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Full Length Research Paper

Impact of information and communication technologies (ICTs) on millennium development goals (MDGs): Context for diffusion and adoption of ICT innovations in East and Southern Africa

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Information and communication technologies (ICTs) impact all the millennium development goals (MDGs), especially in eradicating extreme poverty and hunger. The correlation between ICTs and high economic growth has not been well researched in most African countries. The specific objectives of the research are: to assess the impact of ICTs on MDGs, to ascertain the ICT impact on economic growth, and determine the pattern for diffusion and adoption of ICT innovations in East and Southern Africa, and to recommend a development model or a framework for economic growth for these African countries. The methodology used was largely qualitative on technology capacity needs assessment that covered 6 countries, and also quantitative on gross domestic product (GDP) and Infodensity covering 18 countries in East and Southern Africa. GDP and Infodensity data was collected for 18 African countries to ascertain the link between ICTs diffusion and GDP density per country. The mean for the 18 East and Southern African countries with respect to main telephone density is 3.8%, mobile subscribers is 27.87%, and internet use is at 4.87%. Capacity needs assessment included both the human capital development and social capital aspects in order to achieve sustainable information and communication technology capacity development. Human capital development is central to capacity needs. There is a strong correlation between ICT diffusion and high economic growth, evidenced by high mobile density. The mobile phone has become a good measure of wealth for an average African. The solution to poverty and under-development in these African countries is, therefore, knowledge and economic empowerment. The recommended sustainable technology development with an African model is proposed.

Key words: Information and communication technologies, millennium development goals, sustainable development, diffusion, infodensity, gross domestic product.

INTRODUCTION

The major problem of under-development in Africa characterised by the huge challenge to achieve the Millennium Development Goals (MDGs) is on knowledge empowerment supported by Information and Communication Technologies (ICTs) . Information has become a strategic resource, a commodity and foundation of every activity. The emergence and convergence of information and communication technologies (ICTs) has remained at the centre of global socio-economic transformations. If implemented properly and carefully, these technologies could reduce or eliminate the imbalance between rich and poor, and powerful and marginalized.

The productive capacity of a country is determined by the quantity and quality of its factors of production**.** Info-density is the sum of all ICT stocks, mainly as capital and labour. According to UNCTAD (2006), 1% increase in Info-density resulted on average in 0.3% increase in per capita GDP. The increase in info-density over time is illustrated in Figure 1.

Baliamoune-Lutz (2003) conducted research using data from developing countries and examined the links between ICT diffusion and per capita income, trade and financial indicators, education, and freedom indicators. Internet hosts, Internet users, personal computers and mobile phones represent indicators of ICT. It is important to assess the adoption and diffusion of ICTs in key sectors of the economies of Southern and East African countries, and to collate basic information about the actual and potential applications of ICTs in order to have a clear understanding of the specific policy environments and sustainable capacity requirements. Some researchers argue that the transfer of ICTs to developing countries may not contribute to economic development the same way it did in industrial countries, and that it may be best to localize technology and focus on its use in education (Baliamoune-Lutz, 2003) and sustainable development of economic growth.

Diffusion is the process in which an innovation is communicated through certain channels over time among the members of a social system. It is a special type of communication, in that the messages are concerned with new ideas (Rogers, 2003: 5). Innovations diffuse through a social system explained by the diffusion of innovation theory (Rogers, 2003). Diffusion of innovation is a theory that analyzes, as well as explain, the adaptation of a new innovation. The purpose of this theory to the research is to provide a conceptual paradigm for understanding the process of diffusion and social change associated with ICTs. African countries are largely end consumers of technology and fall among the late majority (34%) and laggards (16%) with respect to ICT innovations. This is illustrated in Figure 2. Innovations that are perceived by individuals as having greater relative advantage, compatibility, trialability, observability, and less complexity will be adopted more rapidly than other innovations (Rogers, 1995).

The major developmental problem being faced by East and Southern African countries, which is the subject of focus for this paper, is multi-faceted and includes the following symptoms derived from Kabanda (2008):

(1) Many donor-driven initiatives that excluded both policy-formulation frameworks and sustainable capacity building have not brought meaningful development in these African countries.
(2) The Government policies, donor interest and community development needs are totally divergent with respect to priority areas for development.
(3) Africa needs to break the under-development, poverty and illiterate cycles in the long term and exploit the blessed resources available to create wealth. Extensive investment in technology and human capital development as a vehicle to exploit the vast mineral and natural resources has not been given sufficient attention.
(4) Poverty reduction requires a sustainable solution that increases production capacity at individual, institutional, community and national levels. The impact of ICTs on MDGs and generally economic growth needs a detailed assessment.

Some researchers argue that the transfer of ICTs to developing countries may not contribute to economic development the same way it did in industrial countries, and that it may be best to localize technology and focus on its use in education (Baliamoune-Lutz, 2003) and sustainable development of economic growth. The correlation between ICT use and economic growth is interrogated and the issue of the direction of causality is investigated. The specific objectives of the research are:

(a) To assess the impact of ICTs on MDGs.
(b) To ascertain the ICT impact on economic growth, and determine the pattern for diffusion and adoption of ICT innovations in East and Southern Africa.
(c) To recommend a development model or a framework for economic growth for these African countries.

LITERATURE REVIEW

According to the International Telecommunication Union study (ITU, 2010), the relevance and impact of ICTs to the MDGs is tabulated in Table 1 (http://www.itu.int/ITU-D/ict/publications/wtdr_03/material/ICTs _MDGs.pdf). Therefore, ICTs impact on all the MDGs in different ways. The fast track to the achievement of MDGs lies greatly in the ability to effectively manage the diffusion and adoption of ICTs for development.

Debates have ensured on how information and communication technologies (ICTs) can help to alleviate poverty in low-income countries (Heeks, 1999). Advances in communication technologies have enabled many countries to improve the lives of their citizens through improved health, education and public service systems, and economies (Kekana, 2002). A knowledge economy requires:

(a) Widespread access to communication networks;
(b) The existence of an educated labour-force and consumers (human capital); and
(c) The availability of institutions that promote knowledge creation and dissemination.

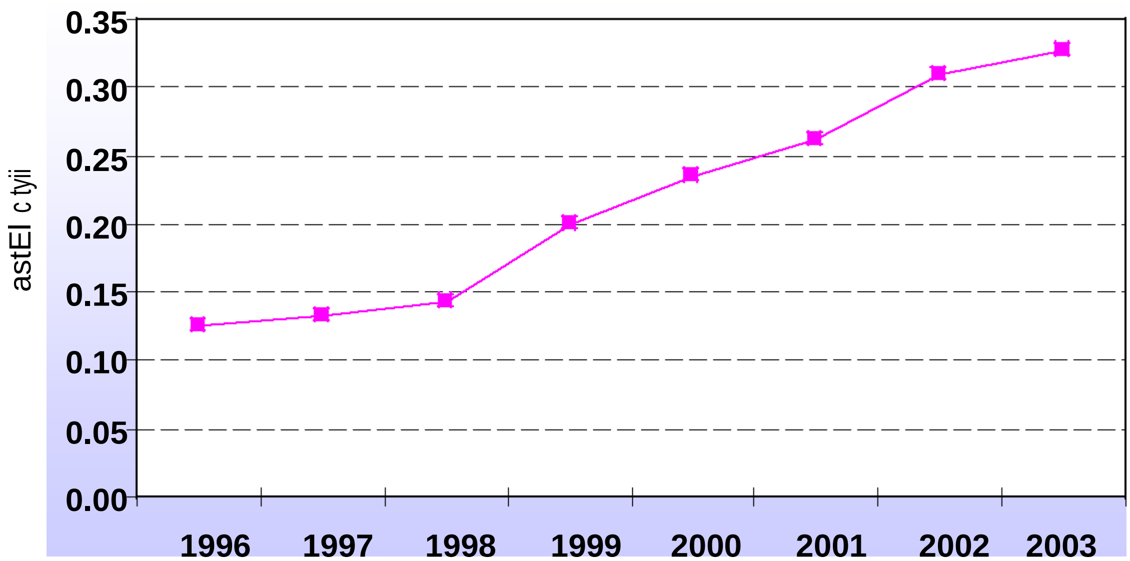


Figure 1. Infodensity and increase in per capita GDP (Source: UNCTAD, 2006).

