from the mandate of the given entities primarily based on what they stand to gain or lose on a given policy. These groups will be used as the basis for the stakeholder analysis because they are much more representative of the salience of the numerous smaller entities within them.

4.4.2 Stakeholder Relationships

In trying to understand each given stakeholder, a useful step before applying the Mitchell framework is to understand the influential relationships between the stakeholders.

The first consideration shall be given to the economic exchanges related to broadband. Broadband as a whole can offer economic benefit through increased productivity and reduced transaction costs primarily through e-services. It also offers employment through software development, provision of IT services such as maintenance, business process outsourcing (BPO)

employment, or the generation of relevant local content. Secondly, broadband attracts investments in infrastructure, manufacture or services. Productivity and investment are the primary goal and objective of this CLIOS System in order to achieve overall economic growth for the country.

Broadband infrastructure owners, hereafter simply referred to as infrastructure owners, play a unique role because it is through their infrastructure that data products and services are transmitted. Infrastructure owners receive payment from broadband value added services and product providers, hereafter simply referred to as service providers in the form of rent and broadband consumers (indirectly through the service providers). The role of the broadband administrators in this system is to provide a management service to infrastructure owners and service providers. From their perspective, the economic benefits of broadband are realized from two sources: the government which collects corporate and individual taxes some of which will be allocated to the administrators and the collection of commissioning and licensing fees from the service providers and infrastructure owners. The service providers will receive payment for their service provision from the consumers. The flow of financial capital among the different stakeholders is represented in figure 4.5, with those flows specific to design, operation and deployment of broadband as solid arrows. The broken arrows are flows that will not affect the design, operation and deployment of broadband. Figure 4.6 shows the actual flow of services among the various stakeholders.

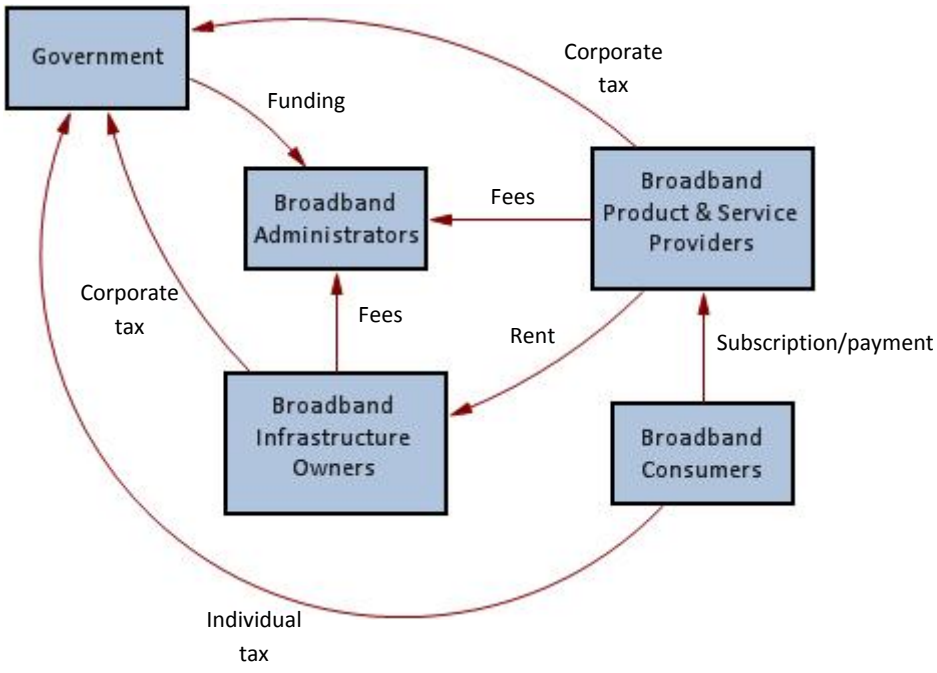


Figure 4.5: Flow of Financial Capital between Stakeholders
Source: Author

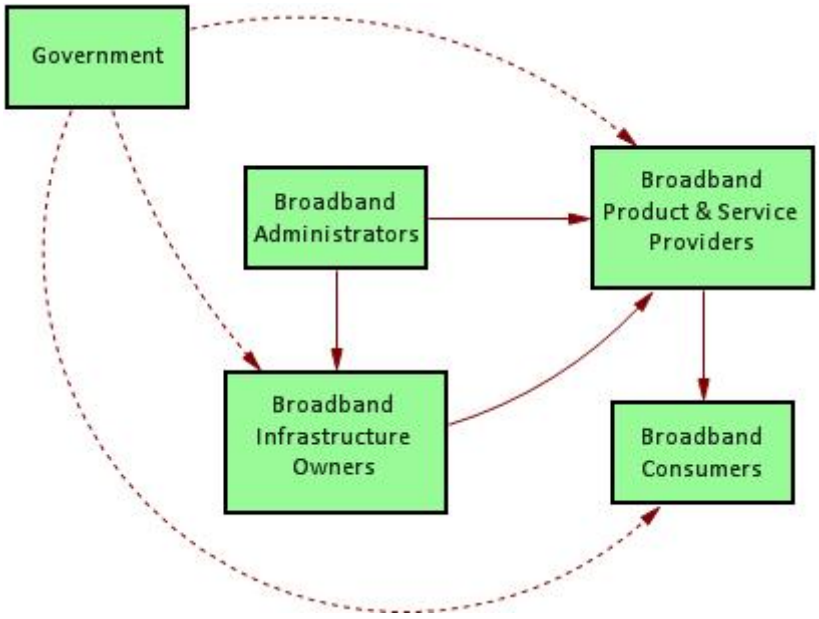


Figure 4.6: Flow of Services between Stakeholders
Source: Author

The second consideration in the analysis of stakeholder relationships is the ability of stakeholders to influence each other. Hanowsky and Sussman (2009) highlight two forms of such influence as either “some form of political power or an enforceable legal contract”.

The government is elected by its citizens. In turn the government appoints the ministers and directors who formulate policy and regulator the sector. The ICT administration influences both the infrastructure owners and service providers through regulation, licensing, standard setting and certification. Consumers would hold contracts with service providers. Figure 4.7 shows the influence that stakeholders hold over each other.

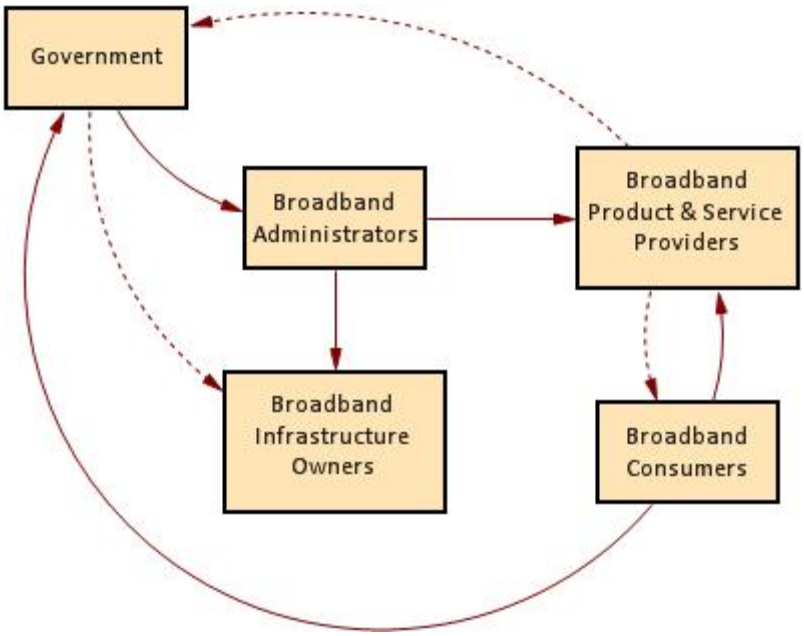


Figure 4.7: Flow of Influence between Stakeholders
Source: Author

4.4.3 Stakeholders using Mitchell's Framework

We can now proceed to analyze the stakeholders based on their power, legitimacy and urgency. Mitchell's framework classifies each attribute on a binary scale. Although this may not be entirely true (with distinct have and have not's) since most stakeholders will possess the attributes in varying degrees, the stakeholders shall be ranked then an appropriate threshold be applied to distinguish whether that stakeholder does possess that attribute or not as shown in Figure 4.8.

In considering power, which in this case would refer to the ability of a stakeholder to affect the design, operation, or outcome of broadband deployment, we can see that the broadband infrastructure owners would possess a high degree of power since they would ordinarily want to obtain the best return on investment, they will definitely affect the design, size, scope and outcome of the deployment. Through policy making, standard setting, regulation and licensing, the administrators can exert a high degree of power on the broadband deployment. The service providers would possess close to no power. Consumers would posses some low degree of power exerted through their market force of demand. Since the administrators are appointed by the government, it follows that the government can also be ascribed a high degree of power.

When considering legitimacy, which is the degree to which the broadband sector affects the stakeholder, broadband infrastructure owners, broadband product and service providers and consumers would all have high legitimacy because decisions made on broadband deployment will affect what services will be available, at what price and at what cost. The administrators shall also have high legitimacy although to a lesser extent simply because they are directly related to the broadband sector and carry a mandate for its successful deployment but will not necessarily suffer tangible loss on its failure. The government on the other hand will have little legitimacy as they are not directly related to the broadband sector.

The third attribute, urgency, refers to the need perceived by a stakeholder to change the broadband sector. Urgent stakeholders usually perceive direct effects from the sector. Infrastructure owners would possess the highest degree of urgency as they would like to recoup revenue from their investments. Consumers and broadband product and service providers would also have a high degree of urgency. Since the broadband administrators possess both a mandate and performance targets, they would have a high level of urgency. The government based on its economic targets also has urgency, albeit to a lesser degree and subject to flux.

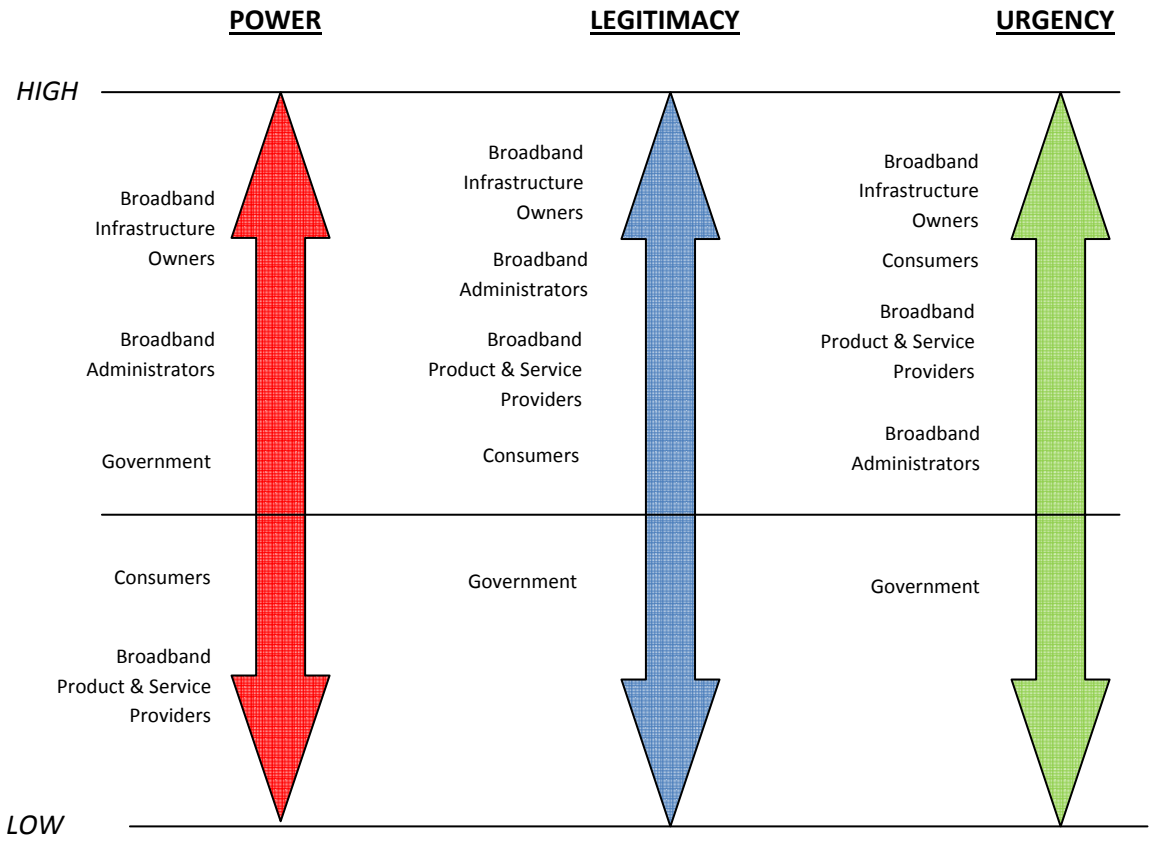


Figure 4.8: A Comparison of Stakeholder Power, Legitimacy and Urgency
Source: Author

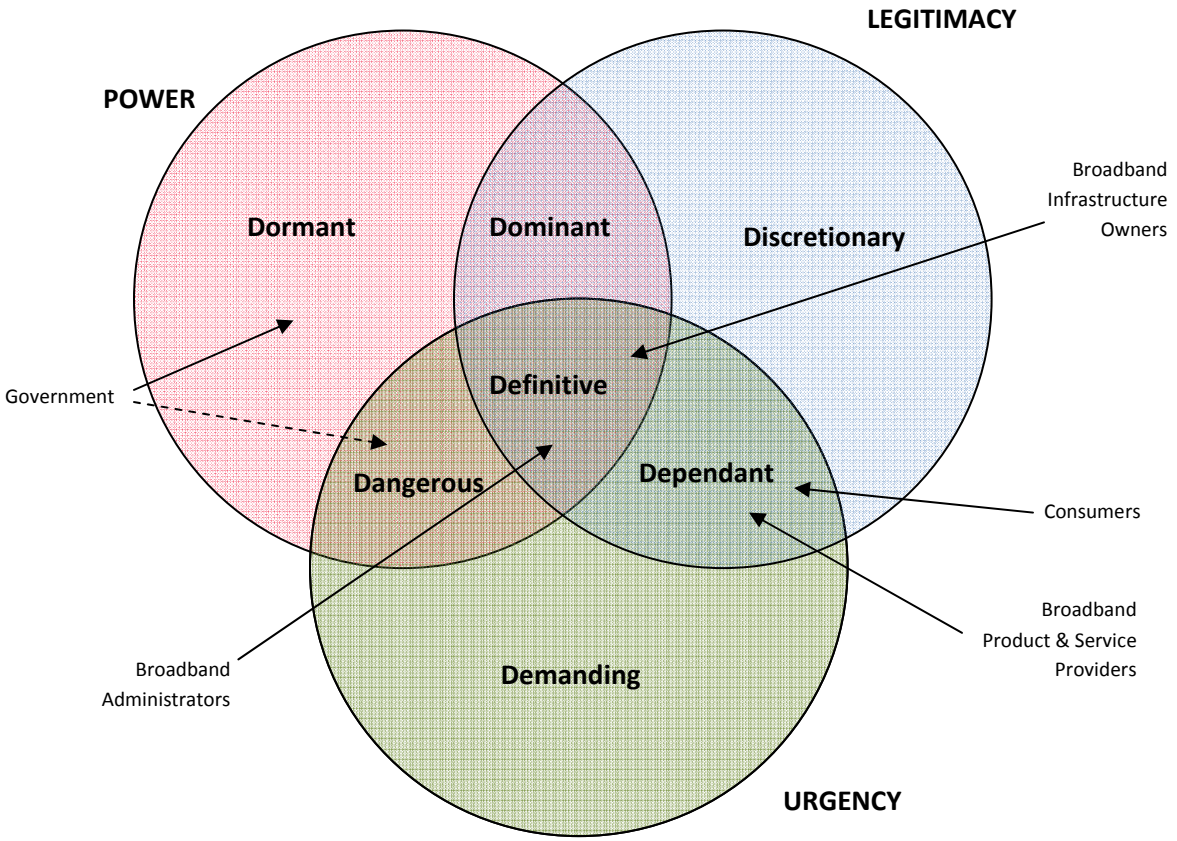


Figure 4.9: Kenya Stakeholder Classification
Source: Author

Figure 4.9 shows the catalogues stakeholders into Mitchell's stakeholder classifications. Based on this classification, the owners of the broadband infrastructure and the broadband administrators will be the most salient stakeholders ("definitive") exercising their power in determining and designing the deployment of broadband using financial or political instruments coupled with legitimacy infused with urgency. This result is consistent with what actually takes place in practice. Government administrators of broadband can encourage deployment of the infrastructure in given areas by offering incentives through tax breaks or as can be seen in the TEAMS project, through proposing public private partnerships or simply through investing in the infrastructure themselves as was the case with the Fiber Optic National Network (FONN). The broadband infrastructure owners such as SEACOM determine the route their cable will take and just how much capacity it can carry.

Consumers and broadband product and service providers possess legitimacy and urgency but do not posses much power ("dependant"). They therefore would need to depend on a stakeholder

with power to effect any changes they would wish to have on the broadband design and deployment.

The government has sufficient power to influence the deployment ("dormant") through the administrators, but at times they may perceive the need to act particularly when they have vested interests such as an upcoming election at which point their urgency would turn them into a ("dangerous") stakeholder lacking legitimacy, yet possessing power and urgency.

4.4.4 Conclusions

The results from the Mitchell framework allow us to draw some general conclusions about the design and deployment of broadband in practice. The stakeholders identified as the most salient, the administrators and the infrastructure owners, are also the most active and involved participants in the broadband design and deployment process. This result not only offers confidence in the current process but also in the eventual application of the framework in later analysis.

It should be noted though that although the three groups (government, consumers and service providers) are not identified as definitive stakeholders, they are also quite important and can sometimes be undervalued in the current design and deployment process. They could also gain a missing attribute either by changing themselves or through the help of an intermediary to become definitive stakeholders. Such is the case with providers such as Safaricom in Kenya that have also invested in the TEAMS submarine cable project. Consumers on the other hand may not seem to have a direct link to power but as can be drawn from figure 5.5 they can indirectly wield power by influencing an intermediary such as the government by way of an electoral process or service providers through contracts. Although it may be perceived that consumers don't have power say over the administrators, they may have power over other stakeholders that do. Alternatively, the consumers and broadband providers can derive power through organization and collective lobbying. Other prescriptive conclusions would include encouraging the government to use its power only to promote rather than hinder the objectives of the broadband administrators.

A stakeholder analysis can be done at a more granular level to specifically include consumer contribution especially on matters such as universal access or e-Learning in the design and deployment process. Nevertheless this analysis can be used to inform decisions, identifying potential pitfalls and offer decision-makers a more pragmatic perspective to decision making.

4.5 Chapter Conclusion

Chapter 4 has set up the understanding of broadband as a CLIOS System. It has also introduced the CLIOS Process and it was also used to perform a stakeholder analysis, which will later be useful in the analysis of the institutional sphere that affects the broadband subsystem. With this understanding the following Chapter carries out the CLIOS Process.

