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Nixon Muganda Ochara
*University of Cape Town*, nixon.ochara@uct.ac.za

Jean-Paul Van Belle
*University of Cape Town*

Irwin Brown
*University of Cape Town*



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# Global Diffusion of the Internet XIII: Internet Diffusion in Kenya and Its Determinants -- A Longitudinal Analysis

Nixon Muganda Ochara

Jean-Paul Van Belle

Irwin Brown

*Department of Information Systems*

*University of Cape Town*

*nixon.ochara@uct.ac.za*

Abstract:

This paper assesses Internet diffusion and its determinants in Kenya using the Global Diffusion of the Internet (GDI) framework. Kenya was selected due to its strategic importance for the economic progress of the great lakes region of Africa. An understanding of Internet diffusion in Kenya provides preliminary insight into how the process might unfold in Eastern Africa.

The analysis shows that in 2008, less than 10 percent of the population accessed the Internet, with a majority of users clustered around two major urban centers. There is an indication that across the sectors of education, commerce, health, and public service, the Internet is being embraced, with potential for further diffusion. The underlying national Internet connectivity infrastructure is well established, but skewed in favor of urban centers that have high levels of electricity penetration. Vibrant competition exists between Internet service providers despite a persistent monopoly in national fixed line telecommunications provision. A few sophisticated applications of the Internet were found in several sectors.

A snap shot of the state of Internet diffusion in Kenya reflects, on average, good performance on the various dimensions of the GDI framework. However, this overall picture masks the reality that the majority of the population, mostly in rural areas, lack access to basic amenities such as electricity, and hence infrastructure to support the Internet. The trajectory along which the Internet is diffusing has therefore led to the exclusion of this majority. The critical role that governments in developing countries play needs to be brought to the fore in order to ensure that the Internet diffusion trajectory is not left entirely to the commercial sector. The government's ability to marshal resources, execute telecommunications regulation, as well as enable change remains pivotal to ensuring inclusive Internet diffusion.

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## I. INTRODUCTION

The Internet has become a dominant infrastructure for supporting a number of public and private sector activities in various countries [Singh et al. 2007]. For instance, the rise of e-commerce and e-business can be linked to the commercialization of the Internet since the 1990s. E-government has also become a mantra for reforming public institutions in many developing countries and is partly premised on the Internet platform [Heeks 2002]. Widespread Internet adoption is an antecedent to the realization of various economic and noneconomic activities.

Kenya was selected due to its strategic role in the great lakes region of Africa. Kenya has been used as a hub for galvanizing international peace efforts in Eastern Africa, with several agencies such as the United Nations (UN), World Bank, African Development Bank, International Monetary Fund (IMF), UNEP and USAID having a strong presence in the country [Klopp and Kamungi 2008]. The global communications needs of these and other institutions require a robust telecommunications infrastructure to enable them to operate. An envisaged undersea fiber optic cable running from its coastal town of Mombasa to Fujaira in the United Arab Emirates covering 4,400 kilometers underlines it role as a regional telecommunications hub [Odero and Mutula 2007]. The project, known as the East Africa Sub-Marine System (TEAMS) will connect the country and region to the global fiber optic network. It is expected that Internet costs will decrease, making the country much more attractive to investors. Kenya was a major beneficiary of World Bank funding (USD165 million) for financing a high-speed Internet connectivity project covering Kenya, Burundi, and Madagascar [Odero and Mutula 2007]. The government of Kenya has recognized that a robust and vibrant telecommunications infrastructure is instrumental in order to facilitate national development [Kagwe 2005].

This study therefore recognizes that despite the "political din" that characterized the December 2007 multi-party elections in Kenya, its "island of peace" status in the region [Klopp and Kamungi 2008] has been regained following mediation efforts by former United Nations (UN) secretary general, Kofi Annan [Fortunate 2008]. An assessment of Internet diffusion in Kenya brings to the fore the role of government subvention efforts in the telecommunications sector in this region, evidenced from various initiatives aimed at making the sector more vibrant [Africa Research Bulletin 2007].

A focus on Internet diffusion is motivated by a number of factors. First, the Internet infrastructure has become integral to several activities such as e-commerce and e-government. For instance, e-government has become the mantra for achieving public sector reforms in many developing countries, yet it relies on a Western-type telecommunications infrastructure that is largely unrealized in many African countries [Heeks 2002]. The Western model presumes a widespread adoption of various technologies by various population groups, yet several studies on Internet diffusion in Africa document low levels of technology adoption [Bagchi et al. 2007; Brown et al. 2007; Bernstein et al. 2005; Foster et al. 2004; Oyelaran-Oyeyinka 2002]. As a result of the inadequacy of the Western-type physical computing model, a number of African countries have been articulating policies to realize the aims of these economic and noneconomic activities that are dependent on the Internet infrastructure. For instance, Kenya has articulated an e-government policy that recognizes the Internet infrastructure as antecedent to achieving e-government maturity [GOK-EGS 2004]. Kenya has also crafted a National ICT Policy and Strategy as a blueprint for actively participating in the network society [GOK-NICT 2006]. This research contributes to the debates on the importance of the Internet by outlining the determinants, diffusion pathway and possible impacts of its diffusion on these activities.

The second motivation arises from the need to contribute to the accumulation of knowledge on experiences related to ICT adoption in Africa. A study on the diffusion of the Internet at the national or macro-level provides an indication of the diffusion of the cluster of technologies that characterize the Internet. There is currently a dearth of studies that have focused on nationwide Internet diffusion in Africa. It therefore reinforces the efforts of the International Federation for Information Processing (IFIP) Working Group 9.4 on ICT in developing countries that specifically calls for articulating the social implications of computers in developing countries by collecting, exchanging, and disseminating experiences of ICT implementation in developing countries.

There are five major sections in the article. The first section presents background information on Kenya; the second section is a discussion of the Global Diffusion of the Internet (GDI) framework used in this study; the third section presents the analysis of Internet diffusion and its determinants; the fourth section reflects on government policy

initiatives and their likely impacts. The last section presents the conclusions structured around the role of government in infrastructure development.

## II. KENYA: ECONOMY, POLITICS, AND TELECOMMUNICATIONS

Located in Eastern Africa, Kenya shares borders with Ethiopia, Sudan, Uganda, Tanzania, and Somalia (Figure 1). The population groups in Kenya are mainly black Africans (99 percent), with a small number of non-Africans (1 percent). The two official languages are Kiswahili and English. Kiswahili is the main language for conducting business transactions and is also used in government offices since for 99 percent of the population, English is considered as a second, third, or even fourth language.


**Figure 1. Kenya Map [CIA 2008]**

Table 1 provides key socio-economic indicators for Kenya. The population estimate for 2008 is based on a projected rate of 2.8 percent natural population increase [UN-WPP 2008]. This gives an estimate of about 38,550,000 by mid-2008.

**Table 1. Key Indicators of Kenya**

| Indicator | Number | Source |
|---|---|---|
| Population (2008 Estimate) | 38,550,000 | UN-WPP, 2008 |
| Literacy (2007) | 85.1% | CIA, 2008 |
| GDP (2007 Estimate) | US$ 59 Billion | PRB, 2008 |
| Telephone (Mainlines) (March 2008) | 286,729 | CCK, 2008 |
| Telephone (Cellular) (March 2008 estimate) | 11,986,007Million | CCK, 2008 |
| Internet Users (2008) | 3.5 Million | CCK, 2008 |
| Number of Computers(2008 estimate) | 1.7 Million | Håndværksrådet, 2006 |

Kenya's economy has grown steadily since 2003 (4.9 percent in 2004, 5.8 percent in 2005 and 6.1 percent in 2006; 2007 estimate is 6.4) and this trend is expected to continue despite a possible slowdown due to the unrest and the chaos that marred the December 2007 elections and the cooling of the global economic climate. The services sector has always played a strong role in the growth of the economy. Services contribute an average of 56 percent to the growth; agriculture, 27 percent, while manufacturing contributes about 17 percent. The government is striving toward a sustained economic growth rate of 10 percent annually over the next 25 years in order to achieve its developmental goals [Gakuru 2007].

The liberalization of the telecommunication sector has been ongoing since the 1990s. Major policy changes in the sector can be traced to the enactment of the Kenya Communications act 1998 (KCA) and the repeal of the Kenya Posts and Telecommunications Corporation (KP & TC) Act [www.cck.go.ke]. The KCA of 1998 resulted in the unbundling of the KP & TC (sole telecommunications operator in the country prior to 1998) into three entities: Communications Commission of Kenya (CCK); Telkom Kenya (as a national telecommunications provider), and Posta (for postal services). The history of the Internet in Kenya however dates back to 1994 when the African Regional Center for Computing (ARCC) was set up to offer full Internet connectivity in the country through the support of the U.S. National Science Foundation (Kenya Institute of Management 1999). The liberalization of the sector also resulted in the creation of a National Task Force on electronic commerce in May 1999 with a view to providing an enabling environment for electronic trade in the country. As a result, awareness of the potential of Internet increased with many stakeholders indicating interests in applying Internet in their business. By 2000 it was estimated that the number of Internet users was around 30,000-50,000 with a total of 34 Internet Service Providers (ISPs) [Odero and Mitula 2007]. Given this background, the next section reflects on the theoretical basis that was adopted for the subsequent analysis and discussions in other sections.

## III. GDI FRAMEWORK AND RELATED THEORIES

The choice of the Global Diffusion of the Internet (GDI) framework as the explanatory lens for mapping Internet diffusion and its determinants is based on its robustness when utilized in making country level assessments of the Internet as a cluster of technologies (Wolcott et al. 2001). The GDI framework consists of six *dimensions,* each of which describes a somewhat intuitive and measurable feature of the presence of the Internet in a country (Wolcott et al. 2001). Figure 2 captures the GDI dimensions and their interrelationships.