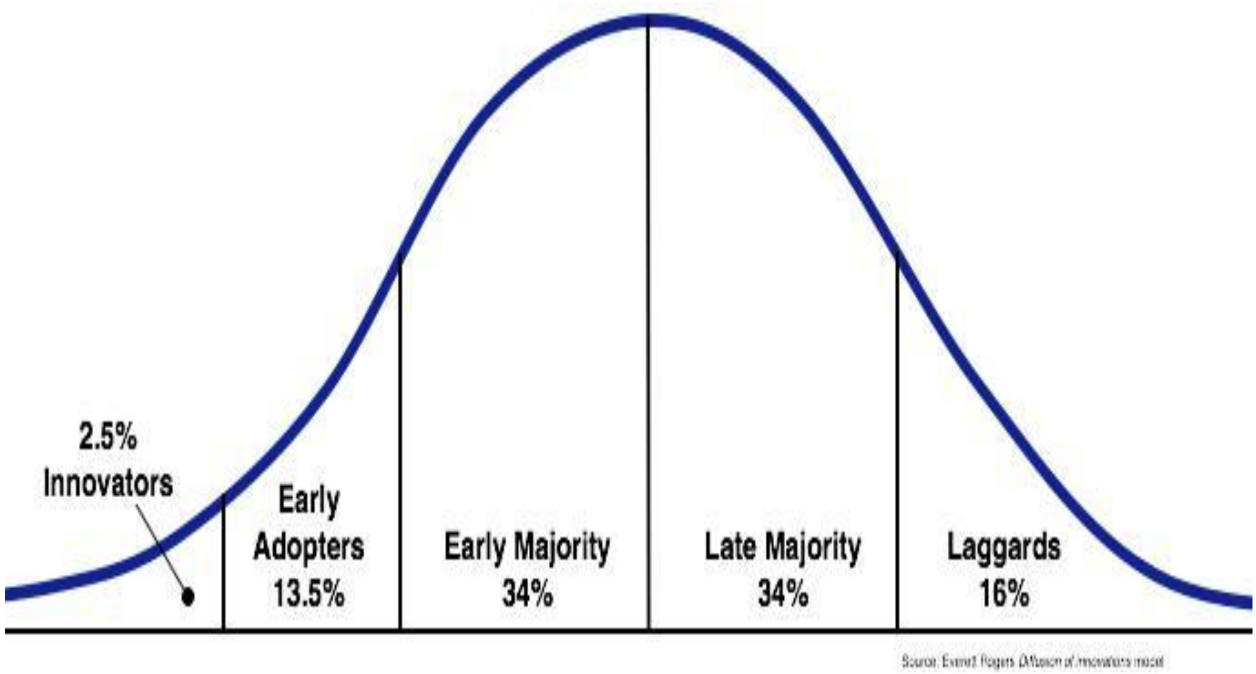


Figure 2. Rogers' bell curve.

A holistic approach to the information economy is required which provides information skills, communication skills and assistance with improving organic-, literate- and intermediate- technology based systems as well as the more obvious ICT-focused areas. A study conducted by Moradi and Kebryaee (2010) explored the impacts of ICT investment on economic growth in a cross section of 48 Islamic countries using the data over the period 1995 to 2005. Panel data analysis was carried out to examine the factors affecting economic growth where the standard Solow growth model was extended to take into account the technological progress, embodied in the form of ICT

Table 1. Relevance and impact of ICTs to the MDGs.

MDGs	Impact of ICTs
MDG 1: Eradicate extreme poverty and hunger	ICTs provide increased access to market information and reduce transaction costs for poor farmers and traders. ICTs create employment and increase wealth. Tele-work allows gainful work from home. ICTs increase skills and productivity resulting in increased incomes.
MDG 2: Achieve universal primary education	ICTs increase supply of trained teachers though ICT-enhanced distance training. Distance learning helps in educational and literacy programmes in rural and remote areas.
MDG 3: Promote gender equality and empower women	ICTs deliver educational and literacy programmes specifically targeted to poor girls and women. Studies show females outnumber males in E-learning programmes. ICTs also empower women to steelwork from home.
MDG 4, 5, 6: Health (child mortality, maternal health – reduce by 2/3 and 3/4, HIV AIDS, malaria, etc. - halt and reverse)	ICTs increase access of rural care-givers to specialist support and remote diagnosis. ICTs enhance delivery of basic and in-service training for health workers. ICTs increase monitoring and information-sharing on disease and famine.
MDG 7: Ensure environmental stability	Remote sensing technologies and communication networks permit more effective monitoring, resource management, and mitigation of environmental risks. Steelwork obviates the need to travel, saves energy and reduces pollution.
MDG 8: Global partnership for development	ICTs are extensively used in communication and nurturing of collaborative partnerships. The regional collaboration strategy supported by ICTs covers: Humanware /social issues. Software oriented technologies. Hardware Oriented Technologies. E-mail styles and problems. Multimedia mail. Shared applications.

Source: International Telecommunication Union study (ITU, 2010).

investment and human capital in order to take the speed of convergence into consideration. The findings showed that the main engines of economic growth are ICT capital, non-ICT capital and human capital in a sample of 48 Islamic countries (Moradi and Kebryaee, 2010), where inflation was noted to have a negative impact on economic growth. ICT investment was found to have a stronger influence on economic growth in the sub-sample of 24 countries that have relatively a higher ICT opportunity index. Moreover, non-ICT investment was found to positively affect on economic growth. However, neither openness nor population growth seems to have significant impact on economic growth, although the speed of convergence in both sub-samples was about the same (Moradi and Kebryaee, 2010).

A global set of indicators (info-state) showing how the availability of ICTs and access to networks can be a misleading indicator if it neglects people's skills, and if ICT networks and skills combined (info-density) are not matched by a measurement of what individuals, business and countries actually do with such technologies (info-use), is worth further interrogation in this study. This approach offers important perspectives into the central role that e-policies and knowledge have started to play in determining how countries will fare in the global competition to benefit from the information revolution and move away from poverty (Sciadas, 2003). A close correlation exists between info-states and per capita GDP. Initial study reveals that for every point increase in info-density, per capita GDP increases anywhere between

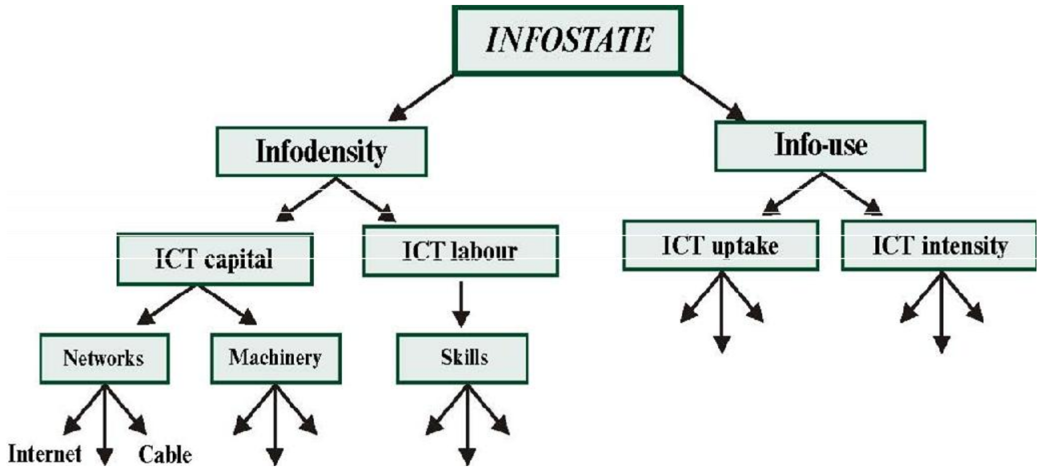


Figure 3. Infodensity versus Info-use.

$136 and $164 (Sciadas, 2003). The interrelationships between info-state, info-density and info use are illustrated in Figure 3 (Sciadas, 2003: 10).

As a result of the convergence of information, telecommunications, broadcasting and computers, the Information and Communication Technologies (ICTs) sector now embraces a large range of industries and services. The potential of ICTs to transform development is now receiving greater attention worldwide. If ICTs are appropriately deployed, they have the potential to combat rural and urban poverty and foster sustainable development (Samiullah and Rao, 2000). Generally, investment in the development of the ICT infrastructure will result in improved economic efficiency and competitiveness; more efficient and effective education; healthcare and public administration; opportunities to exploit low factor costs in international markets; opportunities to increase social capital; and opportunities to bypass failing domestic institutions.