CHAPTER 5: APPLICATION OF THE CLIOS PROCESS

Aided by Sussman's (2009) CLIOS User Guide, this chapter goes through each of the steps in the CLIOS Process applying them to the specific case of broadband deployment for the achievement of economic growth in Kenya.

5.1 Phase 1: Representation

This stage aids in the understanding of the complete CLIOS System by examining the structures and behaviors of the physical subsystems and the institutional sphere and the interactions between them. Phase one draws heavily from Chapter 3 that covered an understanding of the specific case of ICT in Kenya. This was supplemented by several interviews that were conducted by the author on several stakeholders to the deployment of broadband. These include:

- Dr. Bitange Ndemo – Permanent Secretary (Kenya Ministry of Information and Communication)
- Hon. Dr. Kilemi Mwiria – Assistant Minister (Kenya Ministry of Science, Technology and Higher Education)
- Dr. Joseph Sevilla – Dean Faculty of Information Technology (Strathmore University)
- Mr. Paul Kukubo – CEO (Kenya ICT Board)
- Mr. Al Kags – Projects Manager (Kenya ICT Board)
- Mr. Joseph Mucheru – Head of Operations (Google East Africa)
- Mr. Aaron Mbowa – Entrepreneur and Executive Director (Dataposit Ltd)

5.1.1 Step 1: Describing the CLIOS System: Checklist and Preliminary Goal Identification

This step helps in examining the CLIOS System with the deliverables being a characteristics checklist, an opportunities/issues/challenges checklist and a preliminary CLIOS goals checklist.

This step aids in the decision of where and how to begin the analysis, establishing causality in developing an e-strategy

5.1.1.1 Characteristics Checklist

a) Temporal and Geographical Scope

The temporal and geographical scope checklist draws data from Chapter 3 covering the case of Kenya with particular focus on Section 3.5 that describes the broadband infrastructure in Kenya. Some key issues we need to be reminded of include:

- The fiber optic network intends to give universal access of data and communication services to all Kenya citizens (absolute internal connectivity). The flagship project is the Fiber Optic National Network (FONN) described earlier in Section 3.5.7.1
- The fiber optic network intends to connect the nation to the global information superhighway through submarine fiber cables – EASSy, TEAMS, SEACOM – described earlier in Sections 3.5.1 to 3.5.6
- The submarine cable projects are the first fiber optic cable projects along the Eastern Africa seaboard. Countries along the Eastern coast of Africa have previously been depending on slow and costly satellite connections. They are therefore intended to impact the entire Eastern African region
- The infrastructure deployed is intended for permanence
- The deployment of the projects is in different stages of completion, with SEACOM already in operation beginning July 2009, TEAMS projected to start operations in September 2009 and EASSy in the second half of 2010

b) Core Technologies and Systems

The core technologies and systems checklist draws its data from Section 2.2 of Chapter 2 that covers broadband technology and its contribution to ICT for development. It also draws some background information from the Kenya ICT sector analysis in Section 3.3 of Chapter 3. Some issues we need to take note of for the analysis include:

- Poor telecommunications infrastructure and a lack of electricity, particularly in rural areas, have resulted in a disproportionately high concentration of Internet subscriptions in Kenya's largest cities, Nairobi and Mombasa. A small proportion of this is broadband
- Broadband can be delivered via wire-line options such as fiber optic cable or copper based digital subscriber line (DSL); fixed wireless options (Wireless Local Area Network - WLAN) operating on Wi-Fi; mobile wireless such as third generation (3G)/WiMAX mobile networks; satellite particularly low earth orbit satellites such as those offered by O3b.
- Due to its initial investment cost and relative infrastructure permanence, economic decisions on fiber network architecture need to be made. Broadband deployment will not only require laying of cable but also an upgrading of terminals and equipment.

Architecture options include fiber to the home (FTTH), fiber to the building (FTTB), fiber to the neighborhood (FTTN) or fiber to the curb (FTTC)

- Broadband has high data capacities that can carry data supporting services such as messaging, fast file downloading, games, online applications, net storage, image, audio and video delivery

c) Natural Physical Conditions

The physical conditions checklist draws its data from Chapter 3 where the case of Kenya is discussed. Some pertinent issues include:

- Kenya has a high population density in urban areas especially around the three major cities of Nairobi, Mombasa and Kisumu. Population distribution and density are key drivers for broadband demand and eventual infrastructure deployment
- All district headquarters targeted by the FONN are accessible by road
- The North Eastern and North Western flanks of the country bordering Somalia and Northern Uganda suffer from periodic insecurities such as cattle rustling

d) Key Economic and Market Factors

The economic and market factors checklist draws its data from Chapter 3 where the case of Kenya is discussed. Some pertinent issues include:

- Economic growth as a driving policy with the telecommunications industry as an important part of the national economy
- A combination of low computer literacy, appropriate services (e.g., electricity), security and cost present a challenge in the deployment of these projects
- Numerous private ICT training centers that are not standardized or regulated
- As of 2007, Kenya had approximately 1,000 cyber cafes across the country all of which were located in urban areas
- Literacy of 81.5 percent, nevertheless there is limited skilled information technology labor
- A high Gini coefficient (0.425) with immense disparity of wealth between the rich and the poor
- Many areas of the country suffer from intermittent availability and poor distribution of electricity. Kenya's largest hydroelectric dam, Masinga dam, was shut down in July 2009 due to poor rains and subsequent drop in water volumes for hydroelectricity generation.
- According to the Kenya Rural Electrification Authority (KREA), 90 percent of Kenya's rural population are in the dark
- The KREA also notes that 80 percent of Kenya's population or about 3 out of every 4 people live in the rural areas

- Prevailing cost of telecommunications is extremely high
- Consumer income, willingness to pay and purchasing power generally low in rural and semi-urban areas

e) Social and Political Factors and Controversies

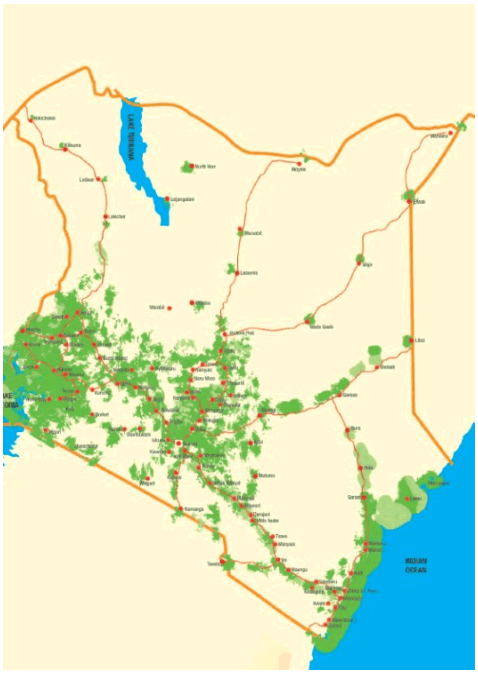
The social and political factors checklist draws its data particularly from Section 3.3.1 of Chapter 3 that covers the Kenya ICT sector governance. Some pertinent issues include:

- The identification of the telecommunications sector as a potential economic engine for the nation
- Sector regulator the Communication Commission of Kenya (CCK) is government appointed
- Potential resistance to change and a loss of jobs
- Lack of gender equality and youth representation within the broadband sector
- Environmental issues such as e-waste management related to broadband deployment and equipment upgrading
- Inadequate education of ICT skilled labor and ICT consumers
- Recent amendment of the Communications Act (2008)
- An incomplete regulatory environment with the following bills yet to be enacted: freedom of information bill and ICT bill. Several other acts need to be reviewed to embrace changes in technology.

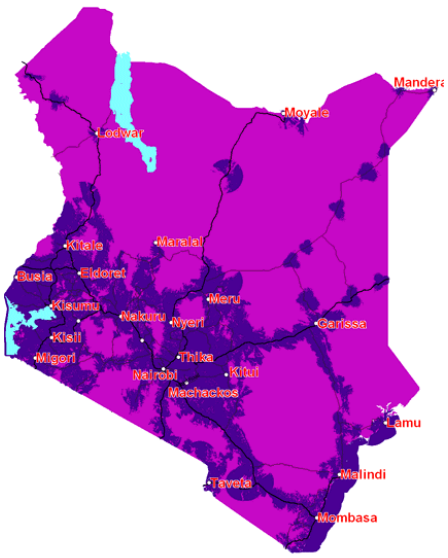
f) Historic Development

The historical development checklist draws its data from particularly from Section 3.3.2 of Chapter 3 which covered Internet background in Kenya. Other data is covered in the rest of Chapter 3 that discusses the ICT sector in Kenya. Some pertinent issues that need to be kept in mind include:

- A currently expensive communications service sector with low capacity relative to demand
- A previously government-owned monopoly of the national internet gateway (Jambonet)
- A vibrant mobile communications sector. Coverage of the two largest service providers shown below in Figure 5.1
- A telecommunications sector that was historically governed by multiple institutions and government agencies including a myriad of lobby organizations
- Projects have investment from both the government and the private sector



Safaricom Limited



Zain plc

Figure 5.1: Kenya's two largest mobile service providers network coverage
Source: Zain, SafariCom Accessed 15th August, 2009

5.1.1.2 Opportunities/Issues/Challenges Checklist

a) Opportunities

With reference to the Chapter 2 covering ICT for development, the following are some of the potential benefits that will result from the deployment of broadband in Kenya.

Government – The government can benefit through added efficiency in its internal processes by utilizing broadband for the movement and collection of information for better decision making. They shall also be in a position of offering better public services through e-Government services.

Private Sector – The private sector stands to gain through e-Commerce. This shall reduce the transaction costs considerably. They will also have better market access and transparency enabling them to take better advantage of opportunities. They shall also be increased market efficiency as a result of process automation caused by broadband deployment.

Education – The education sector shall benefit through e-Learning and increased collaboration for research through open access. Additionally, the population also stands to gain by having electronic means to access the wide body of knowledge available on the Internet.

National Security and Public Administration – Through the use of broadband based equipment, national security may be enhanced through surveillance and faster communication to maintain civil peace.

b) Issues

With reference to Chapters 2 and 3 that covered ICT for development and the specific case of Kenya respectively, we can notice the following issues relating to broadband deployment in Kenya:

- Where will the investors come from?
- Is there adequate demand for broadband among the Kenyan population?
- What is the appropriate deployment design decision of broadband in Kenya?
- Is Kenya a marketable destination for BPO related business?
- Is the regulatory framework conducive for broadband investment and deployment?
- Where and what exactly is the best sequence and approach to deploying broadband for economic growth?
- Does Kenya have sufficient skilled labor to support and make use of the broadband connections?

c) Challenges

The challenges are drawn from Chapters 2 and 3 that covered ICT for development and the specific case of Kenya respectively. A more in depth discussion of some of the challenges can be found in Section 3.4.2 which covered the Kenya ICT Policy (2006) specifics. These challenges include:

- Inadequate legal, policy and regulatory frameworks
- Inadequate ICT infrastructure
- Lack of human resource and skilled labor
- Lack of an e-learning policy framework
- Challenge of universal access
- Lack of public private partnerships on investments
- Inadequate government capacity to deliver e-government
- Lack of policies supporting e-commerce
- Lack of relevant local content on the Internet

- Lack of e-security
- Lack of sustained ICT leadership
- Need to involve women and other marginalized groups in ICT
- Need to involve the youth in ICT
- Limited sector investors

5.1.1.3 Preliminary CLIOS Goals Checklist

According to the Government of Kenya (2007) Vision 2030 document covered in Section 3.2 of Chapter 3, reflecting the visioning process covered in Section 2.5.1 of Chapter 2 regarding effective policy formulation frameworks, the primary goal of the Kenya broadband CLIOS is generation of sustained economic growth (10% GDP Growth) and poverty reduction.

Considering the Kenya ICT policy (2006), with reference to some universally accepted drivers of ICT resulting in economic development highlighted in Chapter 2, ICT for Development), this goal economic development shall be incumbent on the achievement of the following objectives, which can be termed as necessary conditions:

a) Increased Productivity through
    a. Employment
    b. Reduced transaction costs by procuring services online (e-services, e-government, e-learning)
    c. Business process outsourcing (BPO) and off-shoring
    d. ICT equipment manufacture
    e. Research and development (knowledge network and a knowledge based economy)

b) Investment
    a. In ICT infrastructure
    b. In ICT equipment manufacture
    c. In ICT service provision
    d. In ICT training
    e. Capital provision by the government

c) Increased aggregate demand for broadband promoted through
    f. Providing universal access
    g. A visionary ICT leadership
    h. Involvement of gender and youth who are the largest representation of the current population
    i. Standard setting and provision of quality products and services over broadband

5.1.2 Step 2: Identify Subsystems in the Physical Domain and Actor Groups in the Institutional Sphere

In order to understand the proper working of the CLIOS System, one needs to identify its structure determining the major subsystems that make up the physical domain, the main actor groups in the institutional sphere and how they relate to one another on a macro level.

5.1.2.1 Physical subsystems

With specific reference to the ICT development map framework introduced in figure 2.2, the following subsystems can be initially determined with reference to the broadband subsystem:

i. Socio-economic subsystem,
ii. Education subsystem,
iii. Labor and manpower subsystem,
iv. National security and administration subsystem, and
v. Electricity subsystem.

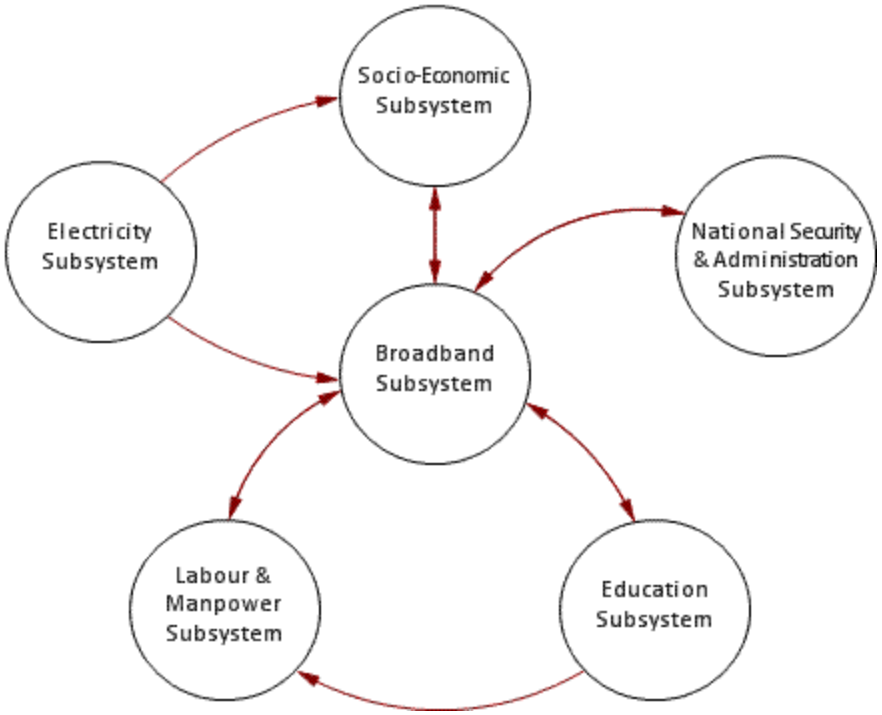


Figure 5.2: High Level Broadband CLIOS System Physical Domain Representation
Source: Author

Figure 5.2 shows how the different subsystems interact with one another. The flow of the arrows represents the flow of influence. A more detailed expansion of this high level diagram follows in step 3 of the CLIOS Process.

5.1.2.2 Institutional sphere

Based on the stakeholder analysis in Section 4.4 of Chapter 4 which summarized six broadband deployment stakeholder groups and contributions from stakeholder interviews mentioned in step 1 previously, the institutional sphere player who possess adequate power and urgency to affect the broadband subsystem directly include:

Table 5.1: Institutional sphere

Physical Domain Subsystem	**Institutions**
Government Agencies	Ministry of Information and Communication (MOIC) Communications Commission of Kenya Office of the President Kenya Bureau of Standards Ministry of Trade Ministry of Finance Ministry of Industrialization Ministry of Education Ministry of Higher Education, Science and Technology Ministry of labor Ministry of Internal Security Ministry of Energy
Private Sector	Infrastructure Owners

Source: Author

Figure 5.3 gives a CLIOS Process high level representation of the subsystems as planes and the institutional domain as a sphere that can project onto the different subsystems.

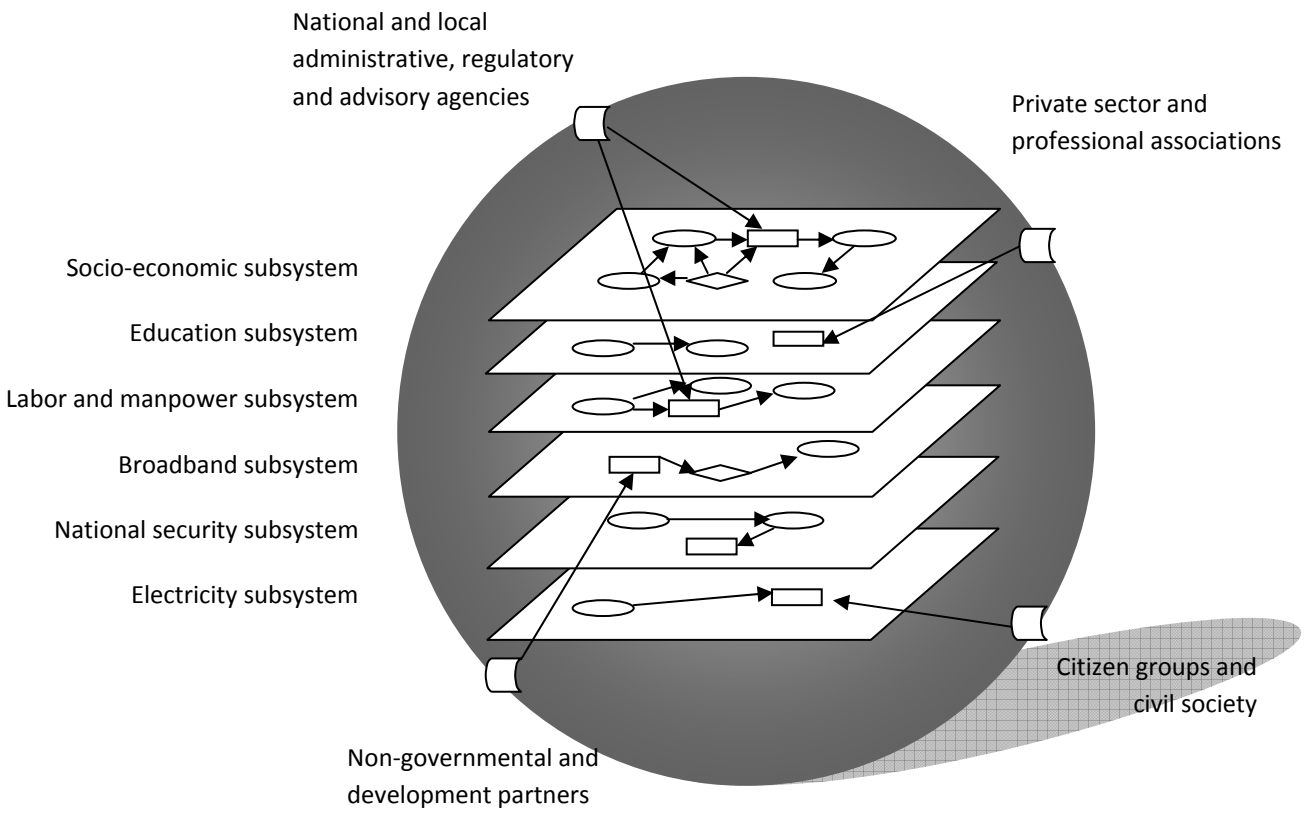


Figure 5.3: High Level Broadband CLIOS System Showing the Physical Domain and the Institutional Sphere

Source: Author

5.1.3 Step 3: Populate the Physical Domain and the Institutional Sphere

This stage requires the initial CLIOS subsystem diagrams to be created by detailing each subsystem. This is done by identifying the major components in each subsystem and the links indicating the influence of these components on each other.