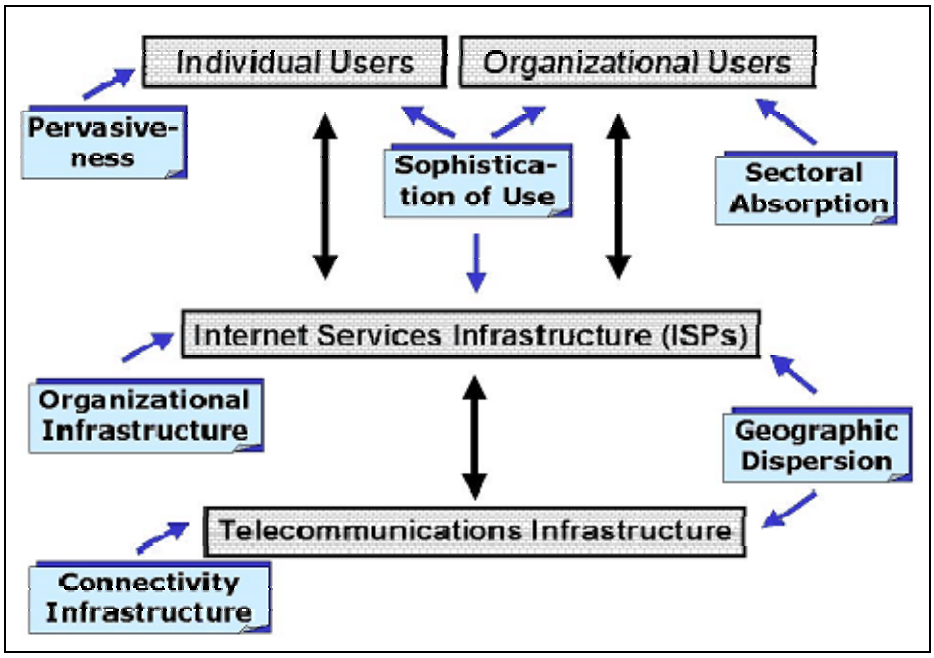


**Figure 2. Constituents of the Internet Technology Cluster [Adopted from Wolcott et al. 2001]**

The *Telecommunications Infrastructure* provides the base, without which there would be no Internet. Between the Telecommunications Infrastructure and the Users (Individuals and Organizations) are a host of proxies (depicted as ISPs, but can also be application service providers). The dimension that captures the state of the telecommunications infrastructure is *Connectivity Infrastructure*. The Users at the top level require certain technologies for accessing the Internet. The dimensions that capture these aspects are *Sectoral Absorption* and *Pervasiveness*. *Pervasiveness* is a measure of the number of individual Internet users in a country relative to the total population. *Sectoral Absorption* considers Internet use from the viewpoint of adoption at an organizational level.

*Sophistication of Use*, on the other hand, recognizes that the adoption of the leading edge applications depends not only on what the users want, but also on what the Internet services infrastructure is able and willing to provide. The Internet services infrastructure has two dimensions—*Organizational Infrastructure* and *Geographic Dispersion*. Organizational infrastructure captures the number and robustness of the organizations that provide Internet services. *Geographic Dispersion* reflects the extent to which these organizations, along with the supporting telecommunications infrastructure, are distributed across the entire territory of a country.

Arguably, the six dimensions cover all aspects that may be of interest when measuring Internet use. Each dimension may be assigned one of five ordinal values ranging from zero (nonexistent) to four (highly developed). These levels indicate the state of the Internet in a particular country at a given point in time. The GDI framework has been used to analyse Internet diffusion in more than 40 countries (Wolcott et al. 2001).

The possible determinants used to explain the various levels of the six dimensions representing Internet diffusion in a country are derived from generic ones that form part of the GDI framework (Table 2). The next section presents the results of the data analysis. The starting point is to provide a summary of the Internet diffusion on a Kiviat diagram and a summary of the possible determinants responsible for the dimension levels. A discussion on how these determinants have influenced the magnitude of the GDI dimensions follows.

**Table 2: Determinants of Internet Diffusion [Wolcott et al. 2001]**

| | |
|---|---|
| **Qualities of the technology itself** | |
| 1. Perceived value | Value the Internet provides |
| 2. Ease of use of the Internet | looking at literacy and availability of local-language content |
| 3. Cost of Internet access | Entails looking at Internet costs (dial-up, ISP, etc.) relative to income levels |
| **Interrelationships within the technology cluster** | |
| 4. Access to constituent technologies | Looks at the balance between all the technologies that must be present for various levels of use |
| 5. Demand for capacity, multiplicity of ISPs, services provided | How demand at various levels of the cluster is driving the connectivity infrastructure development |
| **External/surrounding forces** | |
| 6. Geography | How physical geography influences Internet development |
| 7. Adequacy and fluidity of resources | A broad category considering financial, informational, human, technological or capital, and material resources and the ease with which they can flow from where they are to where they are needed |
| 8. Ability to execute | The ability to develop a sound strategy and a suitable design given opportunities and constraints, and the ability to manage plans through to completion |
| 9. Culture of entrepreneurship | How entrepreneurship is rewarded |
| 10. Regulatory/legal framework | Specific laws and regulations influencing Internet diffusion |
| 11. Forces for change | Include competitive environment, presence of demanding domestic customers, rate of creation of new organisations, presence of champions |
| 12. Enablers of change | Conditions that allow a community to accept and incorporate change, including institutional, historical, cultural, and educational factors |

## IV. ANALYSIS OF INTERNET DIFFUSION AND ITS DETERMINANTS

The GDI framework advocates a qualitative approach since it recognizes that adoption of innovations is a multifaceted phenomenon that takes place in a variety of ways over time [Wolcott et al. 2001]. The qualitative

approach does not constrain the analysis to any predetermined variables. The researcher can gather data from many diverse sources. Below are some of the sources, recommended by Wolcott et al [2001], which this study relied on:

- Collecting any available data from existing sources, including other studies, press reports, net-based collections methods, etc.
- Collecting primary data from the Internet/WWW itself. For example, surfing Web pages of ISPs can be quite helpful
- Opinions from stakeholders in the industry
- Information from ISP's and communications providers
- Interviews with various stakeholders of the telecommunications sector.

The category of interviewees included Internet cybercafé users to understand their use characteristics; interviews with ISP representatives on their perspectives on the liberalization process and an interview with a representative of the Kenya Education Network on academic sector Internet connectivity.

The Kiviat diagram (Figure 3) summarizes the analysis of Internet diffusion in Kenya for 2008 and is discussed in more detail below.

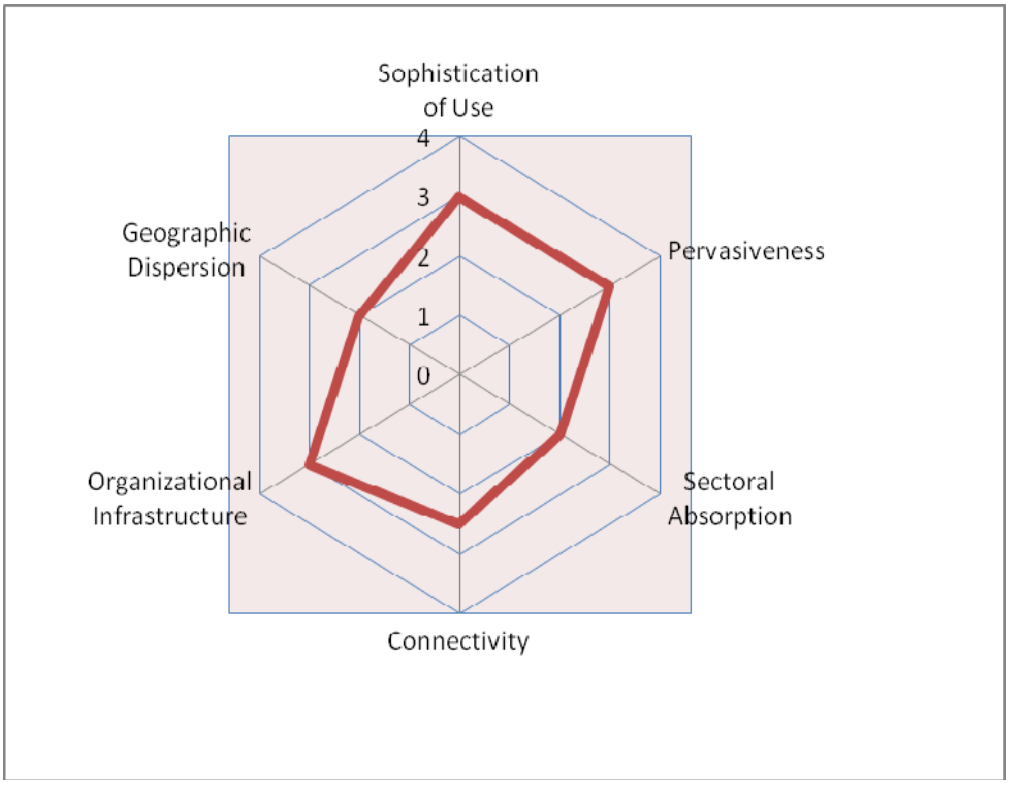


**Figure 3. Kenya-Internet Diffusion [2008]**

The possible determinants that have had the greatest impact by June 2008 are presented in Table 3 and are used to explain the various GDI levels of the Kiviat diagram. The analysis and discussions are structured around the six dimensions in the following order: pervasiveness; geography; sectoral absorption; connectivity infrastructure; organizational infrastructure; and sophistication of use.