The African ICT environment and infrastructure faces tremendous challenges, as evidenced by a synopsis conducted for ICT indicators for Africa (Kabanda, 2008), which shows that:

(a) Africa has the lowest growth in teledensity of any developing region in the world.
(b) Has 12% of World population, but 3% of World's main telephone landlines.
(c) Average level of income is the lowest, but the cost of installing telephone landline is the highest due to the huge costs of civil works involved stretching over very long distances or in areas with a large geographical dispersion.
(d) Highest profit per telephone landline and long waiting period for telephone lines.
(e) Internet connectivity is 1.5% of the world-wide connectivity.

Mobile phones may not just help create jobs and new sources of revenue to the state but can also contribute to economic growth by widening markets, creating better information flow, lowering transaction costs, and becoming substitute for costly transportation that is lacking in rural Africa (Kyem and LeMaire, 2006). The rate of growth of cellphones in Africa has outpaced the growth rate of mainlines. The increase in mobile phone growth versus mainlines, the number of mobile subscriptions worldwide is now exceeding five billion, that is more people today have access to a cell phone than to a clean toilet.

METHODOLOGY

The research methodology describes ways of obtaining and analyzing data to reach conclusions, thus building up empirical evidence to back up these conclusions. The methodology used was largely qualitative on technology capacity needs assessment that covered 6 countries (South Africa, Kenya, Tanzania, Botswana, Zambia and Zimbabwe), and also quantitative on GDP and Info-density covering 18 countries in East and Southern Africa. The 18 countries covered by the qualitative study are South Africa, Angola, Bostwana, Burundi, Democratic Republic of Congo, Kenya, Lesotho, Madagascar, Malawi, Mauritius, Mozambique, Namibia, Rwanda, Swaziland, Tanzania, Uganda, Zambia and Zimbabwe.

The quantitative approach involved the use of surveys and conducting interviews on GDP and Info-density. The survey method used is good for comparative analysis, got lots of data in a relatively short space of time and was cost-effective. GDP and Info-density data was collected for 18 African countries to ascertain the link between ICTs diffusion and GDP density per country. Data was collected on nominal gross domestic product (GDP) of selected East and Southern African countries, that is the market-value of all final goods and services from a nation in a given year. The GDP dollar values presented here were obtained from the International Monetary Fund (IMF) (http://www.imf.org/external/pubs/ft/weo/2009/02.weodata/index.aspx) and are calculated at market or government official exchange rates by the IMF staff. 2009 values and some of 2008 values are estimates. The methodology for collecting data on info-density is supported by secondary data covering East and Southern African countries. GDP of Africa was 2.5% of the total GDP of the world in 2008, and was estimated to be 2.3% of the world GDP in 2009. In this case, GDP density = GDP per capita * number of people per km^2. Data on Info-density was obtained from the International Telecommunications Union (ITU, 2010).

The qualitative research was used to deepen our understanding of the link between diffusion of ICTs and economic growth. It is pleasing to note that the tripartite summit signed in October, 2008 provided a political framework for the harmonisation of various policies, initiatives, infrastructure, institutional arrangements and cooperation from the Common Market for East and Southern Africa (COMESA), East African Community (EAC) and the Southern Africa Development Community (SADC) member states.

The technology capacity needs assessment was conducted in institutions and regional bodies in Kenya, Tanzania, South Africa, Botswana, Zambia and Zimbabwe for the period December 2008 to December 2009. Data was collected from government officials, heads of institutions/organizations and experts in various organisations in East and Southern African countries. The capacity needs assessment was conducted in the context of the systems level, the entity level and individual human capital development needs. Capacity needs assessment included both the human capital development and social capital aspects in order to achieve sustainable information and communication technology capacity development. Human capital development is central to capacity needs. A training need exists when there is a gap between what is required of a person to perform their work competently and what they actual know. Interviews were conducted for the organisations and a questionnaire administered in the form of a capacity needs assessment questionnaire. Secondary data was also compiled and analysed. The following data collection techniques were used in this study:

(a) Formal meetings and focus group discussions
(b) Face-to-face oral interviews
(c) Questionnaires on capacity needs assessment
(d) Secondary data and records observation

The face-to-face interviews allowed for in-depth knowledge sharing, helped to develop the bigger picture on ICTs for development and was good for networking. Focus group discussions were held with selected regulatory, training and research institutions to pick up grassroots input and in developing ideas, whist sharing latent knowledge spontaneously, on technological capacity needs assessment. Site visits were conducted in selected organizations and institutions. A structured questionnaire, the capacity needs assessment questionnaire, was administered in the same institutions in order to solicit detailed information in support of the interviews and focus group discussions.

ANALYSIS OF RESULTS

GDP for Southern and East Africa Countries

The world nominal GDP per capita for the year 2008 was 60,917.477 USD and for the 2009 was 57,228.373. However, the total for Africa was only 1,282.373 (2.11%) in 2008 and 1,184.891 (2.07%) in 2009, respectively. The nominal GDP per capita for the 18 African countries in East and Southern Africa are shown in Figure 4 showing the top 8 countries only. Notably South Africa leads all the countries by far, followed by Angola and then Kenya. The lower end in this group has Uganda, Botswana and DRC.

Figure 5 shows Nominal GDP per capita for period 2008 to 2009 the bottom 10 countries. This league is led by Mozambique, Madagascar and Mauritius in that order. The lowest 3 in this group are Swaziland, Lesotho and Burundi. The nominal GDP per capita excluding South Africa is shown in Figure 6. Outside South Africa, Angola is a leader followed by Kenya.

The GDP per person of the 18 African countries for the period 2008 to 2009, converted to US dollar through estimated IMF exchange rates, are shown in Figure 7 showing the top 8 countries only. Botswana, Mauritius and South Africa are the top 3 in that order whilst Swaziland, Zambia and Kenya are the last 3 among the top 8 countries with respect to the GDP per person. Similarly, the last 10 countries with respect to GDP values are shown in Figure 8. The leading country in this group is Lesotho whilst Burundi is the last one. The ratio of GDP per person/nominal GDP per capita was analysed for the 18 African countries for the period 2008 to 2009 and results are shown in Figure 9.The strongest economies showing economic growth are South Africa, Angola, Kenya, Tanzania, Zambia, Uganda, Botswana, DRC, Mozambique, Madagascar, Mauritius, Namibia, Rwanda, Malawi, Zimbabwe, Swaziland, Lesotho and Burundi in that order.

Info-density for Southern and East Africa Countries

There is a close correlation between the country’s info-state and GDP per capita. For every point increase in info-density, GDP per capita increases by an approximate US$150, rendering widespread, affordable access to information services an absolute imperative. The last decade has seen continual growth in infrastructure development and service uptake. Over the last five years, the ITU reports developed and developing countries have increased ICT levels by more than 30%. However, notwithstanding the rapid expansion, to date access and adoption of Internet services is highly unequal across and within countries. Emerging countries face considerable challenges in broad-basing Internet utilization for their growth and development on account of inadequate fixed-line infrastructure, and lack of supporting infrastructure, including electricity and steep