The CLIOS Process suggests the use a notation shown in Figure 5.4 and Table 5.2 which shall be carried on throughout the analysis here after.

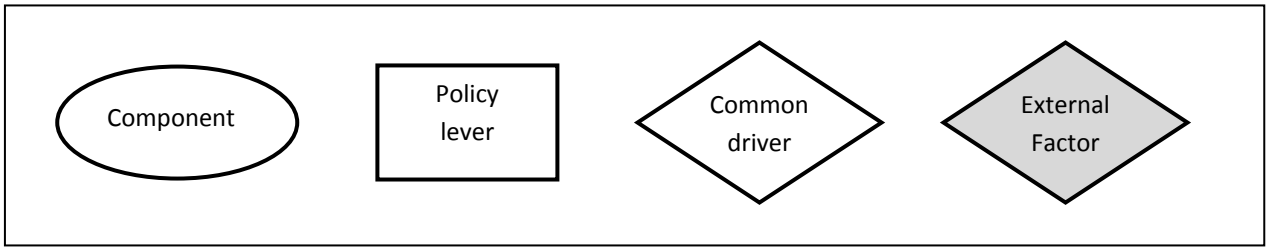


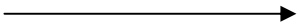
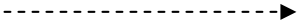
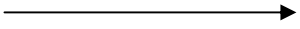
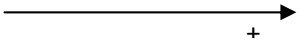
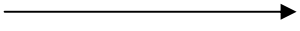
Figure 5.4: CLIOS Component Notation
Source: The CLIOS Process User's Guide (2009), Sussman, et al. and Author

The CLIOS User guide (2009) explains that components of the physical domain are characterized into three basic types:

- *"Regular components* (indicated by ovals) can refer to concepts or can contain complex internal structures
- *Policy Levers* (indicated by rectangles) are components within the physical domain that are most directly controlled or influenced by decisions taken by the actors — often institutions and organizations – on the institutional sphere.
- *Common Drivers* (indicated by diamonds) are components that are shared across multiple and possibly all subsystems of the physical domain.

External factors are indicated by shading, rather than by shape, and can still be either a component or a common driver. " (p.24)

Table 5.2: The adopted CLIOS link shapes for the CLIOS Subsystem Diagram

LINK	SHAPE
Class 1 (link between *components* of physical subsystems) Class 3 (link between *actors* on the institutional sphere)	
Class 2 (links "projecting" interactions between the institutional sphere and the physical domain)	
Weak	
Average	
Strong	
Bi-directional	
Positive (*increase* in component A results in *increase* in component B)	
Negative (*increase* in component A results in *decrease* in component B)	

Source: The CLIOS Process User's Guide (2009), Sussman, et al.

5.1.3.1 Populating the Physical Domain

Socio-economic Subsystem

As summarized in Chapter 2 which covers ICT for Development, the primary economic development benefits of ICT can be broadly summarized as:

1) Collaboration and knowledge sharing
2) Reduction in transaction and distribution costs
3) Production and process automation
4) Increased market access and efficiency
5) Establishment of an ICT sector

The two broad categories of ICT applications and service-based software industry and the hardware manufacturing and/or assembly industry are represented as e-services and products and ICT manufacture and maintenance respectively in the socio-economic subsystem of the CLIOS System. The e-services and products include development of applications, internet service provision, etc. Commercial activities relating to the e-services and ICT manufacture are subject to anti-trust policy that would cover issues of competition, industry standards and policy

regarding local and foreign investment. Employment opportunities shall be subject to prevalent labor policies and the product and process innovations shall be guided by an innovation policy.

The economic effects of the e-services and products as well as ICT manufacture include industry efficiency, collaboration and reduced transaction costs all of which improve productivity. Other benefits include added employment opportunities which will result in increased personal income, increased market transparency which will increase market efficiency and the visibility and communication of opportunities for investment. Personal income and broadband price shall determine the extent to which broadband services shall be adopted and put to use. The downside though would be the loss of jobs due to production and process automation which may beget resistance to change as well as increased unemployment. This is potentially an issue to be addressed within the policy sphere.

Social benefits realized through e-services include the availability of social services such as e-Government and e-Security which increases civic stability.

The socio-economic subsystem plane in the broadband CLIOS System appears in Figure 5.5

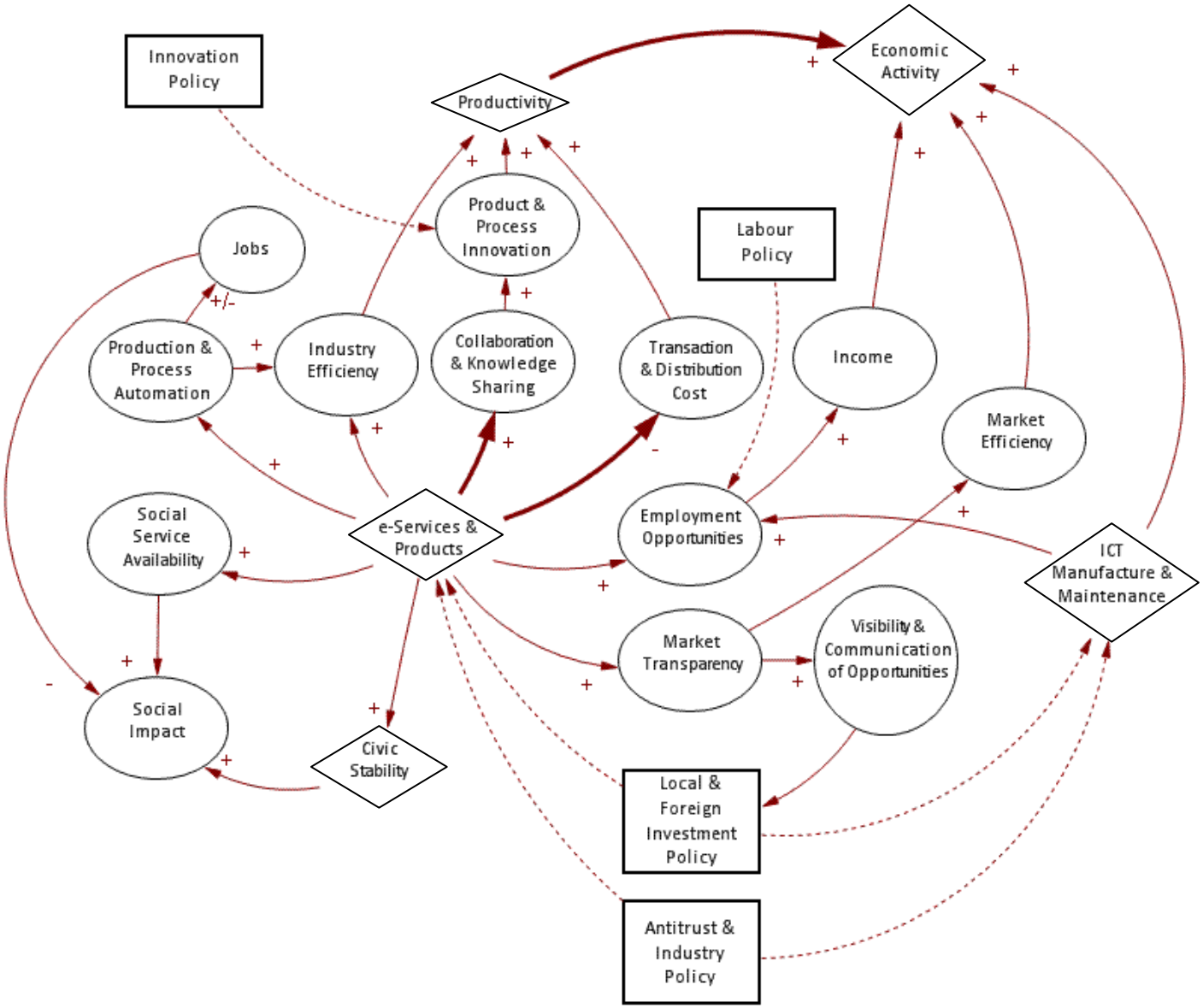


Figure 5.5: A CLIOS Representation of the Components and Linkages in the socio-economic Activity Subsystem
Source: Author

Education

Education hopes to benefit from broadband primarily through knowledge sharing and e-learning applications. Education would result in a skilled workforce certified in accordance to a standards setting institution or a computer literate populace trained through a digital education policy. Innovation through research and development will be guided by an innovation policy and eventually benefit the broadband subsystem through the production of local content, services & products. The set up of community, private or public schools will be subject to an education investment plan/policy.

The education subsystem in the broadband CLIOS System appears in Figure 5.6

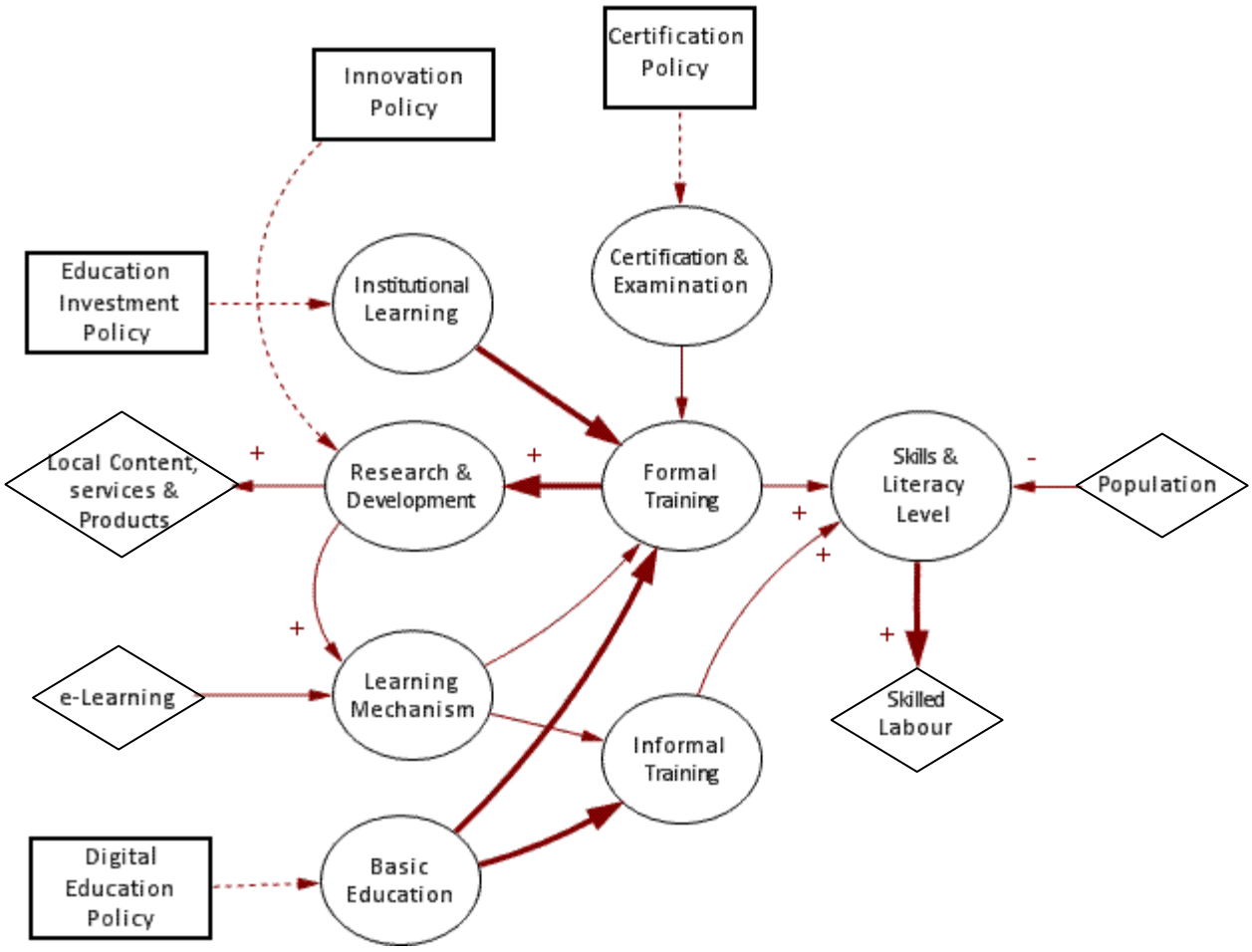


Figure 5.6: A CLIOS Representation of the Components and Linkages in the Education Subsystem

Source: Author

Labor and Manpower

Skilled labor and manpower is needed to operate and maintain broadband and any broadband-based services. Investment in industry generates an aggregate demand for manpower that may be either formal/skilled or informal. This investment may be in ICT or any other sector. The members of the general populace would supply the manpower which may be either skilled (as a result of training within the educational subsystem) or unskilled.

Broadband shall then be useful in providing information for purposes of communicating employment opportunities and further in assisting in collaboration and the execution of employment related tasks. Investments within the economy would be guided by and investment policy and the placement and assignment of labor will be guided by a labor policy.

The labor and manpower subsystem in the broadband CLIOS System is shown in Figure 5.7.

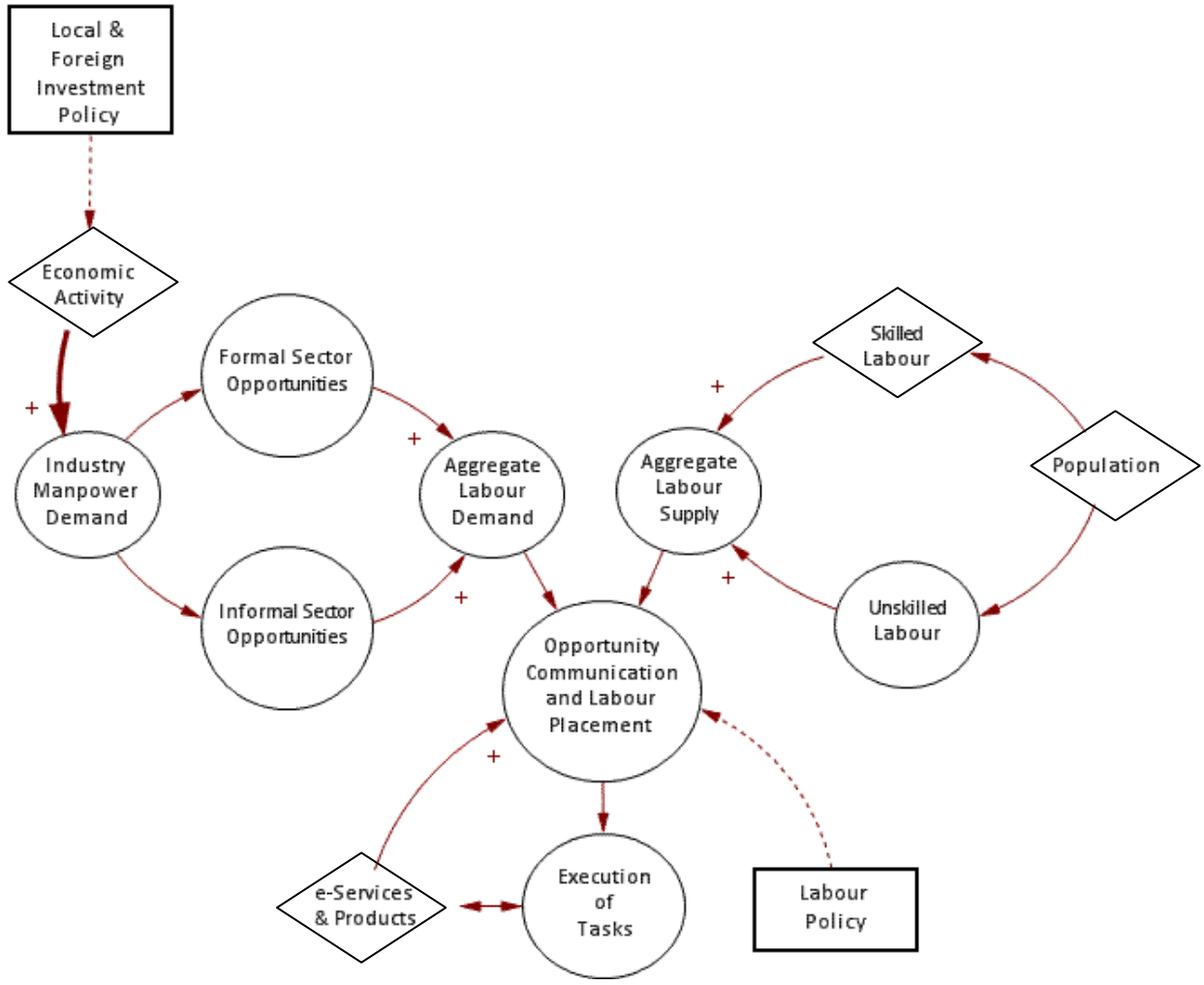


Figure 5.7: A CLIOS Representation of the Components and Linkages in the Labour and Manpower Subsystem

Source: Author

National Security and Administration

National security and administration involves itself in maintaining peace and solving social problems with the ultimate economic goal of establishing an environment appropriate for commerce and investment. A primary aspect of national security is problem resolution. After a problem occurs, several ICT based problem identification mechanisms can be applied such as e-security applications, surveillance, geographic information systems or a simple citizen report to the appropriate administrative body. Use of these technologies need to be governed by a privacy policy. The problem can then be communicated to the appropriate administrative body via broadband. The publicity of such information shall be subject to a freedom of information policy. Well informed problem resolution and the application of resolution mechanisms can then follow guided by a national security, or internal government policy. A timely resolution of these issues maintains civic stability creating an environment adequate for commerce and investment.

The national security and administration subsystem in the broadband CLIOS System is shown in Figure 5.8.