**Table 3. Determinants of Internet Diffusion in Kenya**

| Determinant | Sources | References |
|---|---|---|
| Forces of Change (*"change"*) | ISP knowledge transfer from Diaspora since 1990s and demand for services from the commercial sector organizations | Interviews with ISPs; [Muiruri 2004] |
| | Appointment of competent Minister and Permanent Secretary in charge of ICT since 2004; Establishment of the Ministry of ICT | Personal observations and interviews |

| | | |
|---|---|---|
| | Civil Society campaigns against monopoly in the Telecommunications Sector since the early 1990s and broader push for political democratization impacting on competition | [Muiruri 2004] |
| | Changing Market Structure (supply-side and demand-side); Pervasiveness of Mobile Telephony with mobile connections surpassing fixed lines | [CCK 2008a] |
| Regulatory/Legal Framework (*"regulations"*) | Kenya Communications Act No. 2 (1998), which liberalized the telecommunications sector. Results in Multi-Operator structure since 1999. | [Mudavadi 2001] |
| | A weak consumer protection regime that is not practically enforceable by Communication Commission of Kenya (CCK). For instance CCK balked on implementing their recommendation for a maximum ceiling rate for interconnection charges between networks. | [Kui 2007] |
| Ability to Execute (AE) (*"execution"*) | By April, 2008, there was still no Second National Operator even though exclusivity for Telkom ended in 2004. Players decry poor services from Telkom. | [CCK 2008a] |
| | Accelerated Private-Public Sector Partnerships | [CCK 2007] |
| | Withdrawal of the Kenya Communications Amendment Act, 2007 indicates an inability to speedily execute policy mandate | [Kenya Law Reports 2007] |
| | Long' delays in implementation of communications infrastructure projects that can positively impact on Internet diffusion. For instance, East African Submarine Cable System (EASSy) project was to start in 2002 and managed to take off after five years. Delays were largely based on project design and ownership. | [CCK 2008] |
| Culture of Entrepreneurship (CE) (*"entrepreneur-ship"*) | There were 72 Kenyan owned ISPs in 1999 only 15,000 users. To date there are 51 ISPs. Africa Online was first Pan African ISP started by Kenyans | [CCK 2008] |
| | Changing Market Characteristics | [Okuttah 2008] |
| | Large ISPs have remained able to attract capital while small ISPs remain less profitable; mobile companies are profitable | Observations |
| | As at 2002, there were over 200 cyber cafes even though leased line costs were prohibitive. | www.mulonga.net; analysis |
| | Kenyan-based innovations such as M-Pesa, using the Telecommunications infrastructure for E-Cash; | www.safaricom.co.ke |
| Adequacy and Fluidity of Resources (AFR) (*"resource"*) | Setting up of the Ministry of ICT has improved mobilization of resources towards telecommunications, other bodies National Communications Secretariat, ICTPark.com, ICTVillage.com, Kenya ICT parastatal, are all geared toward development of ICT in Kenya. | Observations and interviews |
| | Increased Foreign Direct Investments | [CCK 2008a] |
| | Private sector resource mobilization for Infrastructure development such as national fiber optic backbone for free Broadband Internet by Kenya Data Networks and Siemens; others are the TEAMS project | [Kola 2007] |
| Cost of Internet Access (CIA) (*"costs"*) | Costs are falling, but are still prohibitively high for many; additionally, unemployment is over 40% thus Internet is not priority | Observations |
| | Uncontrolled software piracy has initially provided some buffer | Observations, press reports |

| | | |
|---|---|---|
| | to "real" Internet usage costs | |
| Perceived Value of the Internet (PVI) (*"value"*) | *Organizational Value*-Public Sector and SME firms slow uptake; commercial sector pioneers | [Mureithi 2005]; [USAID 2006] interview data |
| | Applications: Also, e-commerce use may still be low due to factors such as low credit card penetration, lack of awareness as well as infrastructural problems | [Kinyanjui and McCormick 2002; Muganda, N. & Van Belle, J. 2007]. |
| | Individuals: E-Mail (59%); lifestyle (12%); Career Planning (6%); Religion (5%); Business (5%); other lifestyle interests: pornography; chatting. There is some increased use of the Internet for investments such as Safaricom IPO. Thus going beyond entertainment. | [Mulonga 2003]; Interviews |
| Ease of Use of Internet (EUI) (*"Ease of Use"*) | Based on new tests, adult literacy (62%); Literacy in Nairobi (87%); Literacy in the North East (8%); Rural (55%); Urban (80%); Desired Mastery Level (30%) | [Kilele 2007] |
| | Low Computer Literacy (10-15%) | [Håndværksrådet 2006]. |
| | Digital Content language is predominantly English; Sites now emerging which use local languages | Observations |
| Access to Constituent Technologies (ACT) ("*Constituent Technologies"*) | ICT Costs prohibitive, but initiatives such as Madaraka Computer expected to impact positively | Various sources |
| | Wireless to wire line technologies such as CDMA are increasing; Wireless technologies becoming more accessible. | Various sources |
| | Low Electricity Penetration (15%) overall; Rural (4%) | Kestrel Capital; [KPLC 2007] |
| Demand for Capacity; Multiplicity of ISPs and Services (DCMS) (*"demand"*) | Poor service from the national telecommunications operator has higher costs for ISPs leading to formation of Internet exchange; poor services from ISPs lead to the formation of several consumer groups and CCK complaint resolution; mushrooming of end-user organizations for quality service demands | Interviews, CCK. |
| Enablers of Change (*"Enablers"*) | Quest for democratization fuels the need for liberalization of telecommunications | [Muiruri 2004] |

## INTERNET PERVASIVENESS

Kenya's Internet population accesses the Internet at cyber cafes, at work, in academic institutions, at home, and much more recently through mobile phones.

Table 4 summarizes the source data that was used to calculate the required percentage for measuring pervasiveness. These statistics reflect three data sets: prior to 1998, the CIDCM Report; between 1998 and 2004 data from the CIA (1999 to 2005) Fact Books were used; for the years 2005-2006, the research relied on data from the Government of Kenya [CCK 2008]. There are some differences in assumptions between the different datasets. Data must be treated as approximate and year-on-year growth rates when changing data sources are somewhat suspect. The 2008 population estimate assumes a natural rate of growth of 2.85 percent based on statistics provided by the Central Bank of Kenya [www.cbk.go.ke] and the United Nations World Population Prospects [UN-WPP 2008].

The forecast for 2008 assumes that initiatives by the government, the private sector, and other stakeholders since the start of the year will lead to increases in mobile and non-mobile Internet use.

Thus, the proportion of the total population with Internet access by mid-2008 is estimated at 9.1percent. This shows that Kenya is at level three of pervasiveness (Table 5). This may partly be attributed to the regulatory and legal (*regulations*) reforms that have been undertaken since 1999. Key triggers were the unbundling of KP & TC as a monopoly through the enactment of the Kenya Communications Act in 1998 as well as better enforcement of license

regulations (*execution*) and operational independence of CCK since the 2004 that led to the high increase in number of users in 2006. The reforms that have been undertaken resulted in a 2006 growth rate of 149 percent. The key driver for the reform efforts may be the sustained pressure from the civil society and political opposition to monopoly of government parastatals over the years (*change*).

**Table 4. Internet Penetration Estimates (1995-2008)**

| Year | Approx Users | Growth Rate | Approx Population | % of Population |
|---|---|---|---|---|
| 1995[a] | 100 | | 24,000,000 | <0.01% |
| 1996[a] | 10,000 | 9900% | 25,000,000 | 0.04% |
| 1997[a] | 25,000 | 150% | 26,000,000 | 0.10% |
| 1998[a] | 50,000 | 100% | 27,000,000 | 0.19% |
| 1999[b] | 70,000 | 40% | 28,686,607 | 0.24% |
| 2000[b] | 100,000 | 43% | 30,202,564 | 0.33% |
| 2001[b] | 200,000 | 100% | 30,849,933 | 0.65% |
| 2002[b] | 400,000 | 100% | 31,491,130 | 1.27% |
| 2003[b] | 1,000,000 | 150% | 32,125,315 | 3.11% |
| 2004[b] | 1,054,920 | 5% | 32,751,523 | 3.22% |
| 2005[b] | 1,111,000 | 5% | 33,368,802 | 3.33% |
| 2006[c] | 2,770,296 | 149% | 33,947,066 | 8.16% |
| 2007[d] | 3,300,000 | 19% | 37,538,000 | 8.79% |
| 2008 | 3,500,000[e] | 6% | 38,550,000[e] | 9.08% |

(Sources: (a) CIDCM Report, August 1998; (b) Telkom; (c) CCK[ 2007]; (d) Projection; (e) UN[2008].

**Table 5. Pervasiveness of the Internet in 2008**

| | |
|---|---|
| Level 0 | Nonexistent. The Internet does not exist in a viable form in this country. No computers with international IP connections are located within the country. There may be some Internet users in the country; however, they obtain a connection via an international telephone call to a foreign ISP. |
| Level 1 | Embryonic. The ratio of Internet users per capita is on the order of magnitude less than one in a thousand (less than 0.1%). |
| Level 2 | Nascent. The ratio of Internet users per capita is on the order of magnitude of at least one in a thousand (0.1% or greater). |
| Level 3 | Established. The ratio of Internet users per capita is on the order of magnitude of at least one in a hundred (1% or greater). |
| Level 4 | Common. The ratio of Internet users per capita is on the order of magnitude of at least one in ten (10% or greater). |

In addition, the introduction of the Internet in Kenya has mostly been spurred by initiatives from the commercial sector rather than the Government or education sector. This was noticeable by the large number of ISPs (78) setup with the intention of taking advantage of the Internet boom, a fact which maybe attributed to a strong entrepreneurial culture amongst Kenyans (*entrepreneurship*). For instance, Africa Online (initially Karisi Communications) was set up in 1994 and boasts a presence in eight countries in Africa. It was set up by three Kenyans (Ayisi Makatiani, Amolo Ng'weno, and Karanja). Nairobinet Ltd. was also set up in 1997 by Sammy Buruchara, former employee of a local computer firm and it has been the third-largest ISPs for many years. The ownership of the ISP can therefore be used as an indicator of entrepreneurship.

Despite the positive trends of Internet growth depicted, the Internet is still among the least accessible telecommunications services because only 35 out of 78 licensed ISPs are operational [CCK 2008a]. According to an

Internet Market study by CCK in 2006/2007, this state is largely attributed to low literacy levels, lack of infrastructure and lack of relevant local content [CCK 2007; Eldon 2005]. The total costs (connectivity, equipment costs, maintenance) of Internet access (*costs*) also remain high, despite continued drop in both bandwidth costs and connections costs to end users arising government efforts of zero rating duty on the personal computers and creating an enabling environment for industry competitiveness (PCs) [Eldon 2005]. When the dropping costs are considered in light of a more than 50 percent poverty incidence in Kenya, lower costs may not have contributed significantly to this growth, except to infer that many Kenyans have been realizing the *value* of the Internet in relation to more costly and less efficient substitutes such as postal services.

Therefore, the key determinants that played a role in enhancing the pervasiveness of the Internet in Kenya in its nascent years (1999-2008) are primarily those related to *regulation, execution,* increasing perception of *value and entrepreneurship*. Determinants related to *costs* and *execution* have slowed down the pervasiveness of the Internet over this period.

## INTERNET GEOGRAPHIC DISPERSION

Geographic dispersion measures the physical dispersion of the Internet within a country. The dimension looks at the number of Internet points of presence (POPs) in the first-tier political subdivisions [Wolcott et al. 2001]. An Internet point of presence is taken to mean the physical presence of an ISP or a public data network operator (PDNO) in the first-tier political unit [Wolcott et al. 2001]. The PDNO re-sells bandwidth to the ISPs or directly to large organizations. The presence of PDNOs allows Internet access using local calls to the telephone exchanges.