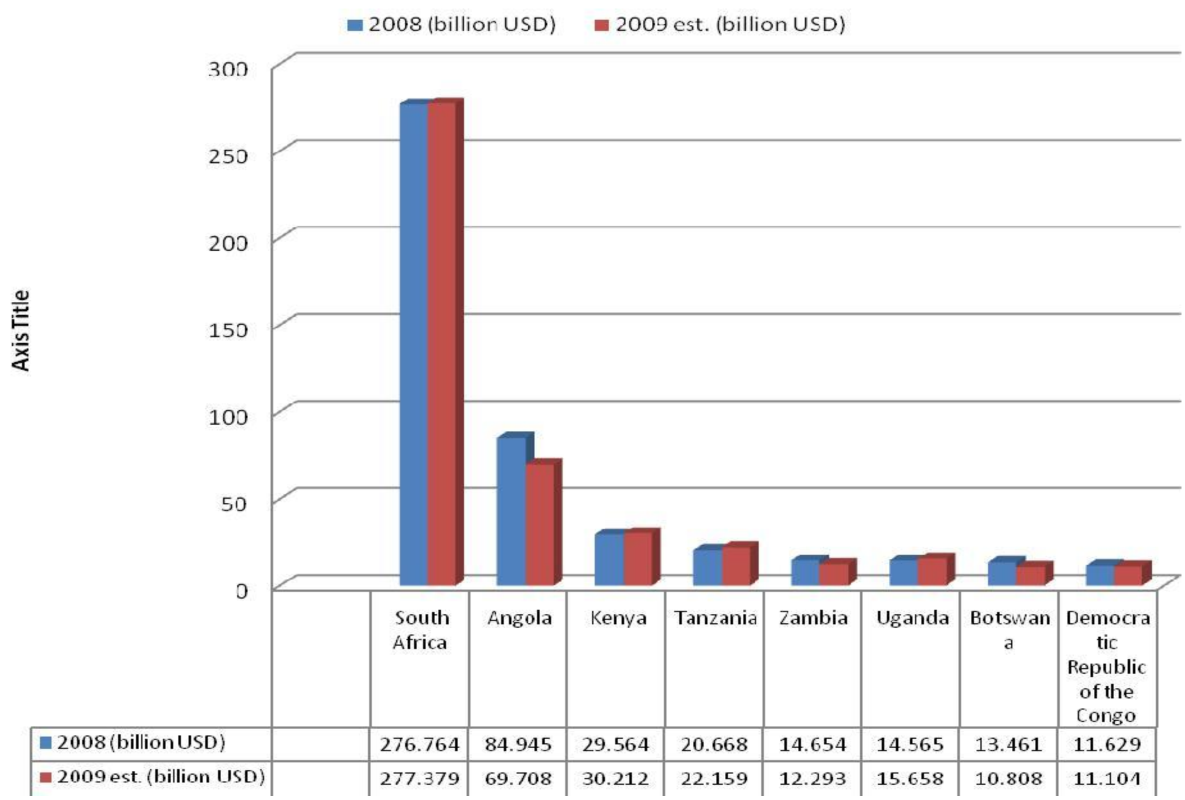


Figure 4. Nominal GDP per capita for period 2008 to 2009 for top 8 countries.

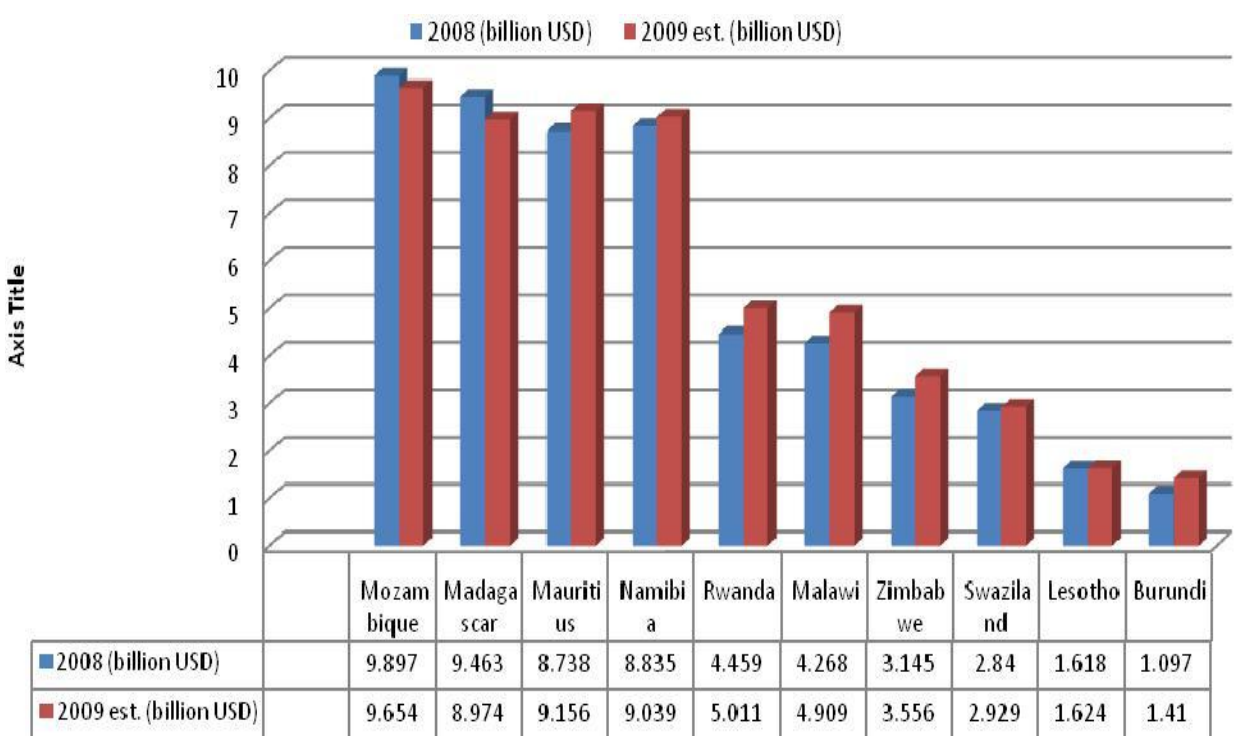


Figure 5. Nominal GDP per capita for period 2008 to 2009 for the least 10 countries.

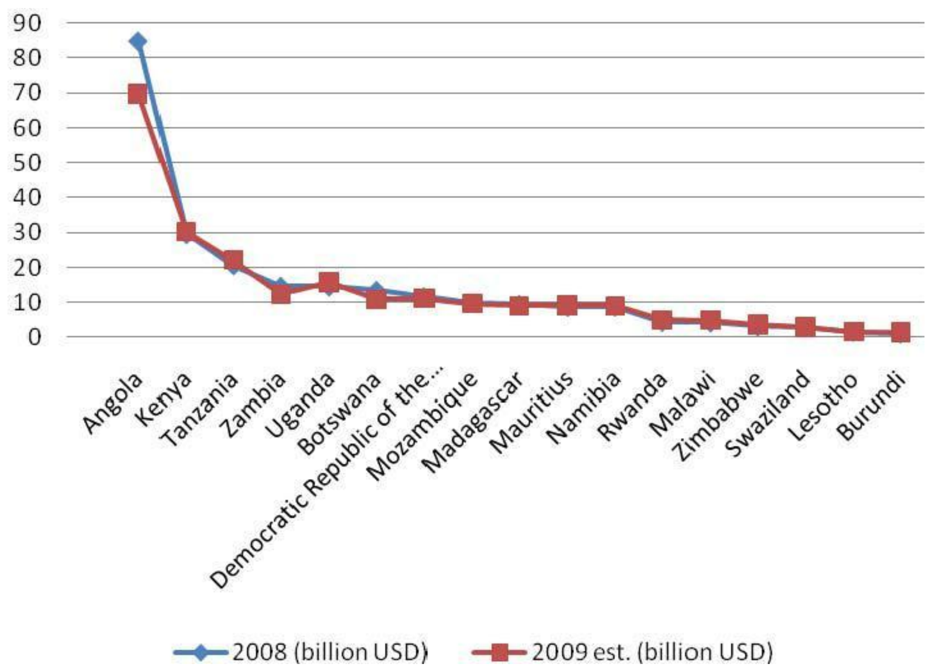
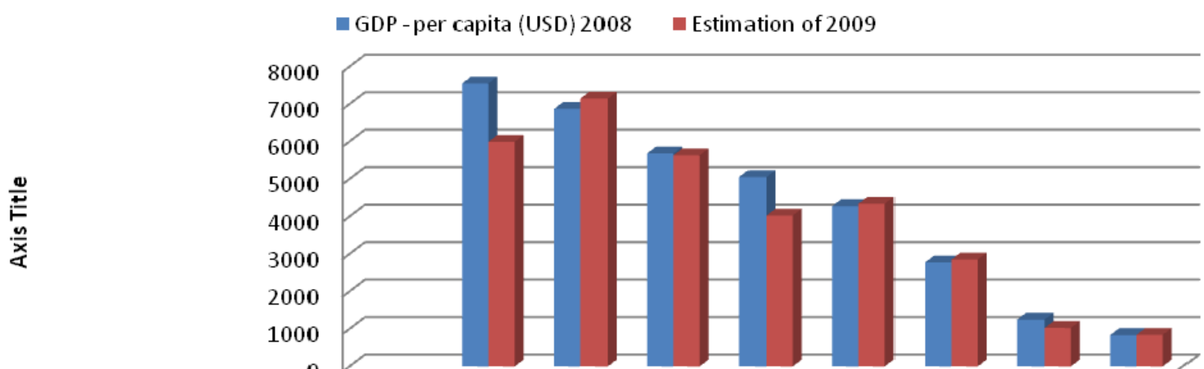


Figure 6. Nominal GDP per capita for 2008 to 2009 excluding South Africa.