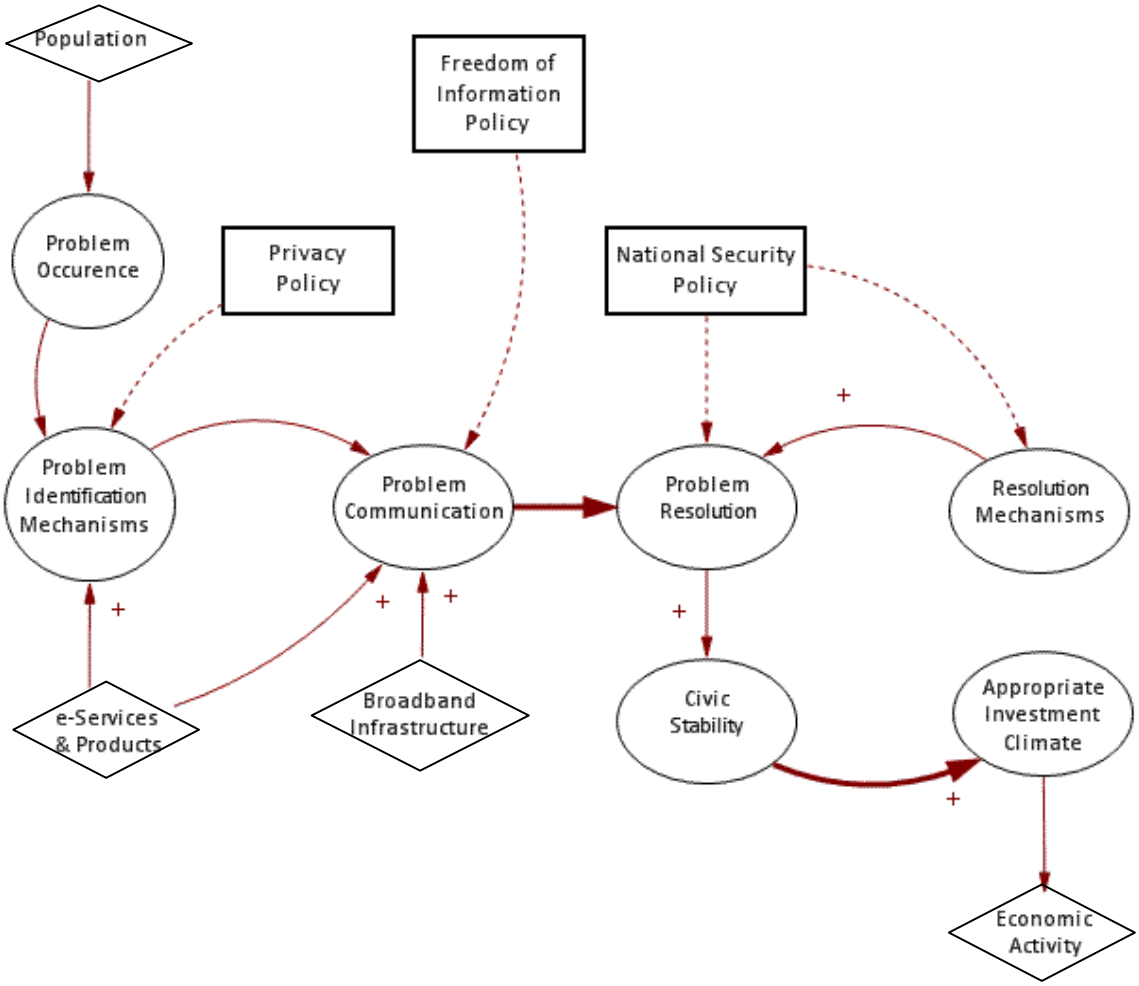


Figure 5.8: A CLIOS Representation of the Components and Linkages in the National Security and Administration Subsystem

Source: Author

It needs to be noted that e-security in this case is distinguished from cyber security (a subset of national security) that involves itself with security within the internet. The scope of this thesis will not cover the technicalities of cyber security; nevertheless the CLIOS Process' conceptual analysis is an accurate representation that can aid further in depth analysis.

Electricity Subsystem

Power (electricity) is a major determinant in the distribution of telecommunication services, basically due to its use in running telecommunications equipment. The availability of electricity will determine how pervasive the broadband deployment will be and how far it can reach. This explains why the distribution of internet use in Kenya is primarily in and around the three major cities and suburbs.

The electricity subsystem begins with the various forms of electricity production. This shall establish the aggregate supply available. Once produced, the electricity is transmitted primarily through a distribution grid whose layout is primarily determined by the population distribution. The size of the population and the nature of their economic status will determine the amount of residential electricity consumed. Economic growth and industrial establishment will contribute to commercial electricity demand. Aggregated, the commercial and residential consumption represent the national demand for electricity.

When deploying broadband, the ready availability of electricity is not only essential in the design of the deployment but also in the aggregate demand for broadband within the community the connection wishes to serve.

The electricity subsystem in the broadband CLIOS System is shown in Figure 5.9

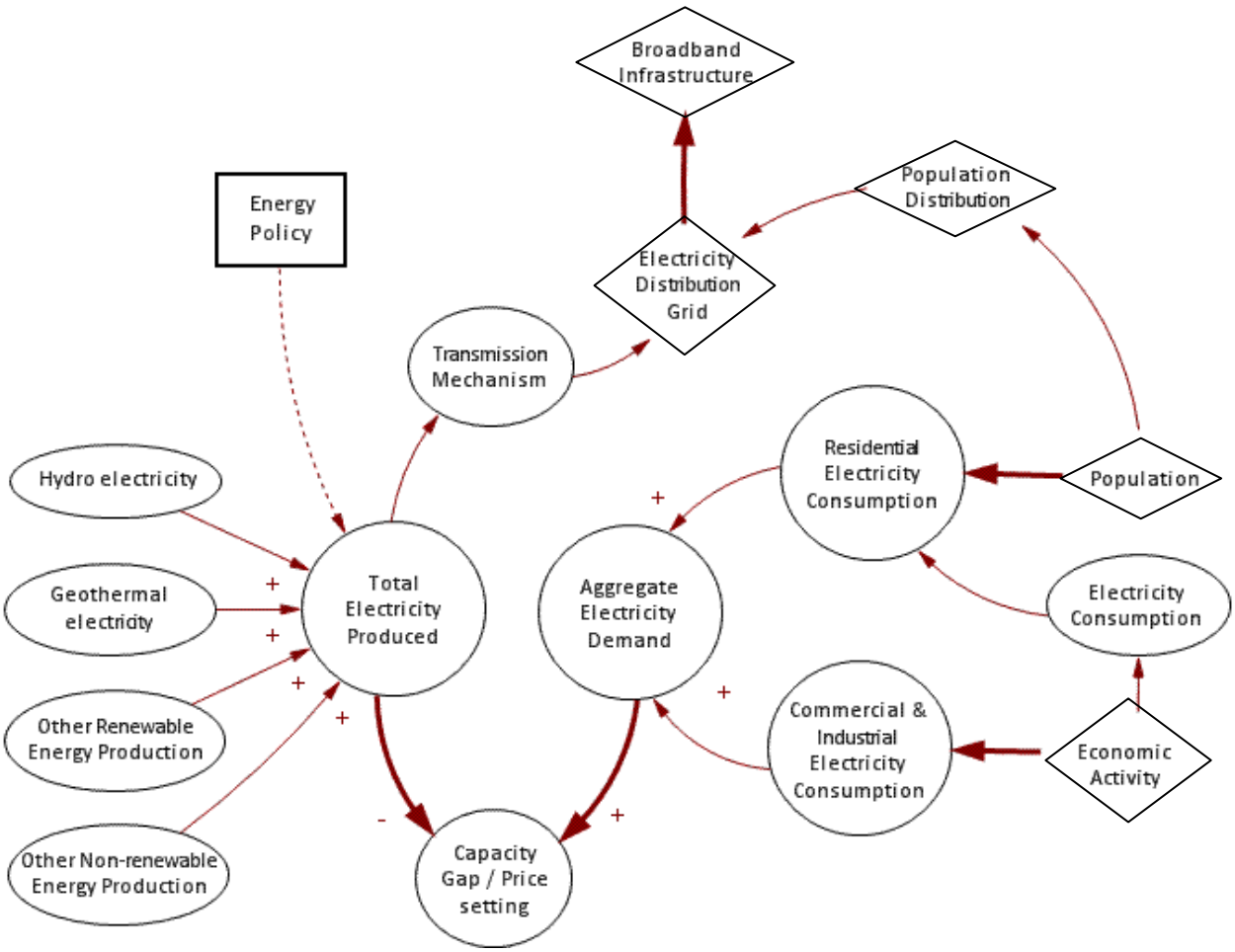


Figure 5.9: A CLIOS Representation of the Components and Linkages in the Electricity Subsystem

Source: Author

The Broadband Subsystem

The broadband subsystem epitomizes the "chicken and egg" conundrum. The subsystem covers broadband infrastructure deployment, broadband products and services and broadband use/consumption which are all drivers for broadband uptake and depend heavily on each other.

In the absence of investment spurred by a universal access policy, the deployment of broadband will be driven by the market forces of demand and supply. Broadband will be demanded by a given community if they perceive benefits from its deployment (relevant content, employment and other benefits) at a given price. They also need to have the ability to make use of the broadband connection by possessing broadband terminal equipment and processors. The supply side shall only deploy broadband if there is perceived opportunity and a market that is willing and able to pay for the service. This is shown in the causal loop diagram in Figure 5.10.

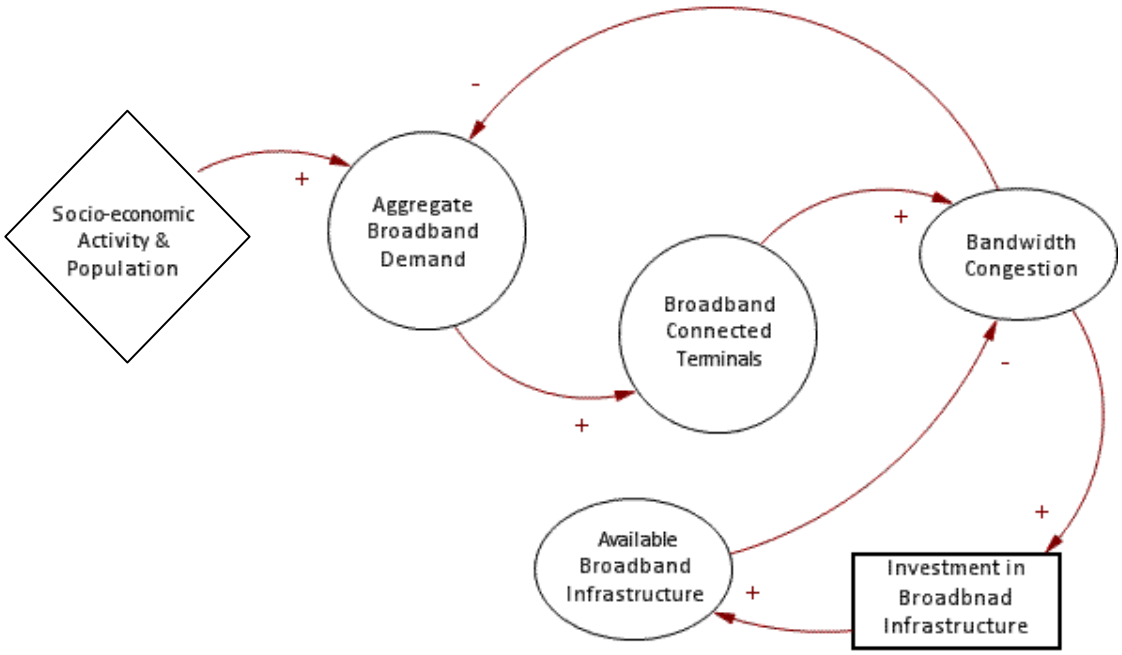


Figure 5.10: Basic Broadband Subsystem Causal Loop Diagram

Source: Author

The above causal loop summarizes the factors that need to be considered in the analysis of the economic feasibility when deploying broadband. Additionally, in relation to fiber-based broadband, technical feasibility of deployment will depend on distance and topography (factored into accessibility), availability or proximity of electricity to run the systems, and skilled labor and manpower to setup and operate it, and the eventual choice of an appropriate form of the

broadband technology to deploy. The entire investment in the deployment will take place in a conducive environment of national security and proper administration.

Additionally, broadband deployment shall be affected by policies guiding investment, both local and foreign and the ICT industry competition policy. These policies are extended into investments regarding resource acquisition, an example of such policy is the ICT equipment importation policy. The pricing of the broadband service shall be guided by a tariff regulation policy. Other policies will affect broadband supported services such as a BPO policy or an e-government policy. Figure 5.11 shows the broadband subsystem in the broadband CLIOS System.

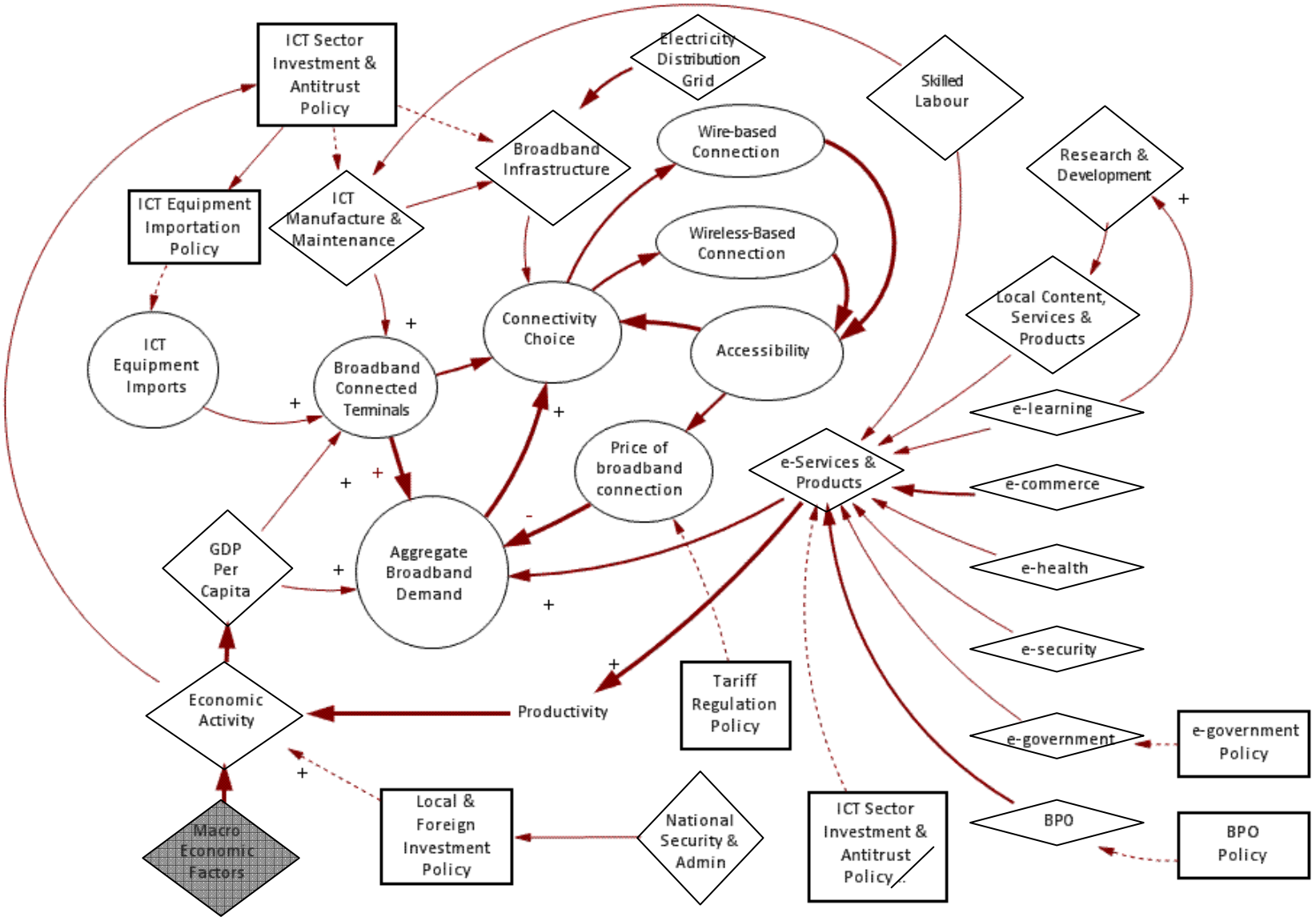


Figure 5.11: A CLIOS Representation of the Components and Linkages in the Broadband Subsystem

Source: Author

5.1.4 CLIOS Step 4A: Describe Components in the Physical Domain and Actors on the Institutional Sphere

At this stage, components in the physical domain are described and grouped into regular components, policy levers and common drivers. Regular components are those indicated by circles in the CLIOS representation diagrams above. Policy levers, which are those components most directly controlled or influenced by decisions taken by the actors in the institutional sphere, are represented as rectangles. Finally, common drivers, which are shared components across multiple layers and/or subsystems, are indicated by diamonds. These are shown in Tables 5.3-5.8 for the different subsystems. A description of the actors in the institutional sphere identifies their important characteristics, such as their power and mandate over different parts of the physical domain. The actors are shown in table 5.9

Table 5.3: Component Descriptions for the Socio-economic Subsystem

	Component	**Description**
Regular Components		
1	Product and process innovation	Involves the development of new and better products and processes to produce those products
2	Jobs	Refers to those jobs lost or gained as a result of office automation
3	Production and process automation	Refers to the performance of production tasks and processes by automated ICT systems
4	Industry efficiency	An increase in industry efficiency refers to an increase in output per unit time.
5	Collaboration and knowledge sharing	Refers to systems that facilitate collective execution and tracking of work as well as pooling knowledge and information
6	Transaction and distribution costs	Refers to costs previously ascribed to middlemen who will currently not be necessary when ICT puts the consumer and the producer in direct contact
7	Income	With more employment opportunities, and increased output and productivity, the income individuals will get will increase
8	Social service availability	Social service availability broadly covers the availability of public services such as government related applications and tasks online
9	Market efficiency	Just as industry efficiency, market efficiency refers to an increase in market output per unit time
10	Employment opportunities	These are ICT and broadband related employment

		opportunities, specifically those from the BPO subsector
11	Social impact	Social impact simply refers to the effect the given service will have on the social life of an individual and/or community
12	Market transparency	This is as a result of connecting the producer and the consumer directly through ICT
13	Visibility and communication of opportunities	As a result of putting more content online, producers can advertise their wares, and consumers can better express their needs
Common Drivers		
1	Economic activity	Refers to an increase in the activity of goods and services production
2	Productivity	A constitutive factor of economic growth, productivity refers to the increase in quantity and quality of units produced to the labor per unit time
3	ICT manufacture and maintenance	This refers to production and/or assembly of ICT equipment. Maintenance refers to the sustenance of ICT systems in good working order
4	e-services and products	These are services delivered electronically and products supporting this electronic delivery
Policy Levers		
1	Innovation policy	Innovation policy governs the research areas of priority for the country. Innovation policy is extended to include intellectual property rights and laws. It also outlines the standards of products, processes and services in the innovation ideas
2	Labor policy	Labor policy covers policies on manpower and employment. The policy may include matters like the constitutive number of local personnel within an organization or the representation of marginalized individuals and gender balance
3	Local and foreign investment policy	Investment policy covers issues such as incentives offered to investors and the level of local ownership required in any investment
4	Anti-trust and industry policy	This refers to a sector policy that regulates monopolies and standards of products produced. Each sector ideally has its own industry policy and a regulator on the commercial interactions within the sector