Kenya's first-tier political subdivision is the province. However for the sake of this analysis, there was need to consider other factors in determining the unit to be used for analyzing this dimension. For instance, Kenya has 72 administrative districts (considered as the third tier), each serving an average of 550,000 people. The telephone exchanges for dial-up access are district-based, not based per province. By contrast, there are only eight provinces translating into an average of 4.8 million citizens per province. Thus an Internet user has to dial a district exchange for access. In addition, Kenyans mostly rely on administrative districts and rarely on provincial districts. This analysis therefore considered the district as the first-tier political subdivision. Table 6 provides the statistics on the status of Internet POPs in Kenya.

**Table 6. Presence of the Internet in Provinces and Districts**

| Licensee Category | Districts | Provinces | % of districts |
|---|---|---|---|
| ISP (Internet Service Providers) | 20 | 8 | 28.57% |
| LLO (Local Loop Operators) | 2 | 2 | 2.86% |
| PDNO (Public Data Network Operator) | 33 | 7 | 47.14% |
| VSAT | 57 | 8 | 81.43% |

(Source: CCK, 2008)

Despite Internet presence in all the eight provinces, only 50 percent of the districts have an Internet presence. Based on the GDI framework, Kenya therefore is at level 2 since there are multiple Internet points of presence (Table 7). Given that fixed telephony has traditionally been considered as a critical infrastructure for Internet access, the spread of the infrastructure was regarded as also critical in giving an indication of the geographic spread of the Internet.

According to available statistics for 2007, urban areas have a total of 243875 fixed lines compared to 26668 available in the rural areas [CCK 2008]. 81 percent of the urban fixed lines are in the four major towns of Nairobi, Mombasa, Nakuru, and Kisumu. More than 80 percent of the population lives in the rural areas. In the urban areas, 71 percent are poor slum dwellers [PRB 2008] who may not prioritize Internet use.

To speed up the installation of fixed line connectivity, CCK licensed 10 local loop operators (LLOs) in 2002 to aid in installation of last mile telephone infrastructures to the national operators' exchanges [CCK 2008]. However, out of those licensed 10 LLOs, only two are operational in two districts. Out of the 78 ISPs licensed, only 35 are currently operational, which limits the national Internet coverage.

| Table 7. Geographic Dispersion of the Internet in 2008 | |
|---|---|
| Level 0 | ***Non-existent.*** The Internet does not exist in a viable form in such a country. No computers with international IP connections are located within the country. A country may be using unix-to-unix copy protocol (UUCP) connections for e-mail and USENET (this is a widely distributed online bulletin board which consists of thousands of online forums on any topic its users could dream up). |
| Level 1 | Single location. The Internet points-of-presence (POPs) are confined to one major population centre. |
| Level 2 | Moderately dispersed. Internet points-of-presence are located in multiple first-tier political subdivisions of the country. |
| Level 3 | Highly dispersed. Internet points-of-presence are located in at least 50% of the first-tier political subdivisions of the country. |
| Level 4 | Nationwide. Internet points-of-presence are located in essentially all first-tier political subdivisions of the country. Rural access is publicly and commonly available. |

CCK's continuous execution of its mandate by licensing more operators (*regulation*) and enforcing licensing conditions has increased the level of competitiveness and forced some of the operators to be based in the rural areas (*execution*). However despite notable positive trends, the lack of a developed venture capital system for entrepreneurs interested in investing in the underserved rural and urban areas is hampering rapid development of the physical infrastructure of the Internet by the licensed operators (*resources*). There are also low levels of electricity penetration with only 15 percent of the population having access to electricity [KPLC 2007]. The physical infrastructure condition, when linked to the low level of electricity penetration, is thus unfavorable to dispersion since power is a requirement for the constituent technologies of the Internet (*constituent technologies*). This further works to discourage investments by licensed operators and may partly point to an inability of the government (through CCK) to craft a strategy for overcoming this bottleneck (*execution*).

## INTERNET SECTORAL ABSORPTION

The dimension of sectoral absorption assesses the extent of Internet diffusion in the academic, commercial, health, and public sectors [Wolcott et al. 2001]. It assesses the proportion of all organizations in each sector that have leased lines. The GDI framework uses IP connectivity as the base measure of the dimension as described in Table 8. Leased line connectivity or the presence of hosted/co-hosted Internet servers are used as its metrics; because buy-in to these technologies indicates a high level of use of, and serious commitment to, the Internet by an organisation.

| Table 8. Sectoral Absorption of the Internet in 2008 | | | |
|---|---|---|---|
| Sector | Minimal (1 point) | Medium (2 points) | Majority (3 points) |
| Academic | 0%-10% have leased line Internet connectivity | 10%-90% have leased line Internet connectivity | 90% have leased line Internet connectivity |
| Commercial | 0%-10% have Internet servers | 10%-90% have Internet servers | 90% have Internet servers |
| Health | 0%-10% have leased line Internet connectivity | 10%-90% have leased line Internet connectivity | 90% have leased line Internet connectivity |
| Public | 0%-10% have Internet servers | 10%-90% have Internet servers | 90% have Internet servers |

The summarized statistics used in this section are based on a market analysis study which was undertaken in 2006/2007 by the Communications Commission of Kenya [CCK 2008b]. According to this study, the government sector has the highest number of leased lines: 29 percent of the total leased lines in the country. The education sector has 1 percent of the total number of leased lines. The health sector has 17 percent, the commercial sector accounts for 23 percent, and other sectors account for 20 percent. However, these percentages need to be

tempered since the overall absorption in learning institution is 12 percent of all the institutions. The report also highlights that the dial-up status follows a similar pattern to the leased line pattern as captured in Figure 3.

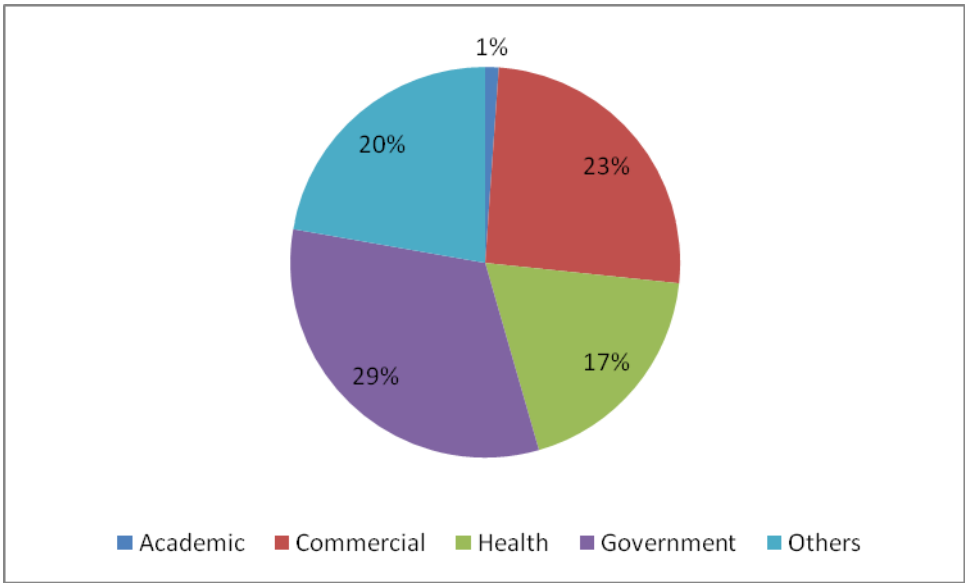


**Figure 3: Leased Lines Sectoral Absorption**

Based on the CCK [2008b] report, the sectoral absorption is depicted in Table 8. Only the CCK [2008b] report was considered because no other comprehensive research has been undertaken, and alternate information proved difficult to obtain or estimate.

The education sector is at a different GDI sectoral absorption level from the other sectors. In contrast to other sectors, the institutions under the Ministry of Education are more widespread since primary and secondary schools are located in all regions of the country. The schools and colleges would require a network infrastructure to support over 10 million students at various levels. The scope of required infrastructure for Internet is much wider than other sectors given the extent of its geographical mandate. The required infrastructure is largely absent, given that many areas lack electricity. The country has 19,890 primary schools and 4,000 secondary schools [CFSK 2007], but very few have Internet access. The public and commercial sectors are largely in the urban centers where electricity and telecommunications infrastructure exist. Public and commercial organizations in rural areas locate in regions that are served with electricity or have affordable alternative energy sources. The health sector, as with education, also has a wide geographical mandate. However, its use of the Internet is mostly for administrative purposes [Kamar and Ongondo 2007], so it is assumed to have a lower absorption rate than education.

The CCK [2008b] report relied on data from the ISPs and other backbone providers. However, some educational institutions may not have been included. For instance KENET (backbone provider for learning institutions) provides Internet connectivity to higher learning institutions in the country; although some like the University of Nairobi have an ISP license with their own independent leased lines. KENET had a network of only 50 institutions linked to its network in 2007, even though there are over 23,000 secondary and primary schools in Kenya, most of which do not have leased line Internet connectivity [Kashorda et al. 2007; MOEST 2005]. The proportion of leased line connectivity available through KENET and the total number of institutions in Kenya is below 1 percent which means Kenya affords only minimal points in terms of sectoral absorption i.e. zero to 10 percent have leased line Internet connectivity (Table 8).

The perceived value of the Internet (*value*) and the availability and fluidity of resources (*resources*) seem to be the likely determinants that have had a positive influence on sectoral absorption status for the commercial, public, and health sectors. Internet adoption in Kenya has been driven more by the commercial sector than the other sectors. The introduction and use of the Internet has been commercial-sector driven since 1994. As of 2007, there were a total of 7,637 leased line connections, a majority of which were leased to commercial sector organizations [CCK 2008b]. The commercial sector uses 81 percent of the total bandwidth compared to 1 percent of the education sector. They have had greater awareness of technological innovations than noncommercial ones. The public sector organizations were the early targets of ISPs when Internet was introduced. Interviews with representatives from the ISP sector indicated that a majority of the ISPs used to offer free Internet to public sector organizations in order to educate officials and encourage them to use the Internet.