	Botswana	Mauritius	South Africa	Angola	Namibia	Swaziland	Zambia	Kenya
GDP - per capita (USD) 2008	7,554	6,872	5,685	5,054	4,278	2,778	1,248	838
Estimation of 2009	5,995	7,146	5,635	4,027	4,341	2,854	1,027	842

Figure 7. GDP per person for the period 2008 to 2009 top 8 countries.

prices of personal computers. An approximate 75% of the world populace, a large segment of which lives in emerging markets, consequentially have limited or no access to the Internet. Data on info-density was obtained from the International Telecommunications Union (ITU, 2010) and the analysis is shown in Figures 10 to 14. The fixed teledensity by continent is shown in Figure 10 whilst the mobile cellular subscriptions (%) is shown in Figure 11. Both charts show that Africa has the lowest penetration ratio for fixed teledensity and mobile cellular subscriptions, respectively.

The mobile broadband subscriptions by continent are shown in Figure 12. Europe leads all other continents whilst Africa remains the least, with at most 2%. The

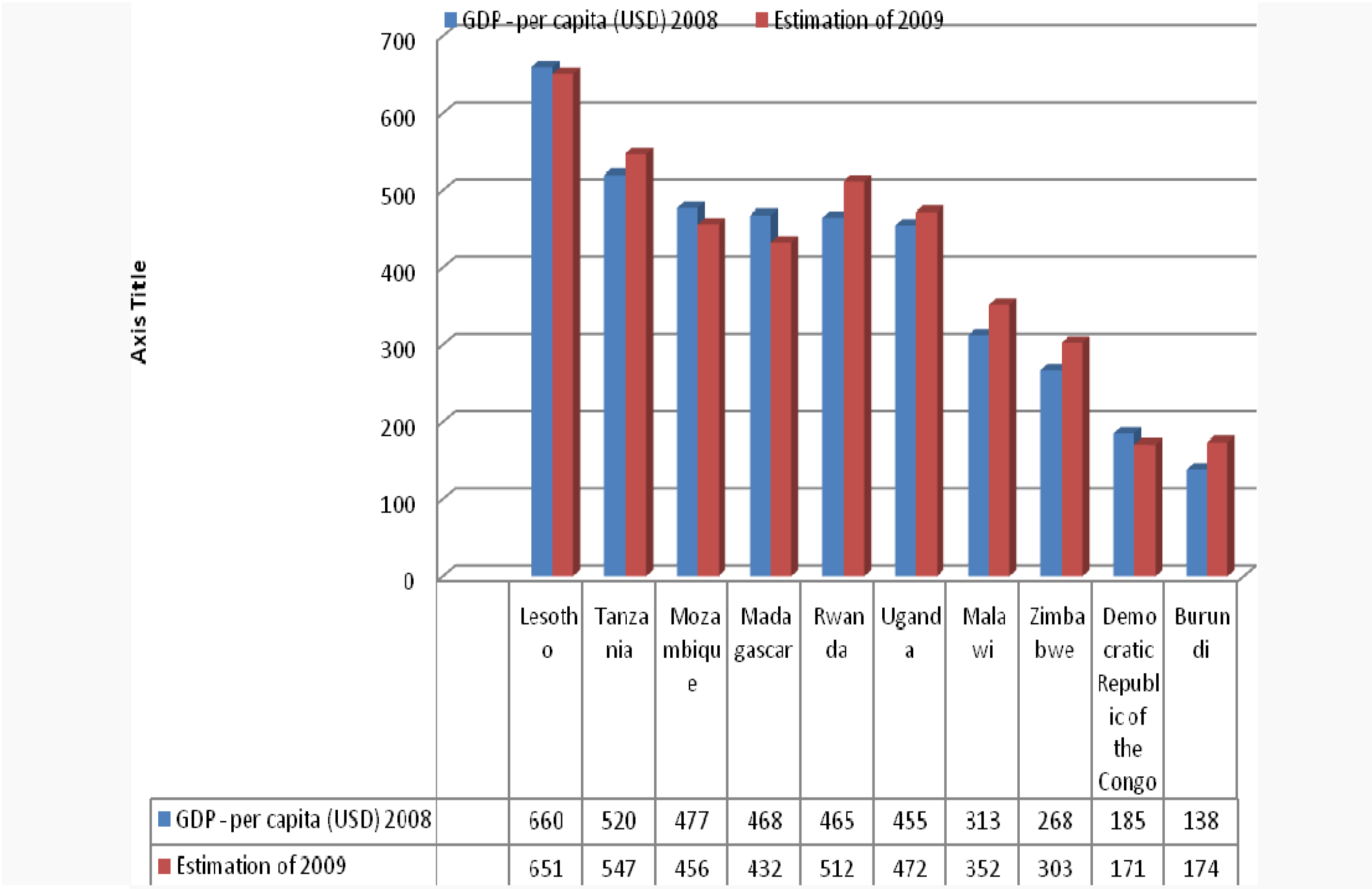


Figure 8. GDP per person for the period 2008 to 2009 lowest 10 countries. Source: World economic outlook database for October 2009.

same picture is reflected on internet users shown in Figure 13. The fixed broadband subscriptions shown in Figure 14 show even a wider gap between Africa and other continents. The ICT indicators by country for the 18 East and Southern African countries are shown in Figure 15. South Africa has the highest number of mobile subscribers followed by Botswana and Mauritius. However, Mauritius has the highest density for main telephone lines and internet users.

A summary of the statistics on Info-density as measured by the ICT indicators and the GDP per capita for the 18 countries in East and Southern Africa is shown in Table 2. The mean for the 18 East and Southern African countries with respect to main telephone density is 3.8%, mobile subscribers is 27.87%, and internet use is at 4.87%. A one-sample T-test for the same data for the 18 East and Southern African countries is shown in Table 3. The 95% confidence interval for the lower and upper levels are shown on the same.

Correlation between ICT indicators and GDP per capita

The correlation coefficients between the ICT indicators and the GDP per capita for both 2008 and 2009 are summarized in Table 4. The correlation coefficients between the main telephone lines (%) to the GDP per capita is 0.721 and 0.798 for the years 2008 and 2009, respectively. The mobile subscriber rate (%) is strongly correlated to the GDP per capita, showing values of 0.881 and 0.902 for the years 2008 and 2009, respectively. However, the correlation coefficients between internet use (%) and GDP per capita remains as low as 0.531 and 0.619 for the years 2008 and 2009, respectively.

The correlation cofficients between the ICT indicators and the GDP per capita are shown in Figure 16 which explains the correlation coefficient between GDP per capita and ICT indicators is highest with the mobile

Figure 9. GDP per person/nominal GDP per capita.

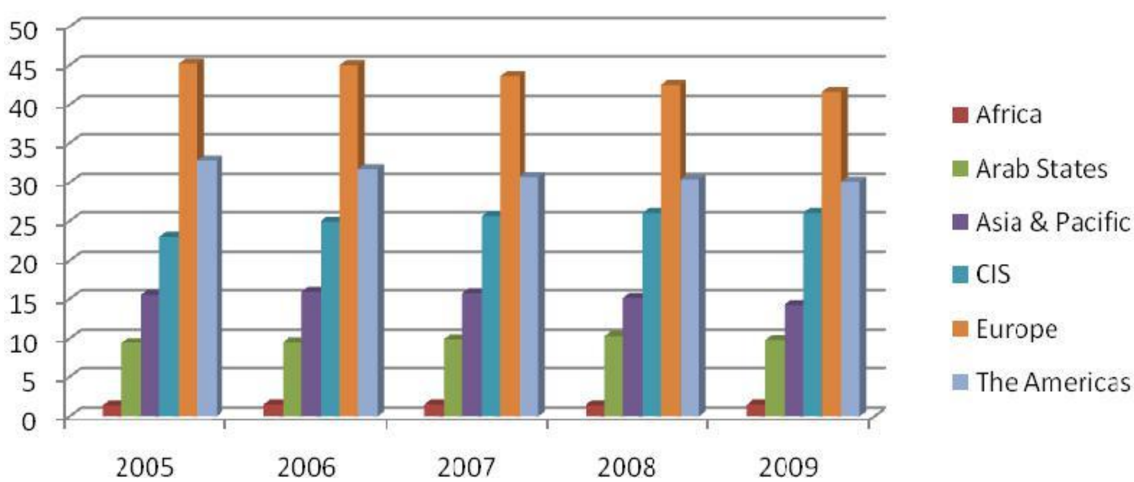


Figure 10. Fixed teledensity by continent (%).

