BUILDING STRENGTHS IN INFORMATION COMMUNICATION AND TECHNOLOGY IN KENYAN UNIVERSITIES: WAY FORWARD FOR THE 21ST CENTURY

John Oluoch[1] and Jeremiah Osida[2]
[1]Senior Lecturer of Communication and Media Studies
And Director, Privately Sponsored Students Programmes at Rongo University College
[2] ICT Experts in ICT Department, Rongo University College

Abstract:
Information and Communication Technology is increasingly becoming crucial part of the education system in Kenya and globally. ICT has changed the functioning of the educational system. This paper considers the rapid spread of ICT applications; which has brought technological, social and economic transformations. These changes have caused higher educational institutions, administrators, lecturers to rethink their roles, lecturing and vision for future. The sustainability of a nation in the era of knowledge economy depends on the effective educational system. The proper integration of ICT with teaching/learning increases educational productivity. ICT provides various opportunities to higher educational learners and make lecturers aware of their new roles and responsibilities. ICT has enabled us to monitor and evaluate what is learned, how it is learned, when and where learning takes place. It is enabling the educational management system to dis-charge functions like, administration of examinations, coordination, and alumni network. ICT provides nontraditional students with internet based education anytime and anywhere, these internet technologies enable innovative ways of lecturing. The innovative practices demonstrate approaches, challenging issues, and success factors in integrating ICT into education.

Keywords: ICTs, Cyber Crimes, Higher Education, ICT Access, ICT and Youth.

Introduction

A growing number of Universities are in the process of establishing ICT standards to address information society issues of e-government, e-infrastructure, e-industry, e-learning, and e-commerce. Some large universities are in the process of integrating telecommunications, IT, and broadcasting into a single ICT standard.

The use of information and communications technology (ICT) is widespread. ICTs are an essential tool for the efficient administration of an organization, and in the delivery of services to its clients. ICTs are being integrated into procedures, structures, and products throughout business, institutions, and the community. The marriage of information technologies and communications combined with the explosive growth in communication networks, illustrated by the Internet, is resulting in major social and economic changes. There is a revolution in the way we electronically store, access, and deliver information which is critical in shaping the effectiveness of an institution. This is equally true of universities. To take advantage of these technologies and use them effectively, universities need to develop an overall framework and strategy for their application, and to have an organizational structure in place to manage the development of strategies and oversee their implementation. This is particularly necessary given the rapid pace at which these technologies are changing.

Governments worldwide have taken responsibility to provide national leadership in the development and application of technology in their countries. It is neither efficient nor desirable to implement ICT projects across government, or in any large organization, without having a policy in place with key strategies specified. These must take account of the government's economic priorities and need for the efficient use of its own resources. This is being achieved by the establishment of an administrative structure within government, with specific responsibilities to develop a national vision for ICT to prepare an implementation plan with key strategies having specific goals to realize the vision, and an action plan for their achievement.

A growing number of universities are in the process of establishing ICT models for the 21st Century. This paper outlines the functional requirements for such a standard, and presents a range of best practices for their focus and operation

Methodology

The survey was conducted in the major public Universities in Kenya. The data for this study was collected through self-administered personal mailed, and e-mail attachment of a well-structured questionnaire to public Universities ICT departments. The survey instrument was first tested and refined after consulting ICT experts before use. The questionnaire was meant for senior ICT managers, Heads of ICT departments, and ICT staff. The Universities selected for this study, are representatives of the general population when considering the ICT developments and personal characteristics.

It is evident from this piece of work that a disproportionate number of examples are taken from the major public Universities in Kenya. This is because the major public Universities are becoming world leaders in looking at and trying out ways to use ICT to address the relationship between education and development, frequently with an awareness of e-learning issues. These applications also present some of the more innovative approaches.

Before proceeding to an in-depth consideration of the areas outlined below, this introduction will address some general issues on University education and ICT.

In order to examine the effects of ICT integration into University education of 5 major Public Universities in Kenya, this study applies the primary research and desk study

When collecting data, computer savvy was essential for the participants due to specific nature of the survey. Well instructed individuals by the author, distributed to and collected back the survey instrument simultaneously. Some incomplete questionnaires were rejected from the usable ones. Overall 150 usable questionnaires were finally selected for analysis purposes. In the survey instruments scales were used to measure the statements (SA= strongly to SD= strongly disagree) Participants' were asked to express the level of their agreement with attributes identified earlier from the literature review. Attributes covered respondent's present ICT models in Universities and perceived importance and challenges of ICT integration in Universities. Data collected therefore was analyzed via frequency and mean scores. In answering the questions, the respondents were assured about the confidentiality of their responses that their names were not published.

Functions of an ICT Standard

The functions of such a standard recognize the three basic responsibilities that central governments worldwide must accept for ICT. These are:

Government as a Regulator

As the national regulator, the central government is responsible for setting national rules for the use of technology. This includes, for example:

➢ The legal framework that enables e-learning to be promoted in universities and the policing of this framework;
➢ The national standards governing data privacy and security;
➢ Laws covering intellectual property;
➢ Adopting data and communications standards to ensure a country is aligned with international developments in ICT, thus enabling international compatibility and interconnectivity, etc.; and rules covering access to information sources, both national and international, and including the internet;

Government as a Facilitator

As a facilitator the government can seek to stimulate the use of and access to ICT in universities and learning institutions. It can encourage the development of the private sector industry by providing assistance and removing roadblocks to progress. The ICT services industry and other knowledge industries do not require large investments in material infrastructure like factories, raw materials, road ways and other public utilities. They can be located anywhere in a country provided there are communications facilities at par with global standards, and high quality and cost effective human resources.