Source: Author

Table 5.4: Component Descriptions for the Education Subsystem

	Component	Description
Regular Components		
1	Institutional learning	Institutional learning refers to formalized training following a systematic structure. Such learning often happens in the confines of an institution such as a school or university
2	Certification and examination	This refers to the process of ascertaining that actual learning has taken place. It is also useful in establishing the quality of desired training
3	Research and development	Research refers to a systematic inquiry and search of knowledge and information and its application to development and the improvement of products and processes
4	Formal training	Formal training refers to a guided discourse in the acquisition of a knowledge or a specific skill
5	Skills and literacy level	Literacy level traditionally means the ability to read and write. Skill refers to an ability acquired as a result of training
6	Learning mechanism	Refers to the mode through which learning occurs. These are varied and may include apprenticeship, tutoring or computer aided training
7	Informal training	Refers to non-institutional training that need not be systematic or structured
8	Basic education	This broadly refers to the 12 years spent in primary/elementary and secondary/high school in most countries
Common Drivers		
1	Local content, services and products	This refers to content that has been locally produced for use in a given regional confine. It is content, services and products aimed at serving the needs of that specific local community
2	e-learning	e-learning refers to automated/computer/technology aided education. This can be in the form of web-based learning, virtual classrooms, or digital collaboration
3	Skilled labor	Skilled labor refers to those individuals trained with the ability to specially perform a given task
4	Population	Refers to the sum of individuals found within a given territory or locale
Policy Levers		
1	Certification policy	A certification policy establishes the standards of training necessary to guarantee the quality of human resource.
2	Innovation policy	Innovation policy governs the research areas of priority for the

		country. Innovation policy is extended to include intellectual property rights and laws. It also outlines the standards of products, processes and services in the innovation ideas
3	Education investment policy	This refers to an investment policy specific to the education sector which is an extension of the overarching investment policy within the country
4	Digital education policy	This refers to the policy governing the type and extent of digital education that will be available in educational institutions nationally

Source: Author

Table 5.5: Component Descriptions for the labor and Manpower Subsystem

	Component	**Description**
Regular Components		
1	Industry manpower demand	This refers to the ability and desire of industry to take up manpower for the performance of production tasks
2	Formal sector opportunities	These are employment opportunities that are structured such as “white collar” jobs
3	Informal sector opportunities	Small often self employed enterprises fulfilling some economic task/activity
4	Aggregate labor demand	This is the total amount of labor that shall be demanded within a given economy
5	Aggregate labor supply	This is the total amount of labor that can be supplied by a given population to support economic labor demand
6	Unskilled labor	Unskilled labor refers to labor that has not undertaken training to perform a given task
7	Opportunity communication and labor placement	This refers to the act of matching labor to employment opportunities they are suited to perform
8	Execution of tasks	This is the fulfillment of duties and tasks to achieve economic output
Common Drivers		
1	Economic activity	Refers to an increase in the activity of goods and services production
2	Skilled labor	Skilled labor refers to labor that has undertaken training to specially perform a given task
3	Population	Refers to the sum of individuals found within a given territory or locale
4	e-services and products	These are services delivered electronically and products supporting this electronic delivery

Policy Levers		
1	Local and foreign investment policy	Investment policy covers issues such as incentives offered to investors and the level of local ownership required in any investment
2	labor policy	labor policy covers policies on manpower and employment. The policy may include matters like the constitutive number of local personnel within an organization or the representation of marginalized individuals and gender balance

Source: Author

Table 5.6: Component Descriptions for the National Security and Administration Subsystem

	Component	**Description**
Regular Components		
1	Problem occurrence	The incidence of a disturbance or disruption to the running of social activities
2	Problem identification mechanisms	These are ways in which a problem can be discovered such as through the use of surveillance systems
3	Problem communication	Refers to the conveyance of information pertinent to a given problem to the concerned decision making and resolution parties
4	Problem resolution	This refers to the process of finding a solution to the problem
5	Resolution mechanisms	These are the different ways through which a problem can be solved
6	Civic stability	This refers to an operative and peaceable state of the community
7	Appropriate investment climate	This refers to a conducive environment for commercial activity
Common Drivers		
1	Population	Refers to the sum of individuals found within a given territory or locale
2	e-services and products	These are services delivered electronically and products supporting this electronic delivery
3	Broadband infrastructure	This refers to the collection of facilities and capital equipment needed for the functioning of broadband
Policy Levers		
1	Privacy policy	The privacy policy governs the extent and circumstances under which a privacy breach to an individual is deemed to

		have happened occurred
2	Freedom of information policy	This Freedom of Information policy enables the public to access information in the possession of public authorities, and to establish systems and processes to promote proactive publication and dissemination of information
3	National security policy	National security policy covers the mandate, duties and quality of service to be offered by the government regarding national security. It covers the different levels of government from local to national

Source: Author

Table 5.7: Component Descriptions for the Electricity Subsystem

	Component	**Description**
Regular Components		
1	Hydro electricity	Refers to electric power generated from water
2	Geothermal electricity	Refers to electricity produced from subterranean heated steam
3	Other renewable energy production	Refers to electricity generated from sources that are sustainable, such as solar, wind and hydro
4	Other non-renewable energy production	Refers to electricity generated from non-sustainable energy sources such as diesel or coal
5	Total electricity produced	This is the aggregate amount of electricity produced by the various sources
6	Transmission mechanism	This refers to the mechanism of delivering electricity from its point of production to the point of consumption
7	Electricity consumption	This refers to the use of electricity power up electronic devices
8	Residential electricity consumption	This refers to electricity consumed in the home
9	Commercial and industrial electricity consumption	This refers to electricity consumed for commercial and industrial purposes
10	Aggregate electricity demand	This is the aggregate amount of electricity desired by a given market
11	Capacity gap	This is the shortfall between the amount of electricity produced and electricity demanded. This determines the price of electricity
Common Drivers		
1	Broadband infrastructure	This refers to the collection of facilities and capital equipment needed for the functioning of broadband
2	Population distribution	This is the spatial arrangement of population per given area
3	Population	Refers to the sum of individuals found within a given territory or locale

4	Economic activity	Refers to an increase in the activity of goods and services production
5	Electricity distribution grid	Refers to the spatial expanse of the electricity grid reach
Policy Levers		
1	Energy policy	The energy policy covers the manner in which energy development is to take place. It includes energy production, distribution and consumption and covers guidelines on energy investment and conservation

Source: Author

Table 5.8: Component Descriptions for the Broadband Subsystem

	Component	**Description**
Regular Components		
1	Broadband connected terminals	Refers to ICT equipment that utilizes broadband connections
2	ICT equipment imports	These are ICT equipment brought into a given country from a foreign producer
3	Aggregate broadband demand	This is the total desire exhibited by a given market for broadband services backed by an ability to pay
4	Connectivity choice	This refers to mode of connection desired. It is affected by among others, the type of terminal possessed and the amount of bandwidth demanded.
5	Wire-based connection	These are connections based on physical transmission media such as copper based or optic fiber
6	Wireless-based connection	These are connections based on non-physical
7	Accessibility	Capability of being in reach
8	Price of broadband	Cost paid for broadband access
Common Drivers		
1	GDP per capita	An extension of economic growth, GDP per capita refers to the total national income shared by the total population
2	Economic activity	Refers to an increase in the activity of goods and services production
3	Macro-economic factors (external component)	These are other governmental economic factors and decisions that affect economic growth on a country level
4	ICT manufacture and maintenance	This refers to production and/or assembly of ICT equipment. Maintenance refers to sustenance in good working order
5	Productivity	A constitutive factor of economic growth, productivity refers to the increase in quantity and quality of units produced to the labor per unit time

6	Broadband infrastructure	This refers to the collection of facilities and capital equipment needed for the functioning of broadband
7	Electricity distribution grid	Refers to the spatial expanse of the electricity grid reach
8	e-services and products	These are services delivered electronically and products supporting this electronic delivery
9	Skilled labor	Skilled labor refers to labor that has undertaken training to specially perform a given task
10	Research and development	Research refers to a systematic inquiry and search of knowledge and information and its application to development and the improvement of products and processes
11	Local content , services and products	This refers to content that has been locally produced for use in a given regional confine. It is content, services and products aimed at serving the needs of that specific local community
12	e-learning	A constitutive element of e-services, e-learning refers to educational activities conducted through electronic media
13	e-commerce	A constitutive element of e-services, e-commerce refers to business activities conducted through electronic media
14	e-health	A constitutive element of e-services, e-health refers to health services provided through electronic media
15	e-security	A constitutive element of e-services, e-security refers to security services provided through electronic media
16	e-government	A constitutive element of e-services, e-government refers to government services provided through electronic media
17	BPO	Business process outsourcing refers to the electronic transfer and contracting of specific business tasks, operations and responsibilities to a third party
Policy Levers		
1	ICT sector investment and competition policy	The ICT sector investment policy would regulate who and how investments can be made within the ICT sector. The competition policy will govern the openness within the sector
2	Local and foreign investment policy	Investment policy covers issues such as incentives offered to investors and the level of local ownership in any investment
3	ICT equipment importation policy	This policy will cover regulations on import taxation of different ICT equipment
4	Tariff regulation policy	This policy will cover the reasonable price to be offered for ICT services
5	e-government policy	This policy will cover the implementation of e-government and issues such as software and hardware standardization
6	BPO policy	The BPO policy would be a business specific policy aimed at maintaining quality and growth of the BPO subsector

Source: Author

Table 5.9: Actor Descriptions for the Broadband CLIOS System

Actors)		
1	Ministry of Information and Communication	Mandate: Formulation of information and communications policy
2	Ministry of Finance	Mission: To pursue prudent economic, fiscal, and monetary policies and effectively coordinate government financial operations for rapid and sustainable development of Kenya
3	Office of the President (Directorate of e-Government)	Mandate: To oversee and coordinate the implementation of the e-Government Strategy
4	Communications Commission of Kenya (CCK)	CCK is the independent regulatory authority for the communications industry in Kenya. Its role is to license and regulate telecommunications
5	Kenya Film Censorship Board	Body that regulates the content in film
6	Media Owners Association	An association that represents the interests of the owners of different media in the country
7	Kenya ICT Federation (KIF)	A federation representing the interests of the private and non-governmental sector in the ICT industry
8	Ministry of Higher Education, Science & Technology	Mandate: To formulate, promote and implement higher education, research, science, technology and innovation policy and strategies
9	Ministry of labor	Mandate: To formulate labor and human resource development policies, programmes and strategies and coordinate their implementation for national development.
10	Ministry of Trade	Mandate: To facilitate trade and investment by championing an enabling environment for domestic and export business to thrive
11	Ministry of Industrialization	Mandate: To formulate and facilitate the execution of and industrialization policy with quality control including industrial standards
12	Kenya Bureau of Standards	Mandate: Includes the promotion of standards in industry and commerce.
13	Ministry of Education	Mandate: To provide, promote and co-ordinate lifelong education, training and research for Kenya's sustainable development
14	Ministry of State for Provincial Administration and Internal Security	Mandate: To provide strategic leadership, policy direction, a secure environment and set the agenda for achieving socio-economic and political development of our people
15	Ministry of Local Government	Mandate: To facilitate Local Authorities to achieve good governance and improved service delivery for enhanced social-economic development
16	Ministry of Energy	Mandate: To be a leader in promoting equitable access to

		quality energy services at least cost while protecting the environment and formulate energy policy and development
17	Communications Commission of Kenya (CCK)	CCK is the independent regulatory authority for the communications industry in Kenya. Its role is to license and regulate telecommunications
18	Kenya Film Censorship Board	Body that regulates the content in film
19	Media Owners Association	An association that represents the interests of the owners of different media in the country
20	Kenya ICT Federation (KIF)	A federation representing the interests of the private and non-governmental sector in the ICT industry

Source: Kenya Government Portal and Author

Figure 5.12 shows the broadband CLIOS System diagram that shows the interaction between the different subsystems and actors within the CLIOS System.

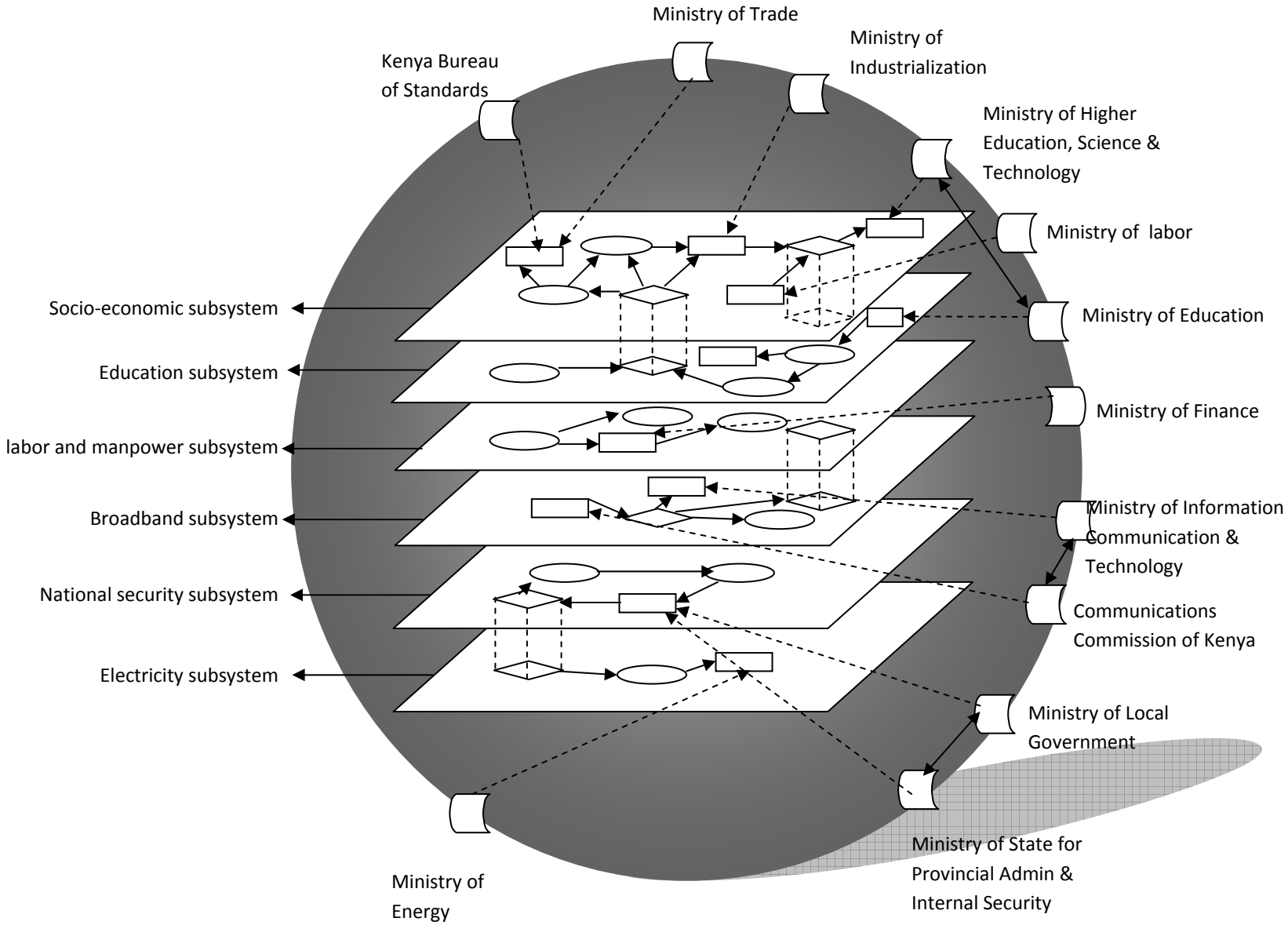


Figure 5.12: A CLIOS System Diagram Showing the Physical Domain and the Institutional Sphere Interactions

Source: Author

5.1.5 CLIOS Step 4B: Describe Links

The next stage involves describing the links which should indicate directionality of influence and feedback loops as well as magnitude of influence (big/small, important or marginal). The CLIOS Process identifies 3 types of links:

i) Class 1: These are links between components in a subsystem
ii) Class 2: These are links between components in a subsystem and actors on the institutional sphere (also called "*projections*" and
iii) Class 3: Links between actors in the institutional sphere

According to Sussman (2009), "different types of links can be identified based on what 'goods' they carry from one component/actor to another. These include:

- *Causal:* Shows causation between two components, two actors, or a component and an actor.
- *Informational*: Shows information/decision flow between two actors or two components
- *Financial:* Shows flow of financial resources between two actors
- *Control:* Usually associated with relations among organizations/institutions, and between organizations and the physical domain. Can be advisory or hierarchical.
- *Mass Transfer:* Shows flow of materials between two components
- *Energy Transfer:* Shows flow of energy between two components"

Other additional links adopted by the author include:

- *Efficiency Transfer:* Shows the transfer of efficiency between one component and another resulting in a reduction of effort in the execution of a given task
- *Constitutive:* Shows the contribution of one component in the makeup of another

The links within the physical domain (Class 1) can be analyzed using engineering and micro-economics based methods and will often be quantifiable.

Class 2 links (projections) are less likely to be quantitatively analyzed since human agency and organizational and stakeholder's interests come into play as they attempt to induce changes in the physical domain. Nevertheless, quasi-experiments and use of proxies using micro-economic concepts can be useful in understanding and analyzing the links

Interactions within the institutional sphere (Class 3) require methods drawing upon theories of organizations, institutions, politics and policy. A typical analysis of class 3 links is as discussed in the previous Section covering stakeholders in the broadband CLIOS. All the links are outlined in tables 5.10-5.15.