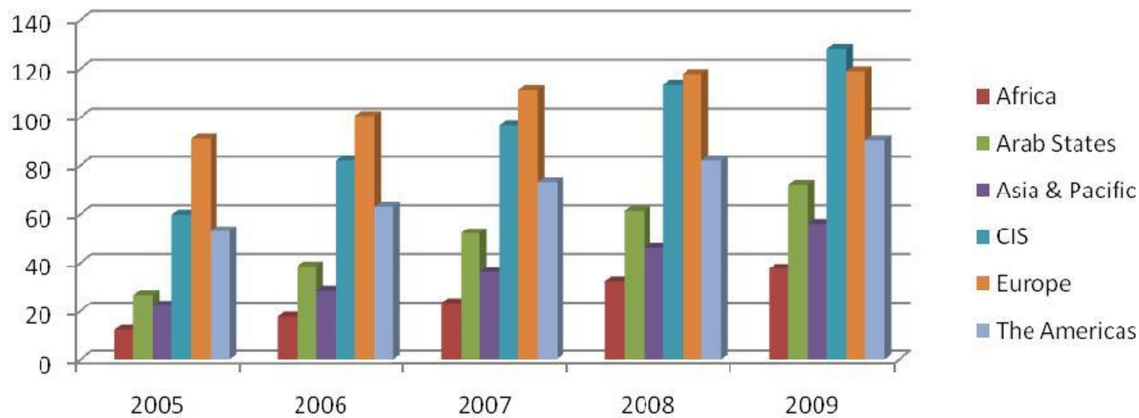


Figure 11. Mobile cellular subscriptions by continent (%).

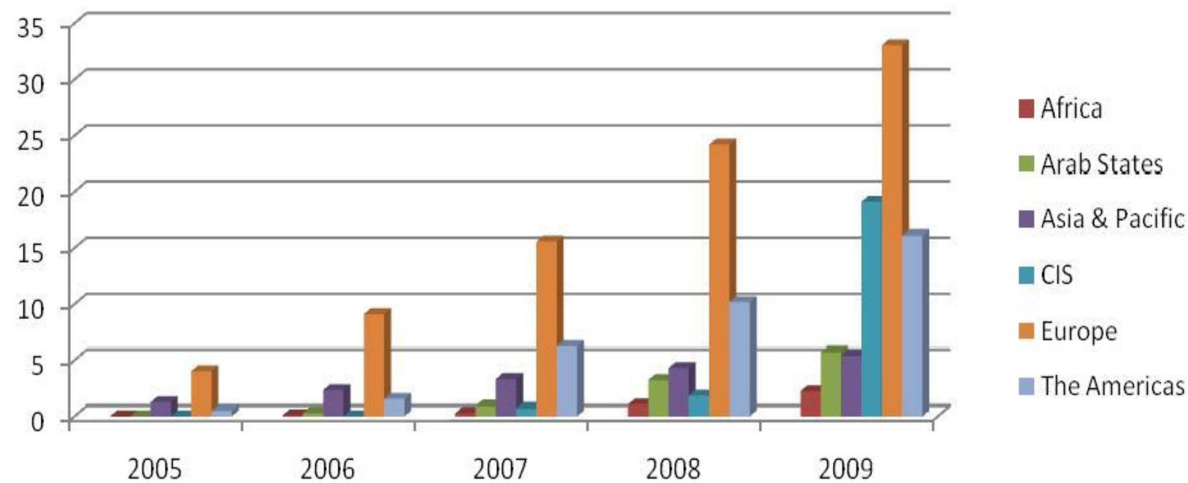


Figure 12. Mobile broadband subscriptions (%).

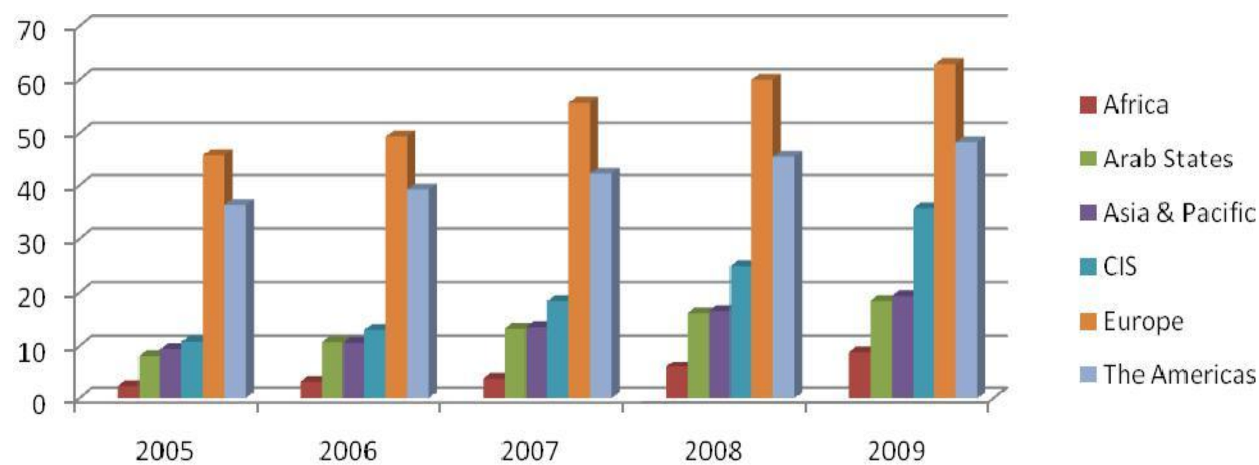


Figure 13. Internet users by continent (%).

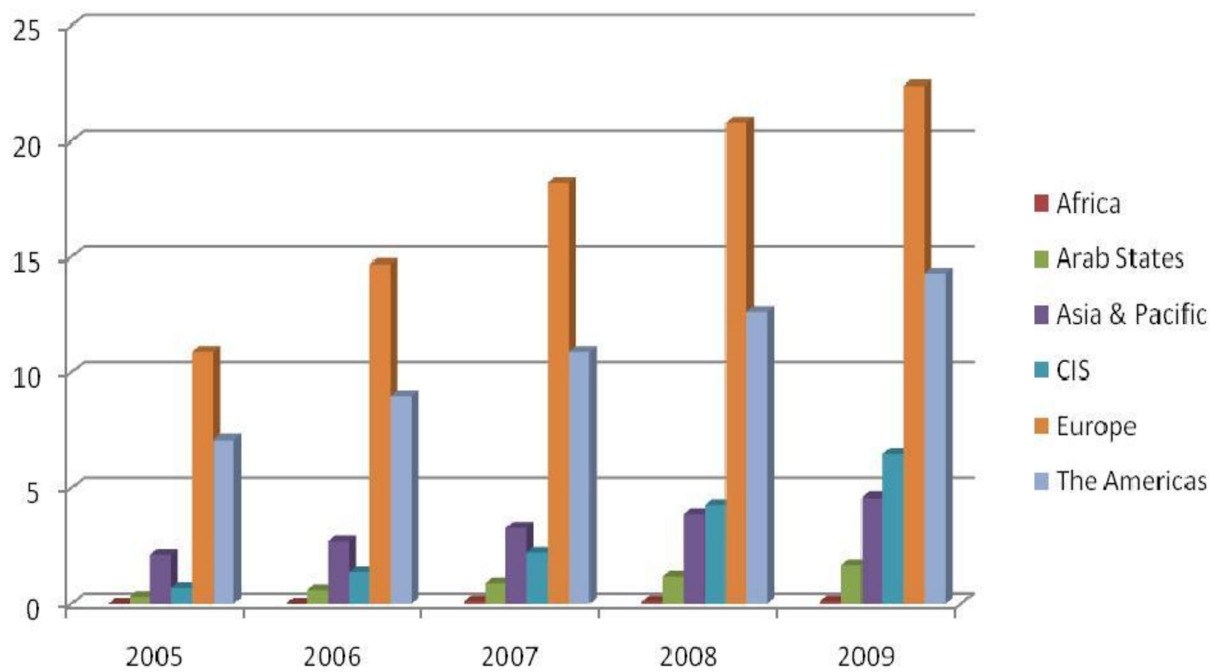


Figure 14. Fixed broadband subscriptions by continent (%).