A lack of resources (*resources*) and perceived value (*value*) of the Internet inhibited Internet diffusion in the academic and health sectors. The geographic scope of operations of these two sectors is country-wide; providing Internet infrastructure to all their institutions would require great financial, human, technological, and capital resources. To marshal adequate resources, these sectors have had to involve various stakeholders. For instance they have involved multinational corporations (such as Microsoft and Oracle), supra-national organizations (such as the World Bank and UN) and even the commercial sector in Kenya. These partnerships have had an impact in creating awareness on the value of the Internet amongst target institutions, but have had minimal impact in extending the reach of Internet connectivity.

Taking into account the results of CCK's [2008a] Internet market study, the estimate of the overall sectoral absorption is moderate, as shown in Table 9.

**Table 9. Sectoral Absorption of the Internet in 2008**

| Sectoral Point Total | Sectoral Absorption | Dimension Rating |
|---|---|---|
| 0 | Level 0 | Non-existent |
| 1-3 | Level 1 | Rare |
| 4-6 | Level 2 | Moderate |
| 7-9 | Level 3 | Common |
| 10-12 | Level 4 | Widely Used |

## INTERNET CONNECTIVITY INFRASTRUCTURE

Connectivity infrastructure refers to the extent and robustness of the physical structure of the network and is measured by the aggregate bandwidth of the domestic and international backbones, the number and type of inter-connection exchanges, and the type and sophistication of local access methods being used [Wolcott et al. 2001]. Kenya is at level 3 in 2008 as indicated by the shaded portion of Table 10 based upon the analysis that follows. The growth of total international bandwidth over the years is shown in Table 11.

**Table 10. Connectivity Infrastructure of the Internet as of 2008**

| Level | | Domestic Backbone | International Links | Internet Exchanges | Access Methods |
|---|---|---|---|---|---|
| Level 0 | Non-existent | None | None | None | None |
| Level 1 | Thin | <=2 Mbps | <=128 Mbps | None | Modem |
| Level 2 | Expanded | 2 Mbps-200 Mbps | 128 Kbps- 45 Mbps | 1 | Modem<br>64 Kbps leased line |
| Level 3 | Broad | 200 Mbps-100 Gbps | 45 Mbps-10 Gbps | More than 1; bilateral or open | Modem<br>64 Kbps leased line |
| Level 4 | Extensive | 100 Gbps | 10 Gbps | Many; both bilateral and open | <90% modem or 64 Kbps leased line |

### International Links

CCK has licensed 22 data carrier network operators who have licenses to operate commercial very small aperture terminal services (VSAT) and Internet backbone gateway services. Table 11 shows a remarkable increase in aggregate bandwidth between 2005 and end of 2007. Kenya's aggregate bandwidth is approximately 485 megabits [CCK 2008a]. This places Kenya at level 3 of the GDI framework since 485 falls between 45 megabits per second and 10 gigabytes per second. CCK links the increase in bandwidth usage to increased investments in the sector

(*resources*) due to greater demand for innovative provision of data services by ISPs (*demand*) (CCK 2008) and also due to a modest increase in the perception in the value of the Internet by consumers (*value*) [Kui 2008].

**Table 11. International Gateway Bandwidth**

| Gateway Options | 2003/2004 | 2004/2005 | 2005/2006 | 2007/2008 |
|---|---|---|---|---|
| International gateway downlink bandwidth (Mbps) | 84.91 | 89.89 | 100.96 | 337.18 |
| International gateway uplink bandwidth (Mbps) | 26.20 | 70.28 | 73.47 | 147.14 |
| International gateway total bandwidth (Mbps) | 111.10 | 223.38 | 174.43 | 485.14 |

Source: Internet Market Study [CCK 2008a]

## Internet Exchanges

Prior to 2002, no Internet exchange point existed in Kenya, and all traffic, local or international, would be routed by network providers outside the country. The state monopoly, Telkom, handled all traffic through its subsidiary Jambonet. Due to pressure from the Telecommunications Service Providers Association of Kenya (TESPOK), the regulator (CCK) granted a license to the Kenya Internet Exchange Point (KIXP) in 2001 [GIPI 2004]. KIXP started operations in February 2002.

As of September, 2007, 23 out of the 51 active ISPs were members of KIXP. A second IXP, Alma Limited, was licensed in 2006 but was not operational at the time of this writing. When KIXP began services in 2002, six ISPs were interconnected while eight were on the waiting list [KIXP, 2007]. KIXP's members actively exchange domestic traffic, improving internal traffic. TESPOK estimates that 30 percent of upstream traffic (229 Mbps) is to a local destination. The impact of allowing local peering through the Internet exchanges has seen reduced bandwidth costs for ISPs (Table 12).

**Table 12. Bandwidth Charges to ISPs [Adapted from CCK 2008a]**

| Bandwidth | 2005 (US$) | 2006 (US$) | 2007 (US$) |
|---|---|---|---|
| 32K Leased Line | 262 | 227 | 192 |
| 64 K Leased Line | 536 | 460 | 384 |
| 128 K Leased Line | 968 | 878 | 768 |

The pressure for Internet exchanges stemmed from prohibitive bandwidth costs that ISPs were charged by international satellite providers. This result was the licensing of the Internet exchange points and a restructuring of the licensing regime to provide more options for ISPs in providing connectivity to consumers (*regulatory*). Despite the positive changes, 80 percent of Kenya's Internet traffic is still routed via expensive satellite connections (*costs*) [Kui 2008]. The positive improvements on this GDI dimension can therefore be linked to pressure for better services (*demand*) by ISPs, even as costs of Internet service provision remain prohibitive (costs) due to over-reliance on satellite links.

## Domestic Backbone

Despite having a liberalized telecommunications market, the domestic backbone Internet infrastructure in Kenya has been dominated by Telkom Kenya, the national landline operator. In 2004, the government regulator licensed three more firms to offer domestic backbone service, which have been operational since: Kenya Data Networks, UUNET and Jamii Telecom. By 2008, eight firms had received a license to offer Internet backbone services.

Data on domestic traffic is difficult to come by, however given that 80 percent of Internet is routed internationally, the remaining 20 percent translates to roughly about 97 Mbs being transferred through local peering as at 2007 (Table 11). This places Kenya in level 2 of the GDI framework. While it was expected that the setup of an Internet exchange in Kenya would result in higher local traffic switching, lack of trust among service providers and costs of network

infrastructure required to link to the IXP are disincentives for collaboration [ISOC 2007]. The necessary conditions for encouraging domestic peering are still inadequate to optimize the value from keeping domestic traffic local (*enablers*). However, the continued licensing of more industry players is acting as a catalyst for changes in how the market is structured in Kenya for the benefit of the industry players (*regulation* and *demand*).

### Access Methods

The access methods measure reflects the percentage of users that use modems to access the Internet and the proportion of 64k Leased Lines in use. Kenyans have the option of accessing the Internet using either modems with dial-up connections or the leased lines. Dial-up connections are available through both fixed telephone lines as well as Code Division Multiple Access (CDMA) technology introduced in Kenya in late 2005.

Three operators provide CDMA wireless access technology: Telkom Kenya, Popote Wireless and Flashcom. Other operators plan to offer a wireless option as a business strategy to remain competitive in the increasingly liberalized telecommunications market. By some estimates 400,000 new Internet users will rely on the wireless option in the first half of the year 2008 [Kinyanjui 2008]. Many Kenyans opt for CDMA as equipment costs drop and coverage extends throughout the country. Currently, the coverage by Telkom is limited to 50 Kilometres of the major urban centres of Nairobi, Kisumu, Nakuru, Eldoret, Mombasa, and Nyeri.

By some analyses, the four major ISPs combined have over 400,000 dial-up connections. According to Telkom Kenya, Internet access is available through either the 64/128/256 Kbps leased lines or through the 64 Kbps dial-up accounts. Home users in Kenya mainly choose the option of the dial-up accounts or the wireless option because they are less expensive than leased lines. The leased line market is dominated by four Internet Gateway and Backbone Operators (IBGOs). Data collected from the IBGOs indicate that they have 7,637 customers on leased lines while 17,737 customers are on dial-up accounts [CCK 2008a]. This proportion of users on dial-up accounts, as an indicator of customers using modems, is approximately 70 percent of the total Internet user population. While there are a number of corporate customers on more than 64Kbs bandwidth, the bigger proportion of customers have connections of 32Kbs and 64Kbs. Kenya can be placed at level 2 (Table 13) since more than 70 percent of ISP customers use dial-up modems and those on leased lines purchase bandwidth capacity of less than 64Kbs.

**Table 13. Connectivity Infrastructure (2008)**

| **Connectivity Option** | **Level** |
|---|---|
| Domestic Backbone | Level 2 |
| International Links | Level 3 |
| Internet Exchanges | Level 3 |
| Access Methods | Level 2 |
| Overall | Level 2.5 |

In summary, the determinants that have played a role in positively influencing the connectivity infrastructure dimensions of the GDI framework are grouped under *value*, *demand*, *regulations* and *resources*. As the Internet sector becomes more competitive due to the licensing of operators by CCK (regulations), ISPs look for efficient ways to fulfil demand for Internet services. For instance, the prohibitive costs of Internet access for ISPs influenced the “struggle” to have a local Internet exchange point (*demand* at the operator level), while continued modest increases in perception of *value* by users fuels consumer *demand*. The result is increased investments in the Internet sector (*resources*).

Despite the positive influencers above, the CCK as the regulator has failed to create the necessary conditions for the operators (*enablers*). The struggle to have an Internet exchange point in the year 2000 and its subsequent shutdown by CCK illustrated that the regulator failed to recognize that having a peering mechanism could only lead to development of the Internet. The *costs* of Internet access are still high, even though there is a general trend that shows they have been reducing over the years [CCK 2008a]. The connectivity infrastructure as shown above is still relatively underdeveloped in terms of domestic backbone, international links, access methods and Internet exchange points.