Table 5.10: Link Descriptions for the Socio-economic Subsystem

FROM	TO	CHARACTERISTICS & MAGNITUDE	LINKAGE
Class 1 Links			
e-services and products	Civic stability	With reference to the national security subsystem, e-services and products can be used for problem identification and resolution to maintain civic stability (average)	Causal
e-services and products	Social service availability	e-service and products can facilitate the provision of social services such as government services online (average)	Causal
e-services and products	Production and process automation	ICT can be applied to a full range of human production activities, particularly within the services sector (average)	Effort transfer
e-services and products	Industry efficiency	Increased automation can cut down production time and costs increasing the efficiency of the industry (average)	Causal
e-services and products	Collaboration & knowledge sharing	The use of software such as social networking and web 2.0 sites allowing for user generated content, enables the sharing of knowledge and collaboration (average)	Efficiency transfer
e-services and products	Transaction and distribution cost	E-commerce applications can greatly reduce the cost of transactions. The ability to connect the consumer to the producer also reduces the distribution costs (average)	Financial
e-services and products	Employment opportunities	The production of e-services and products will offer employment to web designers and software engineers (average)	Causal
e-services and products	Market transparency	ICT enables information distribution that fosters market transparency and access to opportunities (average)	Causal
Civic stability	Social impact	Civic stability results in a positive social impact (average)	Causal
Social service availability	Social impact	Availability of social services will lead to a positive social impact (average)	Causal
Production and process automation	Jobs	When tasks previously done by humans are automated, such as typical clerical jobs, the result is loss of jobs (average)	Causal
Jobs	Social impact	Loss of jobs or unemployment will often result in a negative social impact (average)	Causal
Production and process automation	Industry efficiency	Increased automation can cut down production time and costs increasing the efficiency of the industry (average)	Causal

Collaboration and knowledge sharing	Product and process innovation	The more people collaborate and share knowledge the higher the possibility of discovering newer and better ways for production (strong)	Causal
Industry efficiency	Productivity	With increased industry efficiency, the quantity of goods produced per unit time will increase (average)	Causal
Product and process innovation	Productivity	Newer and better ways of production have the potential of increasing the amount of output per unit time (average)	Causal
Transaction and distribution costs	Productivity	Transactions done online and the lack of an intermediary makes the performance of economic activities more efficient hence increasing productivity (average)	Financial
Productivity	Economic activity	Productivity is the primary contributor to economic growth (strong)	Causal
Employment opportunities	Income	Employment is rewarded contractually by earning income	Financial
Market transparency	Market efficiency	Suppliers have better access to markets with lower barriers of entry and supply chains are better streamlined increasing in efficiency and subsequently reducing costs (average)	Informational
Market transparency	Visibility and communication of opportunities	With increased market transparency, consumers can communicate their needs more effectively to producers (average)	Causal
ICT manufacture and maintenance	Employment opportunities	Setting up of and ICT manufacturing industry will require manpower. Additionally the maintenance of ICT facilities in proper working order will also provide a means of employment (average)	Causal
Income	Economic activity	The more the income the population has, the more they will demand from industry and the more production will take place resulting in economic growth (average)	Causal
Market efficiency	Economic activity	Markets that are efficient have higher production (weak)	Causal
ICT Manufacture and maintenance	Economic activity	Transitively through investment and employment, the set up of ICT manufacturing industries will cause economic growth (average)	Causal
Class 2 Links (projections)			

FROM	TO	CHARACTERISTICS & MAGNITUDE	LINKAGE
Ministry of Higher Education, Science and Technology	Innovation policy	Product and process innovation policy will highlight the opportunities, address the threats and weaknesses and exploit the strengths in guiding the knowledge community to innovate (average)	Informational
Ministry of labor	Labor policy	Through the labor policy issues such as employment opportunities, the organizational workforce constituents to represent equal opportunity for all. It also covers the rights of employees and the minimum equitable wages to be earned (strong)	Control
Ministry of Trade	Local and foreign investment policy	The investment policy outlines the ratio of international to local ownership in investments done within the country. It shall also outline incentives for investment (strong)	Control
Ministry of Industrialization	Anti-trust and industry policy	This policy ensures fair competition within industries without barriers of entry. Most sectors will have their own industry and competition policy (average)	Control
Class 3 Links			
FROM	**TO**	**CHARACTERISTICS & MAGNITUDE**	**LINKAGE**
Ministry of Industrialization	Ministry of Trade	The ministry of trade needs to set up policies that will enable the survival of locally grown industries under the industrialization ministry (average)	Informational

Source: Author

Table 5.11: Link Descriptions for the Education Subsystem

FROM	TO	CHARACTERISTICS & MAGNITUDE	LINKAGE
Class 1 Links			
e-learning	Learning mechanism	e-learning is one of the mechanisms of learning for example through virtual classrooms and online material (average)	Constitutive
Research and development	Learning mechanism	Research and development dwells on discovery of new information that qualifies as learning (average)	Constitutive

Research and development	Local content, services and products	Research and development results in the innovation of products or services that are locally relevant (average)	Causal
Learning mechanism	Informal training	Some learning mechanisms, such as browsing online without any structured instruction are informal (weak)	Causal
Learning mechanism	Formal training	Structured learning mechanism with systematic instruction constitute formal training (average)	Causal
Basic education	Formal training	Individuals who have finished their high school can pursue formal training (strong)	Informational
Basic education	Informal training	Individuals who have finished their high school can pursue informal training (strong)	Informational
Institutional learning	Formal training	Learning within an institution is systematic and structured and will result in formal training (strong)	Causal
Certification & examinations	Formal training	Certification and examinations are a way of ascertaining the quality of education received after some form of training (strong)	Informational
Formal training	Research and development	Formal training which is systematic can make use of collaboration to increase in knowledge through research (average)	Causal
Formal training	Skills and literacy level	The more trained people there are, the higher the level of skills and literacy there will be in a population (average)	Causal
Informal training	Skills and literacy level	The more trained people there are, the higher the level of skills and literacy there will be in a population (average)	Causal
Population	Skills and literacy level	Population growth often exerts a negative force on training by injecting more untrained individuals of reducing the learned ones (average)	Causal
Skills and literacy level	Skilled labor	Individuals who have received special training will attain a particular skill that can be employed in production (strong)	Causal
Class 2 Links			
FROM	**TO**	**CHARACTERISTICS & MAGNITUDE**	**LINKAGE**
Ministry of Education	Education institution investment policy	This policy would govern the formation of different types of learning institutions (weak)	Informational

Ministry of Education	Digital education policy	This policy would specify the digital syllabus that will be taken as the minimum digital training in educational institutions (strong)	Causal
Ministry of Education	Certification policy	The policy of certification will govern how certification shall be conducted and set standards for training (strong)	Causal
Ministry of Higher Education, Science and Technology	Innovation policy	The innovation policy will highlight the opportunities, address the threats and weaknesses and exploit the strengths in guiding the knowledge community to innovate (average)	Causal
Class 3 Links			
FROM	**TO**	**CHARACTERISTICS & MAGNITUDE**	**LINKAGE**
Ministry of Education	Ministry of Higher Education, Science and Technology	The two institutions are complementary of one another. It is important that they work in collaboration as one generates input to the other (strong)	Informational

Source: Author

Table 5.12: Link Descriptions for the Labor and Manpower Subsystem

FROM	**TO**	**CHARACTERISTICS & MAGNITUDE**	**LINKAGE**
Class 1 Links			
Economic activity	Industry manpower demand	With increased economic growth, there will be more investment and set up of industries that will increase the demand for manpower (strong)	Causal
Industry manpower demand	Formal sector and Informal sector opportunities	The demand for manpower in the industry can be formal or informal depending on the type of occupation (average)	Causal
Formal and informal sector opportunities	Aggregate labor demand	The opportunities will represent the aggregate demand for labor within the economy (average)	Causal
Population	Skilled and unskilled labor	The populace of a given nation shall supply the individuals who will undergo skilled or unskilled training (average)	Causal

Skilled and unskilled labor	Aggregate labor supply	All the available labor, skilled and unskilled will make up the aggregate supply of labor (average)	Causal
Aggregate labor demand	Opportunity communication and placement	Industry will communicate the opportunities for employment using various media. After a recruitment process placement occurs (average)	Causal
Aggregate labor supply	Opportunity communication and placement	Individuals will look for opportunities to work on occupations of best fit. This may be facilitated through various means (average)	Causal
e-services and products	Opportunity communication and placement	E-services and products such as job advertisement sites can facilitate the process of matching labor to jobs (average)	Efficiency transfer
e-services and products	Execution of tasks	Several e-services such as e-commerce can assist in the execution of tasks (average)	Efficiency transfer
Opportunity communication and placement	Execution of tasks	This is the basic process of contracting and employment (average)	Causal
Class 2 Links			
FROM	**TO**	**CHARACTERISTICS & MAGNITUDE**	**LINKAGE**
Ministry of Trade	Local and foreign investment policy	The investment policy outlines the ratio of international to local ownership in investments done within the country. It shall also outline incentives for investment (strong)	Control
Ministry of labor	Labor policy	The labor policy covers among other things the organizational workforce constituents to represent equal opportunity for all. It also covers the rights of employees and the minimum equitable wages to be earned (strong)	Control
Class 3 Links			
FROM	**TO**	**CHARACTERISTICS & MAGNITUDE**	**LINKAGE**
Ministry of Trade	Ministry of labor	Ministry of trade needs to be cognizant of the quality of labor available so as to determine what kind of investment to encourage (weak)	Informational

Source: Author

Table 5.13: Link Descriptions for the National Security and Administration Subsystem

FROM	TO	CHARACTERISTICS & MAGNITUDE	LINKAGE
Class 1 Links			
Population	Problem occurrence	Social instability would occur within a given population	Causal
Problem occurrence	Problem identification mechanism	The mode of occurrence of a problem will determine the ease at which it can be identified (average)	Informational
e-services and products	Problem identification mechanism	The use of ICT facilities such as surveillance systems can facilitate problem identification (average)	Informational
Problem identification mechanism	Problem communication	The way in which a problem was identified will determine just how well it can be communicated to the decision makers (average)	Informational
e-services and products	Problem communication	e-services and products can be used to electronically relay the problem to the decision makers (average)	Informational
Broadband infrastructure	Problem communication	Broadband can be used to relay information between different places (average)	Informational
Problem communication	Problem resolution	The proper communication of the problem will then be followed by a choice of various resolutions (average)	Informational
Resolution mechanisms	Problem resolution	There are several options on how to resolve a given problem (strong)	Causal
Problem resolution	Civic stability	Resolving problems will result in civic stability (strong)	Causal
Civic stability	Appropriate investment climate	Civic stability will boost investor confidence causing them to invest more (average)	Informational
Appropriate investment climate	Economic activity	With more investment, more economic growth will be experienced (average)	Causal
Class 2 Links			
FROM	**TO**	**CHARACTERISTICS & MAGNITUDE**	**LINKAGE**
Ministry of Information and Communication	Freedom of information policy	This policy covers the extent of access and publicity of information held by the government (average)	Control

Ministry of state for provincial administration & internal security	National security policy	A national security policy will outline how security will be maintained including the mechanism and institutions that will be put in place (strong)	Control
Ministry of information and communication	Privacy policy	Privacy policy covers the extent of access government will have on personal information and property (average)	Control
Class 3 Links			
FROM	**TO**	**CHARACTERISTICS & MAGNITUDE**	**LINKAGE**
Ministry of Information and Communication	Ministry of state for provincial administration & internal security	The ministry of Information and Communication has a symbiotic relationship with the Ministry of State for Provincial Administration &Internal Security (Average)	Informational
Ministry of state for provincial administration & internal security	Ministry of Local Government	Ministry of Local Government is subordinate to the ministry of State for Provincial Administration &Internal Security (strong)	Control

Source: Author

Table 5.14: Link Descriptions for the Electricity Subsystem

FROM	**TO**	**CHARACTERISTICS & MAGNITUDE**	**LINKAGE**
Class 1 Links			
Hydroelectricity,	Total electricity produced	More hydroelectricity will be produced to increase the total production to cater for broadband expansion (average)	Causal
Geothermal electricity	Total electricity produced	More geothermal electricity will have to be produced to increase the total production to cater for broadband expansion (average)	Causal
Other renewable energy production	Total electricity produced	With broadband expansion to rural areas that may not be connected to the grid, a number of renewable energy sources will be tapped into (average)	Causal
Other non-renewable energy production	Total electricity produced	To cater for the demand for electricity, an increase in the use of non renewable sources is expected (average)	Causal
Total electricity produced	Transmission mechanism	An increase in the total electricity produced will require an improvement/expansion of the transmission system (average)	Causal

Total electricity produced	Capacity gap	The increase in the total electricity produced may cause an decrease in the current capacity gap (strong)	Causal
Transmission mechanism	Electricity distribution grid	Expansion of the transmission system will result in the need for more distribution services (average)	Causal
Electricity distribution grid	Broadband infrastructure	For broadband infrastructure to function, the electricity distribution should (strong)	Causal
Population distribution	Electricity distribution grid	The successful expansion of the grid depends on the spatial distribution of the population; remote areas may not be connected to the grid (average)	Causal
Population	Population distribution	The spatial distribution of the population is dependant on the size of the population (average)	Causal
Population	Residential electricity consumption	Residential electricity consumption is dependant on the size of the population; a large population results in high electricity consumption (strong)	Causal
Residential electricity consumption	Aggregate electricity demand	An increase in residential consumption results in an increase in the aggregate electricity supply (average)	Causal
Commercial and industrial electricity consumption	Aggregate electricity demand	An increase in commercial consumption results in an increase in the aggregate electricity supply (average)	Causal
Aggregate electricity demand	Capacity gap	The increase in the demand for electricity will result in the widening of the capacity gap (strong)	Causal
Economic activity	Commercial and industrial electricity consumption	An increase in economic growth will result in the overall electricity consumption of the commercial and industrial sector with increase production of goods and services (strong)	Causal
Economic activity	Electricity demand	An increase in economic growth will increase residential electricity consumption as a result of increased spending (average)	Causal
Class 2 Links			
FROM	**TO**	**CHARACTERISTICS & MAGNITUDE**	**LINKAGE**

Ministry of Energy	Energy policy	The energy policy outlines the various forms of energy sources, investment in energy sources and which resources will be exploited as well as issues of access (average)	Control

Source: Author

Table 5.15: Link Descriptions for the Broadband Subsystem

FROM	TO	CHARACTERISTICS & MAGNITUDE	LINKAGE
Class 1 Links			
Aggregate broadband demand	Connectivity Choice	Represents an economic decision based on the user's willingness and ability to pay for a given connection (strong)	Informational
Broadband Connected Terminals	Connectivity Choice	The type and number of terminals will often determine what type of connection is taken up (average)	Informational
Price of broadband connection	Aggregate Broadband Demand	The price at which broadband is offered will determine what the demand for it shall be (strong)	Causal
e-services and products	Aggregate Broadband Demand	Consumers will demand more broadband if they can perceive value offered through e-services and products	Causal
Accessibility	Price of broadband connection	The accessibility and availability of broadband will determine the price at which a connection shall be offered (average)	Causal
Accessibility	Connectivity Choice	The readily accessible broadband infrastructure will be the one chosen by a user (strong)	Informational
Broadband Infrastructure	Connectivity Choice	The availability of broadband infrastructure will present a choice on connectivity (weak)	Causal
Local Content, services and products	e-services & Products	More relevant local content will increase the amount of e-Services (weak)	Causal
e-Learning	e-services & Products	Availability of e-Learning will increase amount of e-Services (weak)	Causal
e-Commerce	e-services & Products	Availability of e-Commerce will increase amount of e-Services (average)	Causal
e-Health	e-services & Products	Availability of e-Health will increase amount of e-Services (weak)	Causal
e-Security	e-services & Products	Availability of e-Security will increase amount of e-Services (weak)	Causal

e-Government	e-Services & Products	Availability of e-Government will increase amount of e-Services (weak)	Causal
BPO	e-services & products	BPO is in itself an e-service. Consumers and organizations can outsource some processes to a third party (strong)	Efficiency transfer
Connectivity Choice	Wire-based Connection	Based on various factors a possible choice of connection may be wire based (average)	Informational
Connectivity Choice	Wireless-based Connection	Based on various factors a possible choice of connection may be wireless based (average)	Informational
Wire-based Connection	Accessibility	Availability of a wired connection determines accessibility (strong)	Causal
Wireless-based Connection	Accessibility	Availability of a wireless connection determines accessibility (strong)	Causal
ICT Manufacture & Maintenance	Broadband Infrastructure	The local industry and productive sector can provide infrastructure to deploy broadband (average)	Mass transfer
ICT Manufacture & Maintenance	Broadband Connected Terminals	Local industry can be engaged in the manufacture or assembly of terminals for the local market (average)	Mass transfer
ICT Equipment Imports	Broadband Connected Terminals	Terminals can be imported from other countries where they are manufactured (average)	Mass transfer
Productivity	Economic activity	Productivity is one of the factors contributing to economic growth, an increase in productivity in economic growth (strong)	Causal
e-services & products	productivity	With the availability of e-services and products, less labor is required in some labor intensive jobs thereby increasing productivity (strong)	Efficiency Transfer
Skilled labor	e-services and products	With e-services and products, more skilled labor is required, transferring traditionally non-skilled labor to fewer skilled labor (average)	Efficiency Transfer
Skilled labor	ICT manufacture and maintenance	With ICT manufacture and maintenance, more skilled labor is required transferring traditionally non-skilled labor to fewer skilled labor (average)	Efficiency Transfer
ICT manufacture and maintenance	Broadband connected terminals	The expansion of broadband connected terminals will be accelerated if products are manufactured and maintained internally(average)	Causal

Electricity distribution grid	Broadband infrastructure	The expansion of the broadband infrastructure is dependant on the availability of electricity and the expansion of the electricity grid (strong)	Causal
Research and development	Local content, products and services	The increase in R&D on a national level will give rise to more locally generated content, and increase products and services (average)	Causal
e-learning	Research and development	e-learning products will allow for collaboration with foreign and distant institutions in research and development (weak)	Causal
GPD per capita	Broadband connected terminals	The more personal income the individuals have, the greater the expansion of the connected terminals (average)	Causal
GPD per capita	Aggregate broadband demand	With the increase in personal income and spending, there will be a greater demand for broadband (average)	Causal
Economic activity	GDP per capita	A growth in the economy will result in an increase in the GDP and hence the GDP per capita (strong)	Causal
Macro economic factors	Economic activity	Economic decisions made on the national level will have an effect on the growth of the economy (strong)	Causal
Class 2 Links			
FROM	**TO**	**CHARACTERISTICS & MAGNITUDE**	**LINKAGE**
Ministry of Information and Communication	ICT sector investment and antitrust policy	The investment policy outlines the ratio of international to local ownership in investments done within the country. It shall also outline incentives for investment (strong)	Control
Communications Commission of Kenya	Tariff regulation policy	The tariff regulation policy will set a limit to the amount that can be charged on a broadband connection. It may also cover discriminatory pricing (strong)	Control
Ministry of Trade	Local and foreign investment policy	The investment policy outlines the ratio of international to local ownership in investments done within the country. It shall also outline incentives for investment (strong)	Control
Ministry of Finance	ICT equipment importation policy	This policy will cover what importation taxes will be charged and what specific equipment would qualify for what taxation rate or break (strong)	Control

Office of the President (Directorate on e-government)	e-government policy	The e-government policy will cover among other issues, data standards, equipment standards, and services to be offered (average)	Informational
Ministry of Information and Communication	BPO policy	The BPO policy will cover issues ranging from BPO investment to the conduction of BPO business in the country	Control
Class 3 Links			
FROM	**TO**	**CHARACTERISTICS & MAGNITUDE**	**LINKAGE**
Ministry of Information and Communication	Communications Commission of Kenya (CCK)	The government regulator CCK is a subsidiary of the Ministry of Information and Communication (strong)	Control
Ministry of Information and Communication	Ministry of Finance	These two ministries are complementary as the finance ministry determines the amount of funding that the information ministry shall be allocated	Informational
Ministry of Information and Communication	Ministry of Trade	The Ministry of Information and Communication needs to plead its cause to the Ministry of trade for inclusion of the various strategies to achieve investment into the sector	Informational

Source: Author

5.1.6 Step 5: Transition from Descriptive to Prescriptive Treatment of System

Based on the CLIOS representation, this step seeks deeper insights into the CLIOS System as a pre-amble to the design, evaluation and selection stage. We seek to gain a better understanding of the overall system behavior including both counterintuitive and emergent behavior. The CLIOS user guide (2009) highlights that focus needs to be given to "Class 1 links that have strong interactions within or between subsystems… chains of links with fast-moving, high-influence interactions… links that are strongly non-linear and/or irreversible in their impact… strong positive or negative feedback loops. Class 2 links or projections… that are influenced by many different organizations in the institutional sphere… organizations on the institutional sphere having an influence on many components within the physical domain, and finally, within the institutional sphere itself, class 3 links… in organizations characterized by conflict or cooperation." (p. 29). The following can be taken as preliminary findings of the analysis.