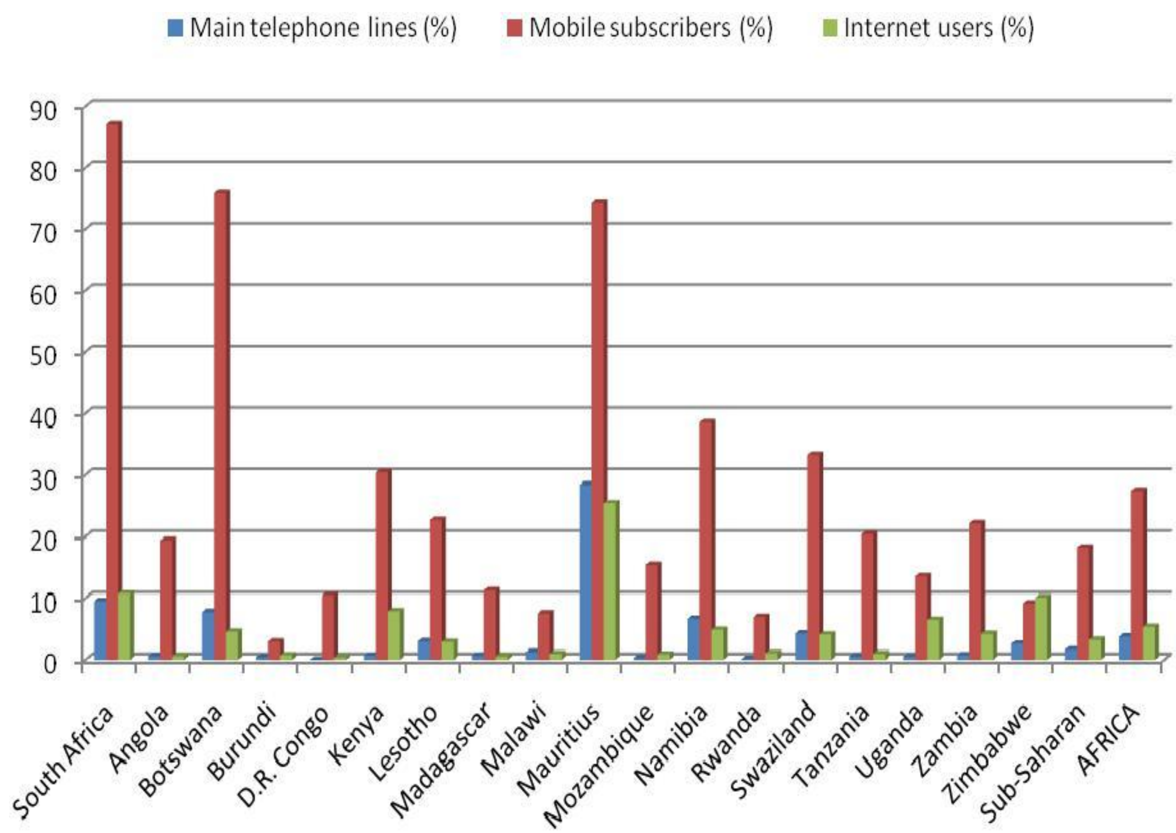


Figure 15. East and Southern Africa ICT Indicators for 2007.

Table 2. Descriptive statistics for East and Southern Africa.

Variables	N	Minimum	Maximum	Mean	Standard deviation
Main telephone lines	18	0%	28%	3.80%	6.791%
Mobile subscribers	18	3%	87%	27.87%	25.490%
Internet users	18	0%	25%	4.87%	6.124%
GDP per capita 2008 (US$)	18	138	7,554	2,125.33	2,554.349
GDP per capita 2009 (US$)	18	$171	$7,146	$1,996.50	$2,349.695
Valid N (listwise)	18				

Table 3. One-sample test for East and Southern Africa.

Variables	Test value = 0					
	t	df	Sig. (2-tailed)	Mean difference	95% Confidence Interval of the difference Lower	Upper
Main telephone lines	2.374	17	0.030	3.800%	0.42%	7.18%
Mobile subscribers	4.638	17	0.000	27.866%	15.19%	40.54%
Internet users	3.371	17	0.004	4.866%	1.82%	7.91%
GDP per capita 2008 (US$)	3.530	17	0.003	2,125.333	855.09	3,395.58
GDP per capita 2009 (US$)	3.605	17	0.002	$1,996.500	$828.02	$3,164.98

Table 4. Correlations between ICT Indicators and GDP per capita.

Variables		GDP per capita 2008 (US$)	GDP per capita 2009 (US$)
	Pearson correlation	0.721**	0.798**
Main telephone lines (%)	Sig.(2-tailed)	0.001	0.000
	N	18	18
	Pearson correlation	0.881**	0.902**
Mobile subscribers (%)	Sig.(2-tailed)	0.000	0.000
	N	18	18
	Pearson correlation	0.531*	0.619**
Internet users (%)	Sig.(2-tailed)	0.023	0.006
	N	18	18

density (about 90%) and then followed by fixed telephony (about 75%), and lowest with internet penetration ratio (about 57%). Hence, the mobile density of a country in East and Southern Africa is a good measure of the relative proportion with the GDP per capita.

Sustainable technology capacity in east and Southern Africa

The ICT policy formulation process went through the due process in all the countries in East and Southern Africa, and its implementation is at various stages from country to country depending on the availability of financial resources. Notable achievement have been achieved in ICT Policies, coordination with National ICT Committees, improvement of regional connectivity through coordination ministries, and access to information through the website, portals, small and medium enterprises (SMEs), etc. ICT education and training is required to address the various e-skills opportunities identified in the public sectors. However, social

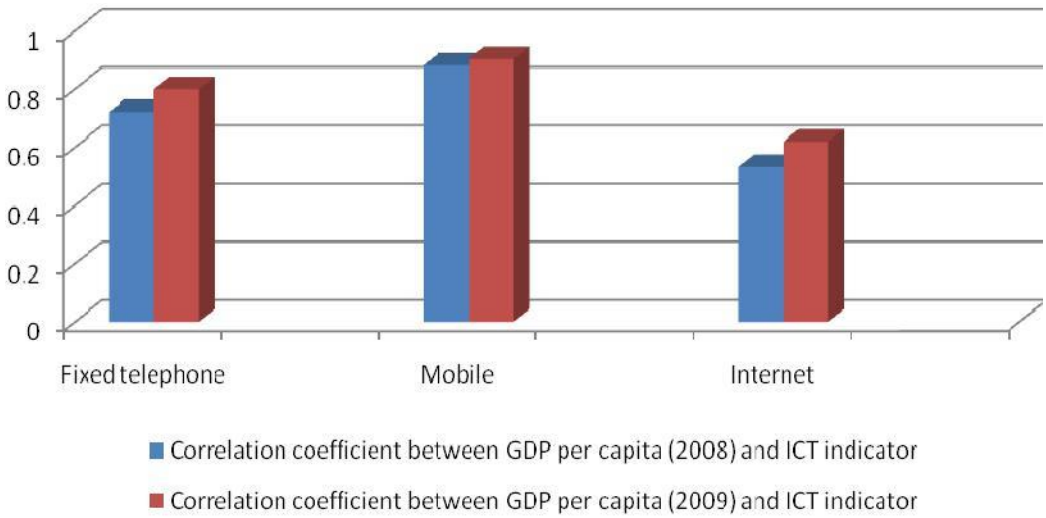


Figure 16. Correlation between ICT indicators and GDP per capita.

capital/networks have not received much attention with respect to technological development and much work is required to establish basic e-business framework in all countries outside South Africa. Availability of electricity in remote parts of member countries is adversely affecting rapid implementation of the telecommunications infrastructure. The convergence in ICTs is shifting the focus to infrastructure, protocols, applications and services (ERPs), and content as specific areas that need capacity building initiatives.