## INTERNET ORGANIZATIONAL INFRASTRUCTURE

The organizational infrastructure dimension provides a measure of the competitiveness of the market for Internet and telecommunications services [Wolcott et al. 2001]. Table 14 provides an overview of the Organisational Infrastructure dimension and the characteristics of the different levels. Kenya is at level 3 in 2008.

| **Table 14. Organizational Infrastructure of the Internet in 2008** | |
|---|---|
| Level 0 | None. The Internet is not present in this country. |
| Level 1 | Single. A single ISP has the monopoly in the Internet service provision market. The ISP is generally owned or significantly controlled by the government. |
| Level 2 | Controlled. There are a few ISPs and the market is closely controlled through high barriers to entry. All ISPs connect to the international Internet through a monopoly telecommunications service provider. The provision of domestic infrastructure is also a monopoly. |
| Level 3 | Competitive. The Internet market is competitive. There are many ISPs and low barriers to market entry. The provision of international links is a monopoly, but the provision of domestic infrastructure is open to competition or vice versa. |
| Level 4 | Robust. There is a rich service provision infrastructure. There are many ISPs and low barriers to market entry. International links and domestic infrastructure are open to competition. There are collaborative organizations and arrangements such as public exchanges, industry associations, and emergency response teams. |

The development of a competitive market sector can be traced to the early 1990s when Kenya was a one party state under President Moi whose government was faced with a lot of international and local pressure to open up democratic space in the country [Muiruri 2004]. The pressure was in the form of aid cuts for budgetary support as well as increasing agitation for reinstatement of democracy. Government agencies, such as the former Kenya Posts and Telecommunications (KP& TC), were under pressure from the government to rationalise their existence by generating revenue for the government. Thus beginning of the restructuring process in 1999 can be traced to the larger democratic processes that were underway since the early 1990s.

Another trigger to the development of a competitive market sector can also be traced to the influence of early Internet entrepreneurs who came with the knowledge from the developed world (*entrepreneurship*). Kenyans who were returning from their studies in the US and UK established the first three ISPs. Dr. Shem Ochuodho started African Regional Center for Computing (ARCC) with support from the British Overseas Development Fund. Africa Online was started by two former MIT graduates and a Princeton graduate. Form-net Africa was started by Nazim Njani who returned from United Kingdom. Africa Online obtained funding from Prodigy Inc while Form-net Africa had financial backing from a politician who was pro-government at that time [Muiruri 2004]. The regulations that have been instrumental (Table 15) in influencing the development of organizational infrastructure should therefore be seen from these two triggers: larger democratization processes since early 1990s (*change*) as well as the influence of commercial sector entrepreneurs in the introduction of the Internet (*entrepreneurship*). Some of the highlights of the regulations are discussed below.

| **Table 15. Critical Regulations Influencing Organizational Infrastructure** | | |
|---|---|---|
| **Government Regulation** | **Year** | **Reference** |
| Restructuring of the telecommunications sector | 1998 | [Mudavadi 2001] |
| Adoption of universal service provision as a strategy for achieving infrastructure goals | 2004 | [www.cck.go.ke] |
| Licensing of Local Loop Operators at the end of Telkom's exclusivity period | 2004 | [CCK 2008a] |
| Consolidation of general international data licenses into one | 2005 | [CCK 2007] |

The restructuring of the telecommunications through the crafting and adoption of the Kenya Communications Act 1998 created a multi-operator market structure formally under the monopoly of KP & TC. The act provided Telkom exclusivity in the provision of national fixed telephony as well as international gateway services up to 2004. The

move has since been instrumental in revitalization of the telecommunications sector through the continued licensing of more sector players, development of a competition policy sector and liberalization policy for the sector [Mudavadi 2001]. The number of registered ISPs increased from three in 1996 to peak at 40 by mid July of 1999 due to activities that followed the restructuring of the sector in 1998.

CCK has continued to focus its regulation of the telecommunications hinged on the need to achieve universal service goals for the Kenyan population. The regulator recognized in 2004 that despite the liberalization of the sector since 1998, access to ICT services is limited to residents of major towns, leaving out the rural areas where 80% of the population live without these services [www.cck.go.ke]. The result of a policy focus on universal service provision has resulted in various infrastructure initiatives such as EASSY and TEAMS that has seen increased resource inflows and more participants in the sector. Prospects of profitability of the sector are high as many ISPs continue to extend their services into the rural underserved areas. There are a total of 78 registered ISPs, 35 of which are operational [CCK, 2008a].

The end of Telkom's exclusivity in the provision of Internet backbone services ended in 2004 and efforts to engage a second national operator (SNO) have since failed. However, CCK has ensured there is competition in the provision of Internet backbone services nationally and internationally by licensing of local loop operators as well as allowing ISPs to provide voice over Internet protocol (VOIP) services [CCK 2008a]. The licensing of local loop operators resulted in the introduction of code division multi-access (CDMA) as a connection option for those requiring Internet services. Latest reports indicate that fixed wireless/wired CDMA connections account for 193064 users, while mobile connections account for close to 12 million users [CCK 2007]. This installed capacity gives an indicator as to the likely influencer of this dimension: that as a result of a high critical mass of potential users requiring Internet services, a requisite number of organizational (ISPs and consumer interest groups) bodies are needed to represent their interests (*demand*).

CCK has also enhanced its licensing procedures by consolidating international data licenses under a category known as Data Carrier Network Operator (DCNO). Under this category, ISPs were allowed to operate as network backbone service providers as well as provide Internet services under a single licence. However, the requirement is that the ISP cannot compete in the two market segments under a single company name. This move resulted in the registration of 22 DCNOs which resulted in reduced cost of provision of data services due to more competition in the sector (*costs*). Bandwidth costs are on the decline for ISPs, who pass on the benefits to the consumers (Table 12).

### ISP Size and Barriers to Entry

Following the 2004 removal of the Telkom Kenya's monopoly clause in both domestic and international telecommunications services many new players in the Internet services market emerged. However, CCK introduced stringent obligations which required ISPs to file returns on an annual basis on whether the ISPs were meeting their service obligations. The subsequent enforcement of this licensing requirement resulted in deregistration of 51 out of 72 ISPs that were registered in 2004. Stringent enforcement of licensing obligations by CCK resulted in deregistration of certain ISPs in 2004. The high number of ISPs (72 in early 2004) point to few entry barriers and a perception of high return on investments by entrepreneurs (*entrepreneurship*). The deregistrations may point to start-up ISPs' difficulty in attracting resources (*resources*) and increased enforcement of rules by CCK (*regulations*) aimed at ensuring consumer protection. The government realized that growth of the Internet driven by the commercial-sector without the subvention of the government failed to meet public policy goals such as universal service. CCK enforced licensing requirements more stringently, leading to increased operational costs for ISPs (*costs*).

### Organizational Bodies

Another measure of competitiveness in the industry is the existence of organizational bodies that lobby for the interests of their members [Wolcott et al. 2001]. In Kenya, ISPs collaborate in an association called the Telecommunications Services Providers of Kenya (TESPOK). The mission of TESPOK is to be the telecommunications industry's voice by providing policy and direction within the industry and government [Southwood 2007]. Since its inception in 1999, TESPOK has been a stakeholder in government ICT policy-making and successfully negotiated for the establishment of KIXP.

In 2002 Kenya formed the Kenya Network Information Centre (KENIC) to manage the registration of domain names. Initially Telkom Kenya and the ISPs handled this task without consulting a central body. Prior to the formation of KENIC, the country level domain (.ke) was administered by an individual based in the USA. This issue was not addressed until the formation of KENIC. The inference may be that Telkom did not see value in managing the registration of country level domains (*value*).

The Cyber Café owners Association of Kenya was formed to lobby for the interests of its members, particularly for a reduction of the costs charged to them by ISPs and Network Operators. The association works to increase the options of type-approved equipment that cyber café owners can use and to lobby the regulator for lower licence fees. There is evidence that the various organizational bodies are in collaboration to enhance the effectiveness of their lobbying. For instance Southwood [2007] indicates that these organizations have been using media resources and mass persuasion, forcing policy changes for the betterment of Internet users countrywide.

Consumer-oriented organizations also have sprung up since 2006. The Kenya ICT Action Network [www.kictanet.or.ke] was formed as a multi-stakeholder network to help reform the ICT sector in Kenya. The group was instrumental in forming the ICT Consumer Association of Kenya, which aims at institutionalizing consumer protection. Its annual meeting held in May 2007 was inundated with consumer concerns revolving around slow Internet connections as well as high costs of Internet access. CCK is also focused on institutionalizing consumer protection and has set up structures for addressing consumer complaints regarding service quality and costs of access.

Given that all these bodies enhance the competitiveness of the industry, it might initially be argued that Kenya is at level 4 of the organizational infrastructure of the GDI framework. However, most of the industry associations are still nascent and the regulator still holds power in the sector. There are currently no visible emergency response teams. Kenya can therefore be placed at level 3.

Overall, the positive influences that have been at play on organizational infrastructure are a mix of the entrepreneurial culture (*entrepreneurship*), forces of change (*change*), regulatory and legal processes (*regulations*), *value* as well as reduced *costs* for service provision. However, *resources* are still a limiting factor in ensuring more organizations registered to offer services realize their growth goals.

## SOPHISTICATION OF USE

The Sophistication of Use dimension evaluates the level of innovation associated with the Internet [Wolcott et al. 2001]. Table 16 provides an overview of the dimension with the highlighted portion indicating the 2008 level based on the analysis that follows. The analysis on sophistication of use shall focus on individual as well as business use of the Internet.

**Table 16. Sophistication of Use as of 2008**

| | |
|---|---|
| Level 0 | **None.** The Internet is not used, except by a very small fraction of the population that logs into foreign services. |
| Level 1 | Minimal. The user community struggles to employ the Internet in conventional, mainstream applications. |
| Level 2 | **Conventional.** The user community changes established practices somewhat in response to or in order to accommodate the technology, but few established processes are changed dramatically. The Internet is used as a substitute or straightforward enhancement for an existing process (e.g. e-mail vs. post). This is the first level at which we can say that the Internet has taken hold in a country. |
| Level 3 | **Transforming.** The use of the Internet by certain segments of users results in new applications, or significant changes in existing processes and practices, although these innovations may not necessarily stretch the boundaries of the technology's capabilities. |
| Level 4 | **Innovating.** Segments of the user community are discriminating and highly demanding. These segments are regularly applying, or seeking to apply, the Internet in innovative ways that push the capabilities of the technology. They play a significant role in driving the state-of-the-art and have a mutually beneficial and synergistic relationship with developers. |

As early as May 1999, there was e-commerce activity in various sectors. A study conducted by Mureithi [2005] showed that the proportion by sector engaged in e-commerce was: tours and travel (58 percent), hotel and restaurant services (20 percent), arts and handicraft (16 percent), with the rest in sectors such as agriculture, shipping, and manufacturing [Mureithi 2005]. Definite figures are difficult to obtain as to the overall level of e-commerce activity in Kenya. Another study by Muganda and Van Belle [2007] examined e-commerce activity in

Kenya for the period 2001 to 2005. The results indicated that firms were using the Internet for business in various ways. Some used it for organizational improvement, transformation or even the redesign of their businesses. Using the Internet as a strategy for achieving transformation implies it is being employed by organizations to redesign their processes.