5.1.6.1 Physical Domain Class 1 Links

i. *Link between aggregate broadband demand and connectivity choice:* These two components have a strong interaction that needs to be considered whenever one is designing or deploying broadband infrastructure. The type of demand for the broadband service should drive the mode of infrastructure deployed.

   A primary distinction that needs to be made is between **commercial and residential broadband demand**. In as much as the intention of deploying broadband is for economically relevant use, the Internet brings with it many other ills such as pornography that may even turn out to be economically harmful. When thinking about broadband deployment therefore, it may be useful to give priority to commercial demand with economic relevance over individual demand. As a policy maker, one may offer incentives for commercial broadband connections or develop policies aimed at Internet content, although this may touch on issues of freedom of information.

ii. *Link between price of broadband connection and aggregate broadband demand:* Price is a good instrument for determining and controlling demand. As mentioned above, this may be used in encouraging certain broadband use over others. Nevertheless, in this case, price needs to be properly considered when pursuing a policy of **universal access**. Many members of rural communities may consider a broadband connection a luxury. An improper pricing of the service over economic benefits derived from it will see many projects, such as e-government projects fail.

iii. *Link between accessibility and connectivity choice:* As mentioned earlier, the topography is one of the factors considered under the technical feasibility of broadband deployment. The accessibility of a given place will often determine the type of broadband technology to be deployed, be it wired or wireless.

iv. *Link between wire-based connection and accessibility:* Wired connections generally have greater bandwidth capacities for both upload and download. Pre-broadband accessibility is necessary in establishing the design and type of broadband technology to deploy, post broadband accessibility would refer to the upload and download capacities the given technology affords the community.

v. *Link between wireless-based connection and accessibility:* A good quality of wireless based connections is that it is easier and may be cheaper to deploy compared to wired solutions. Wireless connections therefore can be a very useful form of accessibility for remote as well as individual broadband customers.

vi. *Link between e-services & products and productivity*: As earlier mentioned in the Chapter 2 covering ICT for development, e-services and products are the content delivered by broadband that shall result in collaboration, knowledge sharing, reducing transaction costs, etc.

vii. *Link between e-services and products and aggregate broadband demand:* There will be more demand for broadband among consumers if there is a perceived benefit from its use. Focus therefore needs to be made to produce as much locally relevant e-services and products to increase broadband demand.

viii. *Link between electricity and broadband infrastructure:* More production and distribution of electricity will foster broadband deployment. This would affect a policy on universal access.

ix. *Link between e-services and products and collaboration and knowledge sharing:* In the establishment of a knowledge economy, particular importance should be given to collaboration and knowledge sharing.

x. *Link between e-services and products and transaction and distribution costs:* Proceeding from collaboration, another major contributor to economic growth is the reduction of transaction and distribution costs.

xi. *Link between institutional learning and formal learning:* Although this is exclusively a matter that needs to be handled within the educational subsystem, the need for skilled labor to support the broadband industry needs to be reflected within local educational institutions.

xii. *Link between formal learning and research and development:* Since innovation is the product of research and development, formal systematic training and the set up of research institutes needs to be encouraged. Together with institutional learning, there is a positively reinforcing loop between the institutions and eventual innovation. A good way of achieving positive results regarding research and formal training is the set up of science parks. The science parks need to provide enough incentive to attract even the professionals within the diaspora to contribute to local innovation.

xiii. *Link between basic education and formal and informal training:* Not only is K-12 the basic source of the individuals who will undertake the formal training, if structured adequately, K-12 education needs to educate the populace on the basic use of broadband and broadband applications so that they can eventually add to the aggregate demand for the service.

xiv. *Link between economic activity and industry and manpower demand:* The only way to get more jobs within the country will be through economic growth. There is a strong relationship between industry growth and employment opportunities. The question of economic growth is wide, but this thesis touches on economic growth as a result of broadband deployment.

xv. *Link between problem communication and problem resolution:* There is basically no way a problem can be resolved if it is not known or properly communicated. One major goal for national security should be the set up of several command centers that can be used to receive and communicate information. This would involve thorough training of the organizations charged with national security duties.

xvi. *Link between civic stability and appropriate investment climate:* Investors will only be confident to lay down their investments if there is adequate security. This is a critical condition not only for the broadband sector but all other economic sectors. The civic unrest experienced in Kenya during the last general elections needs to be something that should not happen if the country seeks to create an appropriate investment climate both foreign and local.

xvii. *Link between population and residential electricity consumption:* Although population related policies are very sensitive, there needs to be good policies relating to urban planning. This is one of the ways through with electricity distribution could at least have the reach of many individuals.

xviii. *Link between economic activity and industrial and commercial electricity consumption:* The availability and cost of electricity will drive industrial establishment and industrial establishment will in turn drive the demand for electricity. Nevertheless the bigger question is whether the supply can expand to cover any surplus demand generated by economic growth.

xix. We observe a positive reinforcing feedback loop around three major components that drive each other in the broadband CLIOS System: broadband infrastructure, e-services & products and, aggregate broadband demand.

xx. On the socio-economic plane, there are one time benefits, such as those achieved when an organization invests in automation, and there are those benefits that continue to accrue benefits over time based on the use of broadband. These longer lasting benefits are represented as strong component relationships and are highlighted below:

5.1.6.2 Class 2 Links

Among the class 2 links are freedom of information policy and privacy policy that are concurrently determined by two institutions, the national security ministry and the ministry of information and communication. Ideally the ministry of national security should take the lead in the drafting of these policies. Investment policy is affected both by the ministry of trade and the ministry of information and communication.

The above situations represent possible areas of contention where either a joint taskforce needs to draft the policies or having a participatory policy making process that takes input from the parties involved.

Further, it is noted that the Ministry of Information and Communication is the organization having a lot of influence within the physical domain. This was also established in the stakeholder analysis where the ministry of information and communication was discovered to be a definitive stakeholder with reference to broadband deployment.

5.1.6.3 Class 3 Links

A high-influence organization within the institutional sphere is the Ministry of Finance. They are an organization of critical importance to the broadband subsystem because they will be involved in the government investment into broadband, they are also in charge of the appropriate taxation to be charged on the sale of services and ICT equipment.

An important class 3 link that can be picked out is the relationship between equipment importation and investment in ICT manufacturing facilities. It seems that the lower the barriers of importation are set, the more ICT products will be imported rather than a local investment in the manufacture or assembly of ICT equipment. This brings up the question of import substitution versus free markets, an issue that has been contentious most especially in the World Trade Organization deliberations.

5.2 Stage 2: Design, Evaluation, and Selection

5.2.1 Step 6: Refine CLIOS System Goals and Identify Performance Measures

The preliminary system goals checklist in Stage 1 of the CLIOS Process states that the primary goal of the system was one of sustained GDP growth through increased investment and productivity. Additionally there were goals focused on social benefits, specifically the reduction of poverty. Some of the refined goals are shown in table 5.16.

Table 5.16: Refined Goals on Class 1 Links

Overarching focus	Refined System Goals	Performance Measures
Broadband Use and Consumption	• Increased aggregate broadband demand	• Number of broadband subscribers nationally • Number of ICT terminals imported • Number of ICT terminals in use • Reasonable broadband price • Amount of internet traffic • Number of ICT professionals • Number of ICT graduates
Broadband Infrastructure Deployment	• Increased connectivity and accessibility	• Points of internet presence nationally • Area of coverage of wireless based broadband connectivity • Length of cable (wire based connections) deployed • Amount of investment in broadband
Broadband Products and Services	• Increased local e-services and products	• Number of local applications produced • Number of local ICT based companies • Number of research and development institutions
Innovation	• Improved quality of innovations • Quality of education • Quality of research institutions • Technical and advanced capabilities	• Number of innovations produced annually • Number of professional awards won • Ranking of local research institutions
Labor	• Better employment opportunities • Ease of entry of women into the ICT sector • labor force diversity • Job satisfaction	• Level of unemployment locally • Number of women professionals in the ICT sector • Number of women in high paying ICT jobs • Average level of pay for ICT jobs
Local and Foreign Investment	• Ease of entry and investment into the ICT	• Number of ICT related companies quoted in the stock exchange

	sector • Investor confidence in the local labor force	• Number of ICT companies incorporated • Number of locally trained professionals in organizations •
Antitrust	• Ease of entry into the market • Market structure and diversity • Platform diversity and differentiation •	• Number and diversity of licenses issued by the regulator • Number of ICT companies •
Education Institution Investment	• Diversity of educational institutions set up • Ease of investment in educational institutions	• Number of educational institutions set up
Digital Education	• Quality and level of computer literacy locally	• Student performance in examinations
Certification	• Quality of certification • Internationally competitive standards and certification recognition	• Number of ICT professionals • Level and remuneration of ICT certified professionals within organizations •
Freedom of Information P	• Increased freedom of information locally • Increased information security	• Number of local media companies
National Security	• Better incidence response • Faster problem communication	• Number of social unrest incidents • Number of communication centers
Privacy	• Increased respect for privacy	• Number of warrants issued • Number of privacy breach complaints
Electricity (Energy)	• Increased diversity in energy sources • Better quality of energy • Affordability of energy	• Number of outages • Number or percentage of population receiving electricity
Tariff Regulation	• Acceptability of	• Number of investors

	established tariffs	• Number of subscribers
E-government	• Ease of use of e-government applications • Efficiency of government services •	• Number of e-government applications produced
BPO	• Increased attractiveness of the country as a BPO destination • Ease of BPO organization set up	• Number of BPO jobs acquired • Number of BPO companies set up
Equipment Importation	• Ease of equipment importation	• Number of ICT equipment imported

Source: Author

Drawing from the analysis done thus far, we noted that class 1 links can be quantitatively analyzed, whereas class 2 and 3 links are more qualitative. The overarching class 2 links refined goal is the set up of appropriate frameworks and institutional structures to bolster the broadband subsystem. The refined goals of class 2 links will be more qualitative in nature; nevertheless, one can make use of quantitative proxies to determine the level of success relating to the class 2 links. Finally, the class 3 links analysis can be drawn from the stakeholder analysis and the primary goal would be to have a participatory relationship whenever policies or regulations affecting the broadband system are made.

5.2.2 Step 7: Identify and Design Strategic Alternatives for CLIOS System Improvement

In step 7, the focus shifts to how the CLIOS system can be improved through strategic alternatives. The strategic alternatives can take 3 forms as highlighted by Sussman (2009); "Thinking about nested complexity, we can characterize strategic alternatives as:

- **physical** changes involving direct modification of components in the physical domain
- **policy-driven** changes involving the policy lever projections from the institutional sphere on the physical domain and,
- **actor-based** – architectural changes of the institutional sphere either within actors or between actors"

Some of the strategic alternatives can be seen in table 5.17.

Table 5.17: Strategic Alternatives

Refined System Goal	Strategic Alternatives
Increased aggregate broadband demand	• Encourage shared terminals through community telecenters and/or cyber cafes • Reduced taxes on terminals • Encourage the use of cheaper terminals such as netbooks • Obtain cheaper, used terminals through donations • Bundle terminals to the sale of a broadband connection • Use of participatory applications such as web 2.0 • Provision of more services online through cloud computing • Price regulation • Time based or bandwidth based billing • Community taxation and set up of telecenters • Discriminatory pricing based on the potential use of the connection, e.g., cheaper prices to educational institutions
Increased connectivity and accessibility	• Phased deployment of expensive wired connections • Careful consideration of pilot programs • Priority to areas exhibiting high broadband demand • Partnership with international equipment manufacturing firms • Set up of engineering schools
Increased local e-services and products	• Ensure that local content services are demand driven • Focus on local knowledge dissemination • Modeling ICT to currently existing information flows and systems • Science parks and local research and development institutions • Professional diaspora inclusion and technology transfer
Innovation	• Provide funding to Colleges and Universities that invest in needed research infrastructure • Enforcement of IP laws and copyrights to encourage local knowledge consolidators such as universities to share their material • Research and higher institution partnerships and exchange programs • Government funded scholarships to reputable international institutions • Set up of think tanks and ICT parks
labor	• Incorporate gender awareness in policies • Enforcing a minimum wage on ICT related jobs
Local and Foreign Investment	• Provide a tax credit for investments in IT • Encouraging foreign partnerships or joint ventures

	• Encouraging access to credit • Government loans and investment funds to local entrepreneurs
Competition and Industry	• Open access policies on broadband vendors • Maintenance of market forces to determine market structure
Education Institution Investment	• Tax incentives on educational institutions • Institutional funding
Digital Education	• Software vendor partnerships • Institutional funding to enhance proper training
Certification	• International accreditation of certifications • Insistence on standards in service and product production
Freedom of Information	• Proper privacy policy • Stringent breach cost or punishment
National Security	• Standard introduction to public security services • Awards and funding benefits
Privacy	• Stringent breach cost and punishment
Electricity (Energy)	• Encourage renewable and localized energy production
Tariff Regulation	• Bandwidth or time based billing • Supplier and consumer consensus
E-government	• Complete availability of services online
BPO	• Encouraging local outsourcing
Equipment Importation	• Allowing IT investments to be completely expensed

Source: Author

The conclusions drawn from the stakeholder analysis in section 4.4.3 of Chapter 4 can be considered as actor-based architectural changes in the institutional sphere. Additionally, the following are some strategic alternatives that can be applied to have more cohesive and participatory interaction among the broadband stakeholders:

i. Conduct workshops and training with key gatekeepers and stakeholders
ii. Cultivate ICT champions who combine some level of technological expertise with an enthusiastic understanding of what technology can do for the targeted stakeholders
iii. Ground ICT initiatives in a good understanding of the local political and cultural contexts so as not to have ICT initiatives perceived as a threat to certain members of the polity or community, especially existing power brokers
iv. Encourage broad-spectrum participation in the planning of ICT initiatives
v. Empower and recognize a single representative intermediary organization per stakeholder type that can serve as the important bridge to that stakeholder group

5.2.3 Step 8: Flag Important Areas of Uncertainty

Step 8 highlights the areas of uncertainty relating to the achievement of the CLIOS System goals. Particular uncertainties relate to the common drivers since they are chiefly controlled or determined and affected by other subsystems. These include:

i. *National security* – without civic stability and a good investor climate, investment in broadband is bound to suffer.
ii. *Education and R&D* – If there is insufficient education on broadband, broadband projects would fail or would simply not be taken up
iii. *Skilled manpower* – without skilled manpower, broadband systems may not be put into efficient use of be maintained to gain maximum benefit
iv. *Broadband infrastructure* – the success of investment and deployment design of broadband infrastructure will determine the success of the entire broadband subsystem
v. *ICT manufacture and maintenance* – Proper maintenance of broadband systems is necessary for the success of the subsystems
vi. *Electricity* – without certainty of electricity availability, the success of broadband deployment and use will be curtailed
vii. *Economic growth* – economic growth is an important determinant in broadband demand. Without overall economic development nationally, the growth of the broadband sector shall be stunted
viii. *Macroeconomic factors* – other external macroeconomic factors such as the current global recession need to be considered as they are bound to affect the success of the broadband subsystem
ix. *e-services and products* – without the production of relevant local e-services and products, the demand of broadband services and the growth of the local ICT industry will be stunted

Other areas of uncertainty based on the identification of causal loops and strong links include:

x. *Getting private investors into the sector - Attracting* investment into the sector is primarily driven by promise for a high return on investment. An area of uncertainty would arise when a tariff regulation policy places prices so low to allow for universal access such that investing in broadband will not reap a good return on investment to the investors

xi. *Growing the national ICT manufacture industry* – and doing so without disrupting the quality and quantity of terminal supply, by protectionist policies and high tariffs on imported terminals.

xii. *Achieving universal access* - Encouraging service provision and connectivity for universal access to spur socio-economic growth contrary to the market forces of demand and supply

xiii. *Growth of a knowledge based economy* almost from scratch in a society that was not initially knowledge based

xiv. Institutional sphere *responses of stakeholders* whose personal interests will be curtailed with the pursuit of certain policies

5.2.4 Step 9: Evaluate Strategic Alternatives and Bundles

At this stage all the strategic alternatives are examined based on their impact to the CLIOS System. Several methods of analysis can be used including system dynamics modeling, social network analysis, agent based modeling, flow network analysis, statistical and economic analysis methodologies or operations research methods.