ICTs affect all the MDGs. There is a strong correlation between ICTs and economic growth. The data collection techniques used in this study include formal meetings, oral interviews, questionnaires and records observation. The major components of the data collected included the identity of the institution; current capacity of the institution ; current and future interventions on staff capacity development; the availability and status of the national/corporate ICT policy framework, and progress towards its implementation; quality assurance philosophy and framework; and strategic programme development, management and reviews. The capacity needs of the national and regional institutions/organisations identified by the research and shown in Table 5. The research showed evidence of technological capacity with tremendous opportunities that can change the face of East and Southern Africa through identified public institutions in each of the countries covered by the research project. Table 5 shows the ICT capacity needs components by country, identified by the research.

All the six African countries covered by the qualitative research have national ICT policy frameworks which are in different phases of implementation due to challenges in the availability of financial resources. The common strategic areas of focus for meaningful ICTs development in East and Southern Africa are summarised in Table 6 and these form a basis for the goals and specific objectives for implementation (Government of Zimbabwe Ministry of ICT Strategic Plan, 2010 to 2014).

It is envisaged that the above key areas for ICTs development would change the landscape for sustainable ICTs development in East and Southern Africa within a period of about five years, as the government support and commitment is very high in all the six African countries visited. The political will and common singleness of heart throughout the public institutions visited needs to be maintained and developed further with the required resources for ease of implementation.

Human capital development is central to capacity development, as adequate human resources are an essential component of a nation’s ability to carry out its mission. In pursuit of the broader objectives of the African Union to accelerate economic integration of the continent, with the aim to achieve economic growth, reduce poverty and attain sustainable economic development, the tripartite summit of the Heads of State and Government of the Common Market for East and Southern Africa (COMESA), East African Community (EAC) and the Southern Africa Development Community (SADC) met in Kampala, Uganda on 22nd October, 2008. The East African Community Partner States have various advantages in terms of geographical proximity, common socio cultural characteristics, and economic complementarities for maximizing the benefits from regional cooperation in the ICT sector. Regional cooperation in ICT does not only facilitate greater access

Table 5. ICT capacity needs components by country.

Capacity components	Country regional / National institution
Policy formulation and planning	Kenya, South Africa, Tanzania, and Zimbabwe
Harmonisation of ICT infrastructure and facilities	All countries in East and Southern Africa
Legislative framework	East African Community , COMESA, and SADC with support from government ministries in all countries concerned.
Establishing centres of excellence: Centres of specialisation Internationalisation Professorial chairs Adjunct professors	South Africa, Tanzania, and Zimbabwe through the Universities/Colleges.
Human capital development and institutional capacity: Staff development programmes Professional continuous development Workshops /Seminars/ Conferences Digital libraries	All Countries in East and Southern Africa through the Universities.
E-Skills development and ICT training: Short-term Long-term Open and distance learning Professional continuous development	Government Ministries and Universities in all countries in Southern Africa.
Collaborative framework and research leadership Collaborative networks Research leadership training/mentoring	South Africa, Botswana and Tanzania.

Table 6. Key areas for ICTs development.

Key areas for ICT development
i) Infrastructure establishment and development, for example, connectivity, fibre, VSAT, wireless, wireline, VoIP, etc.
ii) Human capital and social networks development (Humanware),for example advocacy, skills, e-literacy, sustainable capacity building, languages, curricula, etc.
iii) Governance, for example, policy frameworks, ICT bill, regulatory framework, corporate governance, etc.
iv) E-government and e-business for example, government portal, e-commerce frameworks, e-learning, national payment systems, etc.
v) Application development, for example, innovation, animation, e-development, etc.
vi) ICT industry, investment, and partnerships, for example,. PPPs, innovative SMEs, tax incentives, etc.
vii) Research and development, for example, research, cross and multidisciplinary collaborative projects, etc.
viii) Security and quality assurance frameworks, for example, interoperability, quality of service, etc.
ix) Corporate services, for example, internal ministry support requirements, resource mobilisation, etc.

to ICT infrastructure, but is also essential to promote trade, governance and ICT business opportunities within and beyond the region. Regional ICT special projects covers, COMESA, IGART, etc. ICTs have tremendous roles in achieving the regional economic integration objectives of SADC, COMESA and EAC (http://www.eac.int/treaty.htm), which include the following:

(1) Promotion of sustainable growth and equitable development of Partner States including the rational utilization of the region’s natural resources and protection of the environment;
(2) Strengthening and consolidating the long standing political, economic, social, cultural and traditional ties between partner states and associations between the people of the region in promoting a people-centres mutual development;
(3) Enhancing and strengthening participation of the private sector and the civil society;
(4) Mainstreaming gender in all its programmes and enhancement of the role of women in development;
(5) promoting good governance including adherence to the principle of democratic rule of law, accountability, transparency, social justices, equal opportunities and gender equality; and
(6) Promotion of peace and stability within the region, and good neighborliness among partners States.

Conclusion

ICTs impact all the MDGs, especially in eradicating extreme poverty and hunger. The solution to poverty and hunger is not money but knowledge, hence the thrust on human capital development national programmes with a bias towards sustainable social networks/capital to ensure empowerment of local communities and indigenous people. Revolutionary science and technology innovation drive at the lowest level of education, for example pre-school, up to universities and colleges and then across all communities is inevitably very critical in the eradication of extreme poverty and hunger. Curriculum reviews for schools and universities to contextualise the technology diffusion and innovation to an African environment require urgent attention. Furthermore, the harmonisation of the infrastructure and equipment facilities for schools, colleges, and institutions that drive education for sustainable development, is equally important. ICTs are therefore key enablers to the generation and dissemination of knowledge, hence the achievement of the MDGs. In fact, ICTs contribute to economic growth, as evidenced by the strong correlation between the GDP growth and ICT indicators. ICTs increase productivity through:

(a) Better communication and networking at lower costs.
(b) Digitalisation of production and distribution.
(c) New trade opportunities through e-commerce.
(d) Access to knowledge.
(e) Increased competition.

The mean for the 18 East and Southern African countries with respect to main telephone density is 30.8%, mobile subscribers is 270.87%, and internet use is at 40.87%. With the exception of South Africa, all the East and Southern African countries are among the late majority and laggards with respect to diffusion and adoption of ICT innovations, that is they are largely late end-consumers of technology that has been tried and tested from developed and some developing countries.

The ICT capital comprises network infrastructure and ICT machinery and equipment. ICT and non-ICT factor inputs are combined to produce ICT and non-ICT goods and services, without a one-to-one correspondence. There is a strong correlation between ICT diffusion and high economic growth. The correlation coefficient between GDP per capita and ICT indicators is highest with the mobile density (about 90%) and then followed by fixed telephony (about 75%), and lowest with internet penetration ratio (about 57%). Hence, the mobile density of a country in East and Southern Africa is a good measure of the relative proportion with the GDP per capita.

The methodology used was largely qualitative on technology capacity needs assessment that covered 6 countries, and also quantitative on GDP and Info-density covering 18 countries in East and Southern Africa. GDP and Info-density data was collected for 18 African countries to ascertain the link between ICTs diffusion and GDP density per country. Policy-formulation frameworks and sustainable capacity building provide a conducive environment for meaningful development in the SADC countries. Capacity needs assessment included both the human capital development and social capital aspects in order to achieve sustainable information and communication technology capacity development0. Human capital development is central to capacity needs. There is a strong correlation between ICT diffusion and high economic growth. The solution to poverty and under-development in African countries is knowledge and economic empowerment. The recommended sustainable technology development with an African model is proposed.

The East and Southern African countries covered by the study showed tremendous development potential, even though they are among the late majority and laggards with respect to technological innovations. The solution to poverty and under-development in African countries is knowledge and economic empowerment. The recommended sustainable technology development using an African model is proposed with the following major components:

(1) Human capital development national programmes with a bias towards social networks/capital to ensure empowerment of local communities and indigenous people.
(2) Curriculum reviews for schools and universities to contextualise the technology diffusion and innovation to an African environment.
(3) Revolutionary science and technology innovation drive at the lowest level of education, for example pre-school, up to universities and colleges and then across all communities.
(4) Universitisation of the entire education system where the academic leadership offered by academia and research institutions inculcates and influences the curricular of the entire education system in order to provide a meaningful contribution to knowledge.
(5) Harmonisation of the infrastructure and equipment facilities for schools, colleges, and institutions that drive education for sustainable development.
(6) Review of the legal framework and policy formulation mechanism with a view to rapid development initiatives.
(7) Establishing centres of excellence in specialised fields to provide leadership (academic, research and consultancy) on key developmental issues.

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