Apart from new enterprises emerging, there are also organizations such as E-sokoni found at www.symphony.in, a business-to-business trading hub, which is trying to use the Internet to integrate suppliers and consumers so that firms can cut down on operational costs. It had about 200 suppliers by 2002 [Kinjanjui and McCormick 2002]. Kinyanjui and McCormick [2002] also studied the use of the Internet in the garment sector, which has traditionally been considered to be slow in the uptake of technology. The 12 firms they focused on confirmed that the sector had been engaging in B2B ecommerce, resulting in either a change of their suppliers, increased international suppliers or increased revenues.

In 2004, Kenya initiated an ambitious five-year e-government strategy. The E-Government Strategy [GOK-EGS, 2004] spells out short-term, medium-term and long-term initiatives aimed at enhancing collaboration within government, with businesses and with citizens. As a result of this initiative, a total of 34 government departments now have their own Web sites, most already at a transactional level though some are currently still purely informational.

According to Wolcott et al [2001], 5 percent of all Web sites should be interactive to be at level 3. Analysis shows that most of the 33 government Web sites are interactive since they allow for provision of online feedback, online enquiries, and online applications for services such as licenses, national identity cards, etc. In tandem with these web initiatives, the government is also in the process of enhancing connectivity via CDMA technology up to the fourth tier (location) of political administration. Enhancing connectivity to this level of political administration is expected to increase accessibility and use of government Web sites by citizenry in the rural areas.

These developments point to the use of the Internet by leading edge groups for transformation purposes. For instance, Mobile Government in the Ministry of Education to transform delivery of examination results to the population, 80 percent of which lives in the rural areas [MOEST, 2007]. Therefore, Kenya has achieved level 3 in sophistication of use. A determinant which has strongly driven this dimension to level 3 is the perceived value of the Internet (*value*). The Internet infrastructure has been used to exploit opportunities available as well as the adequacy and fluidity of resources (*resources*) given that most of the leading edge initiatives are private sector driven. Even some initiatives within government have private sector participation. The Ministry of Education has partnered with the private sector through the Kenya ICT Federation to help it realize its ICT Vision [MOEST 2007]. The private sector has the ability to marshal resources coupled with the ability to execute (*execution*) to realize their plans. However, the relevance of digital content on the Internet and the low levels of computer literacy (*enablers*) are still challenges to the realization of higher levels of sophistication of use [CCK 2008]

## SUMMARY OF THE OF THE INTERNET INFRASTRUCTURE

A summary of the values of the six dimensions is shown in Table 17. A minus indicates that the determinant has a negative influence, while a positive sign indicates a positive influence.

**Table 17. Summary of Kenya's Internet Dimensions for 2007/8**

| Dimension | Level | Diffusion Determinants |
|---|---|---|
| Pervasiveness | Level 3: Established | *Entrepreneurship (+); Value (+); Execution (+, -); Regulations (+), Costs (-); Access [-]* |
| Geographic Dispersion | Level 2: Moderately dispersed | *Regulations (+); Resources (-); Execution (-); Constituent Technologies (-)* |
| Sectoral Absorption | Level 2: Moderate | *Value (+, -); Resources (+, -); Access [-]* |
| Connectivity Infrastructure | Level 2.5: Expanded | *Resources (+), Demand (+), Value (+); Regulation (+); Enablers (+,-); Costs (-);* |
| Organisational Infrastructure | Level 3: Competitive | *Entrepreneurship (+); Change (+);Costs (+); Regulation (+) Resources (-); Value (-)* |
| Sophistication of Use | Level 3: Transforming | *Value (+); Resources (+); Execution (+); Enablers (-); Access[-]* |

In summary, Internet diffusion has been positively influenced primarily by a healthy culture of entrepreneurship in Kenya (*entrepreneurship*), witnessed in the lead role that commercial sector organizations took in introducing it in the formative years. A strong impetus for change linked to the overall democratization process in Kenya (*change*) forced early liberalization of the telecommunications sector by the government (*execution, regulation*). With the e-government strategy and ICT strategy, the government has taken an active interest, mobilizing resources and increasing the perception of value (*value*; *resources*). Government interventions, as well as pressure from commercial interests and civil society provide an explanatory lens for explaining the positive state of the Internet infrastructure in Kenya.

Negative influences on Internet diffusion cluster around unclear licensing requirements, thus continued lack of a SNO (*execution*), lack of resources (*resources*) to extend connectivity to underserved areas, an unclear value-proposition of the Internet in the health and education sectors (*value*) due to their prevalence in areas with no electricity (*constituent technologies*), persistent high bandwidth *costs* for ISPs due to expensive satellite connections and a continued inability for CCK and other sector players to create an enabling environment for realization of universal goals despite positive trends (*enablers*).

However, it is hoped that policy initiatives that are being undertaken by the government and other stakeholders in the telecommunications industry will change the negative impact of these determinants on Internet diffusion in Kenya. The following section lists some recommendations on how the government can impact the various determinants of Internet diffusion, some of which are likely to be addressed by more recent (2007/2008) policy initiatives.

## V. GOVERNMENT ROLE AND POLICY RECOMMENDATIONS

Shin [2007] provides several roles that may be played by the government during the process of building a national information infrastructure. The government can act as a direct intervener, by setting goals and guidelines for industry to follow (controller); by providing the physical infrastructure for everyone to access information (builder); by creating a fair business competition ground (regulator) and by becoming a major producer and buyer of ICT (investor). The government can also act as an indirect facilitator, in which it becomes the main body for developing a vision for the whole country (strategist); creates a proper environment for innovation and growth through channeling of resources to the ICT sector (guider); establishes ICT as a national priority (leader); and articulates the objectives of various programs into a single vision (integrator). The two major sub-categories (direct or indirect intervener) are used to point out possible roles that were not adequately played by the government in positively influencing the Internet diffusion trajectory. This is done by looking at the various determinants.

When looking at the perceived value of the Internet (*value*), the lack of government involvement in the earlier years of Internet development brings to the fore why the dimensions such as geographic dispersion, connectivity and sectoral absorption are still at lower levels. Appreciation of the Internet's value in government limited the Internet's diffusion outside of the major urban centers, though commercialization in Kenya is now over 13 years old.

The skewed development of the Internet in favor of the urban populace, and more specifically within the two largest cities, Nairobi and Mombasa, can be linked to other proximate causes arising from the "value." For instance, the fact that the government was not instrumental in the commercialization of the Internet, except in a regulatory role (*regulations*), may have forced the 78 ISPs that have been part of the Internet landscape since its inception, to focus only on locations where they would get a financial return on the basis that a physical infrastructure already existed (such as electricity and relevant ICTs) as well as requisite demand. A private entrepreneur may not be in a position to marshal the necessary resources to invest in areas that do not have adequate demand or the physical infrastructure. Therefore, what emerges is a situation where the government did not, in time, rightly conceptualize the value of the Internet (*value*) and marshal resources (*resources*) to build requisite infrastructure in areas that lacked them, or act as an enabler of change (*enabler*) by fostering favorable conditions for its adoption.

These determinants, or the lack thereof, can be linked to the inability of the government to play specific roles required for the building of a national technological infrastructure. Analyzing the various roles of government under the two categories of direct intervener and indirect facilitator [Shin 2007] reveals that the government of Kenya in the formative years of Internet infrastructure development did not play a prominent role as either. For instance, the role of government as an ICT investor in Kenya is a recent phenomenon appearing post-2004 with the creation of the Ministry of ICT and the subsequent articulation of an ICT vision and strategy. Even the role of government as a regulator was mainly as a result of larger democratization processes in Kenya which culminated in the establishment of CCK in 1998.

In addition, the government's role as a builder is also questionable, especially given the skewed nature in which the physical infrastructure of the Internet has developed, more in favor of urban centers than rural areas. While these

roles may have improved since 2004, the inadequacies prior to that date play an important role in explaining Internet diffusion as it is.

| Table 18. Recent Policy Initiatives for Kenya |
|---|
| ***P1. Government Crackdown on Pirated Software*** *(piracy)*:<br>Under the office of Attorney General, the Government, is cracking down on businesses using illegally acquired software. This initiative is being undertaken in conjunction with Microsoft and Kenya Copyright Board. Kenya has one of the highest piracy rates in the world in which 8 out of 10 computers have pirated software [Kenya ICT Board 2008]. |
| ***P2. Digital Villages Project (DV)*** *(digital inclusion):*<br>The Ministry of ICT and the Kenya ICT Board have embarked on a connectivity and e-services delivery project. The goal of the project is to boost ICT Connectivity in the country, improve service delivery to citizens, improve type and quality of information to and from citizens and ensure government's ability to ensure transparency. [Kenya ICT Board 2008]. |
| ***P3. Rising Profile of ICT Sector within Government and Globally*** *(ICT Profile)*:<br>The Government of Kenya has formally developed a national ICT Policy and Strategy, a Freedom of Information Policy, the Electronic Transactions Act and an E-Government Strategy which is in the medium-term review process. In addition, many multinational corporations consider Kenya to be Africa's major ICT-hub besides South Africa. [GOK-EGS 2004; GOK-NICT 2006; Kenya ICT Board 2008] |
| ***P4. Strengthening of Public-Private Sector Partnerships*** *(partnerships):*<br>The government and the private sector are collaborating on a number of ICT-related initiatives. These include collaborations with Kenya ICT Federation, ICT Village, banking institutions and multinational organizations. [MOICT 2008] |
| ***P5. National and Regional Infrastructure Projects*** *(infrastructure):*<br>The Kenya government is involved with a number of telecommunications and other physical infrastructure projects which are financed by the private sector, the World Bank, the government of Kenya and consortia of local and multi-national organizations. These infrastructure projects include the Eastern Africa marine cable system (TEAMS; EASSY) and the National Fiber Optic Backbone Infrastructure (NOFBI) [CCK 2008a]. Promote Regional and International cooperation within the ICT sector.<br><br>Other projects include the implementation of COMESA Telecommunications Project (COMTEL) that aims at improving connection between telecommunications network within the COMESA Region. The project will put to an end the rerouting of regional traffic through other countries outside COMESA thus reducing the regional communications costs. The other projects include East African Internet Exchange Point and East African Postal Automation Project among others [MOICT 2008]. |
| ***P6. Continuing liberalization of the Telecommunications Market*** *(Restructuring):*<br>The licensing of a second national operator, the licensing of additional fixed-to-wireless CDMA service providers, the sale of Telkom to France Telecom and general industry mergers (various sources and observations) |
| ***P7. Improve Equity in the Provision of ICT*** *(Equity)*<br>In order to promote social equity for the disadvantaged groups, targeted programs will be implemented to enhance their participation in development process. The Ministry will support development of multipurpose community centers and public libraries as public ICT access centers through provision of complimentary infrastructure like electricity and telecommunications. The project will target farmers, "Jua Kali" artisans, community based organizations, marginalized groups among others by providing internet Kiosks at proximity locations in both urban and rural areas. The Ministry will also provide physical incentives as a way of addressing inequitable access to ICT [MOICT 2008]. |
| ***P8. Financing*** *(financing)*<br>The government will explore financing mechanism for the development of the ICT industry including public private sector partnership establishment of universal access fund; digital solidarity fund; multilateral and bilateral funding; promotion of investment through liberalization and licensing of additional operators; and encouraging equity ownership [MOICT 2006; Kenya ICT Board 2008). |