The scope of this thesis however confines itself to a basic qualitative tradeoff analysis that looks at the potential performance measures, response times, costs and benefits of some of the strategies proposed in prior stages. These are shown in the table 5.18

Table 5.18: Preliminary trade off analysis

Physical Domain	Strategies	Performance Measure	Response Time	Costs	Benefits
Broadband Use and Consumption Increased aggregate broadband demand	• Community telecenters	• Number of users per given time period	• Actual time to set up the telecenters • Campaign to notify the public about the telecenters and actual use	• Telecenter hosting costs • Terminal and networking costs • Maintenance and running costs of the telecenters	• Broadband access to non-terminal owners • Only single point connection required
	• Reduced taxes on terminals	• Number of terminals purchased per given period	• Procurement cycle	• Loss government revenue • Terminal cost	• Added availability of cheaper terminals
	• Encourage the use of cheaper terminals such as netbooks	• Number of netbooks purchased	• Procurement cycle	• Terminal cost	• Added availability of cheaper terminals
	• Obtain cheaper, used terminals through donations	• Number of computers donated	• Donor dependant	• Shipping and installation • Potentially obsolete machines donated	• Free or almost free terminals
	• Bundle terminals to the sale of a broadband connection	• Number of connection and terminal sale in a given period	• Procurement cycle • Connection set up time	• Infrastructure set up • Terminal cost	• Plug and play solution to consumers
	• Use of participatory applications such as web 2.0	• Number of web 2.0 sites • Relevance of user contribution to economic development	• Site development time	• Site development • Site maintenance • Site hosting • Large amounts of data • Data mining	• Generation of relevant local content • User contribution and participation

	• Provision of more services online through cloud computing	• Number and capacity of data centers set up • Number of applications offered in the cloud	• Data center set up time • Application procurement and/or development time	• Data center hosting costs • Servers and networking costs • Maintenance and running costs of the data centers	• Support of cheaper terminals such as netbooks • Better application costing mechanisms (rent)
	• Price regulation	• Number of subscriptions vs. price	• Appropriate price allocation and communication to providers	• Under pricing may cause a fall out among the suppliers • Over pricing may cause a fall out with the consumers	• Lack of monopolistic tendencies and price hiking by suppliers • Assured minimum revenue to supplier investment
	• Discriminatory pricing based on the potential use of the connection, e.g., cheaper prices to educational institutions	• Number and type of institutions receiving broadband credit	• Formulation, justification and negotiation of a discriminatory price	• Lost revenue as a result of price discrimination	• Targeted incentives to economically relevant use of broadband
Broadband Infrastructure Deployment Increased connectivity and accessibility	• Phased deployment of expensive wired connections	• Length of cable deployed • Usage intensity to infrastructure deployed	• Dependant on how long the phases will last	• Actual infrastructure cost • Lack of instantaneous universal access	• Better and more certain deployment of infrastructure
	• Careful consideration of pilot programs	• Pilot success or failure • Usage details of pilot program	• Identification and planning of the pilot program	• Pilot set up costs • Opportunity cost of non pilot areas momentary omission	• Learning experience of the challenges in deployment • Ease of successive deployments
	• Priority to areas exhibiting high broadband demand (such as BPO business parks)	• Bandwidth and data volumes • Economic relevance of broadband demanding service	• Proper identification of broadband high priority areas	• Actual infrastructure set up cost	• Instantaneous realization of economic benefits

	• Partnership with international equipment manufacturing firms	• Number of international company partnerships • Number of machines locally manufactured or assembled	• Negotiation time • Factory set up	• Factory set up costs • Set up of related industry infrastructure for the manufacturing supply chain	• Employment • Availability of more terminals in the market • Increased potential for learning and innovation
	• Set up of engineering schools	• Number of schools set up • Number of graduates	• Identification and set up of the institutions	• Institution set up costs • Teaching and running costs	• Skilled labor • Innovation
Broadband Products and Services Increased local e-services and products	• Ensure that local content services are demand driven	• Number of users per application	• Amount of time it would take for an application to go viral	• Application development costs	• Employment of local software engineers • Other ICT related benefits
	• Focus on local knowledge dissemination	• Number of local knowledge based services	• Obtaining, digitizing and presenting local knowledge	• Data collection costs • Data cleansing and digitization costs	• Inceptions of a knowledge economy • Better understanding of local needs and innovation potential
	• Science parks and local research and development institutions	• Number of science parks/science park participants • Number of research institutions	• Funding and set up time of the parks and institutions	• Construction costs • Funding costs	• Innovation
	• Professional diaspora inclusion and technology transfer	• Number of diaspora individuals engaged	• Communication and persuasion time	• Communication costs	• Technology transfer • Innovation

Source: Author

5.3 Phase 3: Implementation

CLIOS stage 3 covers steps 10 through to 12 which are design and implementation plan for the physical domain/subsystems, design and implementation plan for the institutional sphere and evaluation monitoring and adoption of strategic alternatives respectively.

After stage 9 of the CLIOS Process one can draw appropriate recommendations to be implemented in the CLIOS System. The first nine stages fulfill the analytical objective of this thesis. The implementation phases cover a more project management approach. It would be worth noting however that based on the CLIOS Process, policymakers and decision makers need to be aware of the highlighted uncertainties and incorporate contingency plans on the strategic alternatives, as well as develop a mutually supportive implementation plan including both the physical and institutional spheres.

As a preliminary step too the broadband CLIOS analysis, an understanding of the stakeholders would be useful in defining the scope of the analysis. The following section is a stakeholder analysis.

CHAPTER 6: CONCLUSION

An important step in the policy making process is framing the policy problem. Proper framing of a policy problem elucidates the issues, the challenges and the opportunities for resolving the policy problem. It is the hope of the author that this thesis has effectively framed the policy question surrounding the deployment of broadband for economic development.

The primary conclusion of this thesis is that the deployment of broadband for economic development in Kenya is indeed a CLIOS System type problem that was adequately framed and analyzed using the Massachusetts Institute of Technology (MIT)-developed CLIOS Process, a product of Sussman et al. The deployment of broadband not only involves making technological decisions but it also includes a berth of policy and institutional decisions for the deployment to achieve its goal of economic development.

It is the hope of the author that this thesis can be useful to policymakers, investors, researchers and members of the academia. Particularly, it is the hoped that the thesis will assist:

i. *Policy makers* – to gain a deeper understanding of the complexity of the broadband deployment question, recognizing the policy levers they can utilize to affect the broadband CLIOS System. It also gives them a better holistic view of the broadband CLIOS System which is a good basis for policy discussions on the subsector with stakeholders, having a complete picture of how the sector can affect or be affected by different elements.

ii. *Policy analysts* – to create a basis for effective modeling that will capture the broadband deployment question. Policy analysts would involve themselves in finding out how different policy alternatives will affect a given policy space. The broadband CLIOS System analysis in this thesis should offer policy analysts a holistic representation of most (if not all) of the different components and links within the broadband CLIOS System and how each of them will affect of be affected by a change in another.

iii. *Researchers and academia* – as a foundational tool in understanding the broadband sector for economic development question. Researchers and academia in agreement with the CLIOS model of the broadband subsector can then use it as a basis for further analysis (quantitative and qualitative) in attempting to gain a deeper understanding of the effects of various facets of broadband deployment for economic development especially in emerging economies such as Kenya.

iv. *Investors* - to understand the dynamics of the broadband CLIOS System enabling them to make strategic business decisions in the provision of broadband products and services

v. *Stakeholders* – to give them a holistic understanding of the broadband CLIOS System, giving them and understanding of the scope of the deployment which would go beyond their own advocacy and representative aspect. This would lead them to understand their level of influence and where within the system their representation falls with respect to the entire system.

6. 1 Findings

With reference to the preliminary finding outline in Step 5 of the CLIOS Process covered in Section 5.1.6 other supplementary findings discovered after using the CLIOS Process are:

i. We observe a positive reinforcing feedback loop around three major components that drive each other in the broadband CLIOS System: broadband infrastructure, e-services & products and, aggregate broadband demand. It is not entirely certain where the appropriate point of entry or intervention into the entire broadband subsystem would be, but as a policy maker intending to utilize broadband for economic development, but it is the thought of the author that the best would be through broadband infrastructure deployed in phases. One can begin with deploying a first phase of broadband connection, targeting areas of higher population density with potentially higher economically relevant use of broadband, such as the central business districts. Once the infrastructure is in place, have it properly priced, such that content and application providers can utilize it and put relevant content that will then drive demand for broadband. This demand will guide the deployment of later phases of the infrastructure.

The CLIOS Process can be utilized by both the government and the private sector to recognize points of intervention. The government should for instance invest in deploying broadband infrastructure to start off the reinforcing loop. The government can then strive to have most of their services available via broadband, driving up the demand for a broadband connection. Policies that will drive e-services and reduce price will increase the aggregate demand for broadband, which will lead to an economic decision on the connectivity mode which should guide the deployment of the infrastructure.

Within this cycle, the most irreversible of the links seems to be broadband investment in wire-based connections because this has a higher level of permanence. The laying of a wired connection should be well justified with the potential of having proportional economic returns. The only negative feedback loop is between price and aggregate

demand. Price happens to be the primary source for broadband investors to receive a return on investment, and concurrently it seems to be a key driver of broadband demand.

ii. In the establishment of a knowledge economy, particular importance should be given to collaboration and knowledge sharing. This is a primary means by which development can be achieved. One of the currently popular means of collaboration and knowledge sharing is through **web 2.0.**

The current trend in internet development termed as Web 2.0 (exemplified by applications such as facebook, myspace, etc) has been referred to as the **"Architecture of participation"**. It encourages users to add value to any given internet application as they use it.

This stands in contrast to very old traditional websites, the sort which limited visitors to viewing and whose content only the site's owner could modify. The concept of Web-as-participation platform can be juxtaposed against development concepts such as "grass roots" and bottom up approaches to development exemplifying participation. The primary phenomenon of user generated content and participation within Web 2.0's can then be viewed as a basic foundation to development campaigns under circumstances that previously did not consider user input by addressing the following key issues:

- **Transparency:** many innovative opportunities are often not recognized because the individuals with the requisite knowledge and/or capacity cannot spot them; this has been accentuated through the use of legacy and more classical formal communication channels; small successful innovations lack scalability as they lack adequate publicity for replication; and many social and village entrepreneurs often lack the appropriate solutions or appropriate areas (markets) to deploy and apply development solutions.
- **Communication:** the lack of communication prevents members of the international development community and other willing participants from learning from each other's experiences, and the communities in need from expressing their problems. The diffusion of research findings that would increase efficiency as well as the availability of other information and knowledge both tacit and codified has not been taken advantage of because of poor communication. This may primarily be a problem of poor information management.
- **Collaboration:** the lack of collaboration prevents individuals and groups with similar goals from working together to achieve better refined solutions and results. The phenomenon of crowd-sourcing and the increased push towards open source and open innovation have been based on the realization of the added value collaboration has in the development of better solutions and products.

iii. Proceeding from collaboration, another major contributor to economic growth is the reduction of transaction and distribution costs. Not only will these benefits be achieved by the initial automation of classical financial methods, but additionally through another current Internet development termed **cloud computing**.

Gatner Research Consultants characterized cloud computing as computing that is service-based; scalable and elastic; it makes use of shared infrastructure; it is metered and users pay according to usage and it utilizes internet technologies.

Cloud computing transfers most of the processing requirements to a centralized server and is a less expensive application and software distribution scheme. The end user terminals therefore need not be high end. Netbooks, which are a rapidly evolving inexpensive form of laptop computers can be utilized to primarily accesses web-based applications. This goes back to the broadband subsystem broadband terminal equipment.

Web 2.0 and cloud computing are some specific strategies that the government can make use of to effectively execute a broadband for economic development campaign. They may do this by encouraging policies that would ensure e-government services take advantage of these new Internet developments and also establishing data centers to maintain the cloud applications.

iv. Although this is exclusively a matter that needs to be handled within the educational subsystem, the need for skilled labor to support the broadband industry needs to be reflected within local educational institutions. Policies establishing institutions focusing on broadband need to be encouraged. The move by the Kenya government to establish a multimedia university reiterates this link.

Basic education needs to educate the populace on the basic use of broadband and broadband applications so that they can eventually add to the aggregate demand for the service. Including computer related courses as compulsory within the education syllabus will ensure that the general population that gets educated will not only be literate in the literal sense but will also be digitally/computer literate. This can be done through the a digital education policy.

6. 2 Effectiveness of the CLIOS Process

The CLIOS Process has proven to be an exemplary analytical tool for e-strategy development and analysis. Based on the Effective Policy Making discussion in Section 2.5 of this thesis, the CLIOS Process has properly executed key steps in the policy making process.

In Step I of the CLIOS Process, a checklist covering various facets of the broadband deployment question were done. Some data was collected from interview respondents and more was collected from relevant documents that covered the question of broadband deployment in Kenya. Although the information collected was sufficient to undertake a the broadband CLIOS System representation, a more in depth e-readiness assessment covering measures on computer literacy, number of computers, etc. would have offered a good basis for eventual policy proposals.

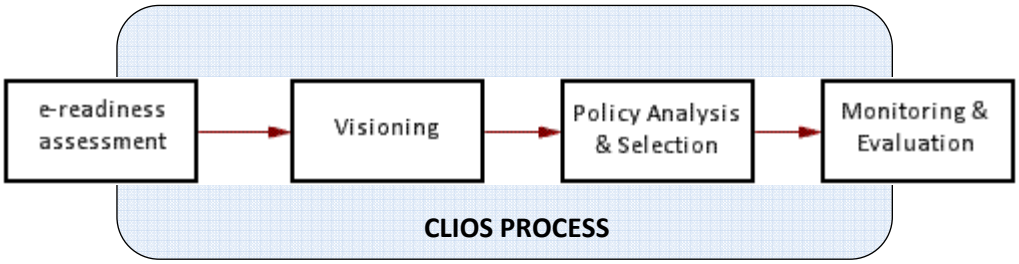


Figure 6.1: A CLIOS Process Supported Policy Making Process
Source: Author

In Step I, the CLIOS Process outlined the overall vision of the system and Step 6 refined this vision even further presenting specific measurable goals. Although the process of visioning is ideally external to the entire CLIOS Process, as the goals need to be set by the particular leaders considering policy proposals, the CLIOS Process added a realistic element to the visioning process that supplemented an e-readiness analysis by explaining how complex or interrelated a given vision or goal of the system will be and highlighted paths to how that vision can be achieved.

The CLIOS Process proved to be an exemplary tool for policy analysis and selection. It presented policy questions with the entirety of the physical and institutional domains. Added to this, it showed the linkages within the components within and among the subsystems, highlighting common drivers and even outlining areas of uncertainty.

Because the thesis did not touch on Phase III of the CLIOS Process covering implementation and evaluation, the author can only state that the CLIOS Process gave good insights into monitoring and evaluation, offering measurable goals tied to the ultimate system objective.

The CLIOS Process therefore effectively did the following:

i. The accuracy of the CLIOS Process representation notation offered clarity in understanding exactly how different components in the broadband subsystem are affected and affect each other. This is important for decision making and can be useful for decision makers and other researchers who would need to have a better understanding of the system interactions. The division of the physical domain and the institutional sphere gave clarity on institutional intervention on the physical domain. In addition, this representation showed the true flexibility of institutions in taking up different multi-sectoral and interdisciplinary roles to determine just how a physical domain should operate. The simple three dimensional representation of the institutional sphere solved this representation problem

ii. The CLIOS Process included a representation of the institutional sphere and a proper understanding of its influence on the physical domain subsystems. The CLIOS Process outlines policy levers as instruments that can be used for system determination giving the policy maker a bigger and better understanding of the repercussions and interactions of a given policy proposal

iii. The CLIOS Process offered a structured way of approaching the problem of understanding the complex broadband systems physical and institutional aspects with a simple and understandable visualization of the system. It gives you a single glance comprehension of the system components and relationships that can be useful when speaking about the system or considering policy affecting the system.

iv. The CLIOS Process allowed the incorporation of economic, social and political issues with an understanding of how they interact. This was useful in understanding a complex system with a variety of interacting goals.

The following challenges were experienced while using the CLIOS Process to analyze the broadband CLIOS System:

i. Although the information collected in Step 1of the CLIOS Process was sufficient to undertake a proper representation of the broadband CLIOS, the lack of an e-readiness analysis made it difficult for the CLIOS Process to propose any specific strategy for application. It is imperative that the strategic alternatives be realistic with a basis on achievable objectives based on what can be seen within the particular place the policy analysis will take place.

ii. The vastness of the virtual world as opposed to the real world presented infinite possibilities of information representation, based on the intangibility, volatility, versatility and dynamic attributes of information. This has the potential of stretching the CLIOS

process representation to too many components. The analysis within this thesis therefore only focused on some critical and beneficial uses of information that were highlighted in the previous chapters that analyzed use of information systems for development to specify the analysis system boundaries

6.3 Recommendations

The analysis has presented recommendations for touching on the different kind of links and the physical and institutional sphere. We can summarize them as follows:

i. Policy makers can make use of the CLIOS Process analysis in this thesis to develop a multifaceted e-Strategy for the deployment of broadband, considering all socio-technical aspects of the system with realistic achievable goals.

ii. The government and investors need to match technology to the context of what is needed so as to avoid over-spending on infrastructure. A phased approach in deploying universal access programs needs to be considered. This will lower the initial prices of broadband offering for ready uptake.

iii. Proposed policies need to stay within system boundaries. This offers a better understanding of their effects and repercussions, as well as understanding the challenges and limitations to be experienced.

iv. Policies and policy formulation needs to be attached with grand system goals. The policies proposed need to have the ability of tracing their effects within the broadband CLIOS System with the eventual effect of having the CLIOS System achieve its goals.

v. Policymakers need to be transparent and present clarity of intent. This is particularly important if they wish policies to have their intended effect on stakeholders because the attachment of policies to grand system goals offers predictability. Investors and players within the sector will therefore have more confidence to operate within the sector.

vi. Political process reforms are needed to include the voice and/or vote of different stakeholders. Apart from transparency the policy making process needs to have broad-spectrum participation.

vii. The disorder among the stakeholders with duplication of effort and activities needs to be rectified through insistence on clarity of mandate and recognition only of registered associations and societies as having voice. Nevertheless, this is not supposed to be an

exercise of locking out stakeholders, but an encouragement to make them more representative of their stakeholder group and purge private interests.

viii. Clarity and proper selection of performance measures needs to be done. Focus on simply deploying technology for the sake of technology needs to be avoided, and the deployment of those technologies need to be seen in light of what contribution they will make to the eventual achievement of the CLIOS System goals. Therefore instead of simply having the number of networks or computers deployed as a goal, these also need to be attached to the number and extent of processes automation

6.4 Further Work

Based on the CLIOS Process analysis undertaken in this thesis, it is the hope of the author that based on its accuracy, the CLIOS process can be used a basis for more quantifiable analysis to the question of ICT for development, particularly through:

i. *Systems Dynamics Modeling* – The constructions of a systems dynamics model based on the CLIOS representations will enhance the understanding of how the different components within the CLIOS System affect one another

ii. *Class 1 Link Analysis* – As mentioned earlier in Section 5.1.5 of this thesis that covered Describing the CLIOS Links, the links within the physical domain (Class 1) can be analyzed using engineering and micro-economics based methods and will often be quantifiable

iii. *Class 2 Link Analysis* – As mentioned earlier in Section 5.1.5 of this thesis that covered Describing the CLIOS Links, class 2 links (projections) are less likely to be quantitatively analyzed since human agency and organizational and stakeholder's interests come into play as they attempt to induce changes in the physical domain. Nevertheless, quasi-experiments and use of proxies using micro-economic concepts can be useful in understanding and analyzing the links

iv. Class 3 Link Analysis - As mentioned earlier in Section 5.1.5 of this thesis that covered Describing the CLIOS Links, interactions within the institutional sphere (Class 3) require methods drawing upon theories of organizations, institutions, politics and policy

v. *Balanced Score Card* – An objectively developed balanced score card based on the effectiveness of different ICT qualities for development can be useful in enhancing the tradeoff analysis and the eventual selection of strategic alternatives

vi. *Additional Creative Strategic Alternatives* – As the process of developing strategic alternatives was open ended, there is always room for more strategic alternatives to be proposed and analyzed within the CLIOS Process

vii. *Implementation and Monitoring* – Covering steps 9-12 of the CLIOS Process to give completeness to this analysis

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