The above analysis reveals that the government role as an indirect facilitator is inadequate and contributes to the low GDI levels as they are. For instance, to play a role of a strategist, the government would have had to craft a vision for the development of the Internet visible in its formative years. Had the government been able to marshal resources, the development of the Internet would not have been so skewed. For instance, the household penetration rate of electricity is barely 4 percent with approximately 920,000 electricity accounts, yet it is a prerequisite for Internet access. This forces Internet users to access the Internet from cyber cafes, at work, or in homes that have electricity connections. The inability to marshal resources has hindered the availability of technologies dependent on electricity.

Another indicator of an inadequate role of indirect facilitator is not only the lack of proper articulation of ICT as a national priority within a knowledge-based society in earlier years of Internet commercialization, but the subsequent inability to show urgency in the process of its crafting and adopting [Waema and Mitullah 2007]. Finally, it may also be pointed out that the country has not really been galvanized under a single banner of building a common national information infrastructure (NII) clustered around both physical and wireless technologies, where the government plays the role of integrator. Instead, the structural organization still shows that the government has not adequately conceptualized the NII as a necessary antecedent to applications reliant on it such as e-business, e-commerce, mobile government and e-government. For instance, the government of Kenya has two ministries: the Ministry of ICT which is mostly charged with universal access issues, and the Directorate of E-Government which is seemingly tasked with co-coordinating back office integration of government.

Overall, the government's inability or unwillingness to play a dominant role as a direct intervener and an indirect facilitator have influenced the trajectory of Internet diffusion in a way that promotes the concentration of the Internet and its use in the urban centers, excluding more than 80 percent of Kenya's population. In addition, the use of English on Web sites excludes large portions of the population. Table 18 lists some of the policy initiatives of the government and the industry which are likely to impact on the determinants over the medium and long term. The authors' (Table 19) recommendations attempt to re-dress the skewed Internet diffusion trajectory, as well as give pointers on how the recent government initiatives are likely to impact positively on the determinants of Internet diffusion. Table 20 summarizes the recommendations and the policy initiatives and how they are likely to impact on the determinants of Internet diffusion.

## VI. CONCLUSIONS

The analysis in this article has shown that as of 2008, Internet diffusion in Kenya is at level 3 of pervasiveness, connectivity infrastructure, organizational infrastructure and sophistication of use. Sectoral absorption and geographic dispersion are each at level 2. The determinants that positively influenced the GDI dimensions were primarily clustered around the external/surrounding forces and specifically those related to "change,", "regulations,", "enablers," and "entrepreneurship.". Overall, the surrounding social/economic and regulatory system in Kenya elevates the role of champions returning from the diaspora as change agents; the quest for greater democratization and a more open government due to years of dictatorial rule, and generally a culture of entrepreneurship inculcated from a history of capitalism in Kenya. Determinants that negatively influenced the GDI dimensions significantly were found to be *execution*, *constituent technologies*, *value,* and *resources*. More recently, *cost* has also played a role.

The Internet growth trajectory brings to the fore possible unintended consequences related to the exclusion of large segments of the population that can be linked to the geographic dispersion and sectoral absorption. The penetration of electricity is unacceptably low reaching only 4 percent of the population with the distribution primarily skewed in favour of urban populations. This has limited the geographic dispersion of the Internet to Kenya's urban centres. While the policy initiatives of the government are laudable, priority should be given to extending the physical infrastructure of electricity to underserviced areas. If the physical infrastructure of electricity is not built, then large segments of the population will not engage in those activities that rely on the Internet infrastructure such as e-government and e-business. Exclusion of large segments of the population from participating in activities that are reliant on the telecommunications infrastructure has been characterized as digital or social exclusion [Warschauer 2003]. This finding maybe masked by the good average performance as reflected on the dimensions of the GDI framework.

The sectoral absorption analysis prominently elevated the dominance of the commercial sector over the public sector, yet public sector participation is critical in ensuring equitable growth. The policy initiatives envisage greater participation of the public sector especially with regard to universal service goals. This should be coupled with a confluence of other events such as increasing public awareness of the value of the Internet, as well as formalizing the provision of ICT education. This is necessary to make those applications that are dependent on the Internet acceptable to a large segment of the population, without exclusion.

| Table 19. Expected Impacts of Policy Initiatives for Kenya | | |
|---|---|---|
| **Determinant** | **Policy recommendations and objectives** | **How Policy Initiatives impact** |
| 1. Perceived Value of the Internet | Speed up implementation of e-government | *ICT profile* and *Equity*. These are likely to impact positively, since as more resources are channeled to the ICT sector, questions of ROI will be paramount. |
| 2. Ease of Use of the Internet | Introduce information and computer literacy education at all levels<br>Develop content in local languages to encourage Internet use<br>Develop more mobile phone-based applications | *Digital Inclusion* may encourage this as the Internet is brought closer to populations; it becomes less of a myth.<br>*Piracy* may have a negative influence initially, even though piracy is unethical. |
| 3. Cost of Internet Access | Remove impediments inhibiting Second National Operator (SNO) operations<br>License more fixed-to-wireless operators | *Partnerships, Infrastructure* and *Restructuring* may encourage this. |
| 4. Access to Constituent Technologies | Extend the accessibility of electricity<br>Encourage local assembly of technologies through incentives. | *Digital Inclusion, Equity* and *Financing* may encourage this. The government expects to assemble the *madaraka* computer using local capabilities. |
| 5. Demand for Capacity, Multiplicity of ISPs, Services Provided | Make Internet communications at lower administrative levels mandatory<br>Brand local tourism using Internet-based commerce | *Infrastructure* may be critical in the setting up of ISPs in all the districts, who can stimulate demand.<br>*Digital Inclusion, ICT Profile, Partnerships, Infrastructure* and *Restructuring* may encourage this. |
| 6. Geography | Speed up implementation of infrastructure projects<br>Provide “tax havens” for infrastructure projects in underserviced areas | *Digital Inclusion, Partnerships, Infrastructure, Equity* and *Financing* are likely to impact positively |
| 7. Adequacy and Fluidity of Resources | Encourage projects that enhance social resources of communities<br>Provide incentives to projects in under serviced areas | *Partnerships* and *Financing* are likely to encourage this. |
| 8. Ability to Execute | Define mandate of government as facilitator, intervener | *Restructuring* and *Partnerships* are likely to encourage this. |
| 9. Culture of Entrepreneurship | Re-orient education systems to reflect this | *Digital Inclusion* is likely to encourage this. |
| 10. Regulatory/legal framework | Innovate regulatory regimes relevant for local context | *Partnerships* is likely to impact positively |
| 11. Forces of Change | Encourage competition | *Restructuring* is likely to encourage this |
| 12. Enablers of Change | Explore applicability of mobile technologies as the basis of a National Information Infrastructure (NII) | Current *Infrastructure* may discourage this, but rising costs may force a re-look into other options. |

Future research can build on this study by examining the consequences of the policy directives in more detail in order to establish the extent of their effect. In addition, the possibilities of building a national information infrastructure based on wireless technology should be researched. The evidence emerging from Kenya is that more users prefer the use of mobile telephony as opposed to fixed telephony, and in fact there has already been a reduction in fixed line subscribers [CCK 2008a]. Research could explore how mass scale adoption of Internet-based applications can be structured around mobile telephony, especially in the case of developing countries that have an inadequate physical Internet infrastructure.

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## ABOUT THE AUTHORS

**Nixon Muganda Ochara** is a research associate and doctoral candidate (2005-2008) at the University of Cape Town, South Africa. He is also a lecturer in Information Systems at the School of Business, University of Nairobi, Kenya. His doctoral thesis is on *The E-Government Technology Artifact*. He has published papers in *CAIS, AMCIS 2006 Conference; IBIMA 2007 and 2008 Conferences*, *Electronic Journal of Information Systems in Developing Countries and the African Journal of Information Systems*.

**Jean-Paul Van Belle** is an associate professor in Information Systems at the University of Cape Town, South Africa. He obtained his Ph.D. from the University of Cape Town in 2001 by investigating the topic of Enterprise Information Architecture. He has publications in the *Electronic Journal of Information Systems Evaluation, Electronic Journal of Communication, Journal of Community Informatics, Academy of Educational Leadership Journal,* and *South African Computer Journal,* among others.

**Irwin Brown** is an associate professor in Information Systems at the University of Cape Town, South Africa. He obtained his Ph.D. from the University of Cape Town in 2005 by investigating the topic of Strategic Information Systems Planning. He has published in the *CAIS, Information Resources Management Journal*, *International Journal of Information Management*, *Journal of Global Information Management*, *Journal of Global Information Technology Management, Electronic Journal of Information Systems in Developing Countries, Journal of Internet Banking and Commerce,* and *Educational Technology and Society Journal*.

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