Government as a Large user of ICTs

As a large user of ICTs, often the largest in the country, government must seek to use ICT for the cost efficient delivery of services and information to its citizens and in the efficient running of the government administration. Being a major purchaser of ICT equipment and services, it can also influence the market and, for example, use its buying power to foster the development of a national ICT industry. It can also serve as an example of best practice

Structure of an ICT Committee for University

For a university, a typical structure of the ICT committee would consist of the following structure:
An ICT management board with specific terms of reference (TOR) comprised of representatives from University management board, ICT department, academia, and others who are competent to contribute under the TOR of the

board (e.g. distinguished ex-patriots). The emphasis should be placed on those with a vision of what is required in the university, have leadership skills, are pragmatic, and above all, are prepared to actively participate.

A small secretariat to support the board ensuring the ``mechanics'' of its operation, e.g. calling meetings, agenda, minutes, follow-up action, ensuring papers are submitted correctly and on time, and publicity etc.

A support committee is typically small and focused. The staff will have technical and managerial skills to develop and oversee visions, goals, strategies, and project plans. The head of this group must be a skilled leader and facilitator who work successfully with senior university management members; and commands respect both technically and managerially in academics and industry. This person could be designated the chief information officer (CIO). To ensure that a candidate of appropriate caliber is appointed, care must be exercised in the recruitment of this position.

The support committee needs to be flexible, dynamic, and focused on achieving outputs. The establishment of ``just another bureaucratic organization'' must be avoided.

A senior member in university management board must be given responsibility for the standards and be accountable for its operation. The CIO should report directly to the responsible senior management board representative.

Work groups should be formed to address specific strategies and projects. These typically should be small, and be given specific tasks with specified deliverables and goals with resources, budget, and a timeframe to complete the task. Having completed the task and delivered the product, the work groups should be abolished or reconstituted under a different set of parameters. The head of the work group should be competent and understand the specific area being considered, and be selected on the basis of knowledge and abilities. To perform effectively the committee needs to be constituted with a mandate, TORs, a budget, work plans, goals and deliverables, reporting mechanisms and measures of accountability. Developing these is a significant exercise in its own right, often supported by aid organizations with experience in establishing their committees

ICT as a tool for social and economic transformation
Along with globalization, ICT provides the tools that can transform the way production is organized and information shared around the world.

These technologies offer flexibility of time and space, a way out of isolation, and access to knowledge and productive resources. They are enabling tools for economic development and social change. Arguably, ICT can be most valuable to those who suffer most from limited time availability, social isolation, and lack of access to knowledge and productive resources due to limited access and or poor infrastructure.

The last decade has seen an incredible expansion in access to ICTs as well as an explosion in applications
The spread to ubiquity of the telephone has been both rapid and widespread. More than half of the Kenya's households now have access to a mobile telephone; there are in the region of thirty million mobile subscribers (CCK 2012); and the bandwidth usage footprint now covers as much as 48.3 percent of the Kenya's population (CCK 2012).The growth in access was particularly phenomenal in the urban Kenya where fixed and mobile teledensity expanded from about five mobile telephones per 100 people in 2000 to more than 50 percent in 2013.

The mobile revolution has also had a dramatic impact on access in rural areas. In South Nyanza, there were fewer than 7,000 telephones outside major towns of Kisii, Homabay and Migori in 2004, serving a population of 2 million People spread over 100,000 square miles. Today, the mobile footprint covers more than 60 percent of the population, living outside these major towns

It is worth noting how much developing countries have led the way in the mobile revolution, not least demonstrated by the fact that China is by far the world's largest mobile market and that there are considerably more mobile subscribers in the developing than the industrial world. Very simple data applications over mobile phones have also spread rapidly in Kenya.

Perhaps 778 SMS text messages per 1000 subscribers are sent in Kenya in every day (Hub Research), with some developing countries leading growth in SMS usage. For instance, the average Ugandan mobile subscriber sends ten text messages a day, accounting for nearly 55 billion messages each year.

Kenyan Universities are even beginning to catch up in terms of more advanced use of information infrastructure. The number of Internet users in Kenyan Universities increased, in 2008 the Internet availability indicator was at stage 1.6, suggesting that most universities were providing limited Internet access to students. In 2013, this indicator was at stage 2.9 mainly because of increased Internet bandwidth ratios of the universities. The number of secure servers in learning institutions grew between 2008 and 2013, reaching above 10,000, but this still left the institution's share of secure servers at about ten percent of the global total. This suggests a broader issue with the adoption of advanced Internet applications in universities. Internet access on campus also required availability of networked PCs in the labs and offices

ICTs Challenges in Kenyan Universities

Kenyan Universities are now aware of the benefits derived through adoption and use of ICTs but there are many serious challenges which must be addressed and the chief among them are:

➢ Inadequate communications and power infrastructure

➢ Shortage of ICTs facilities and ICTs skills

➢ Inadequate institutional arrangements

➢ Limited financial resources

➢ Inadequate public private partnership

➢ Limited data management capacity

➢ Inadequate horizontal and vertical communication

➢ Inadequate bandwidth nationally and on the Gateway

Some of the above challenges can be addressed through public-private, institutional and government smart partnerships.

Mindset Change in Kenyan Universities

In Kenya, universities are now faced with the challenge of transformation, a paradigm shift, necessitated by the age of network intelligence. Universities must undergo internal and external transformation in order to move in unison with the private sector and respond swiftly to ICT developments and its dictates. Internally, Universities are called to improve the efficiency and effectiveness of internal functions and processes within university departments and institutions through internetworking while externally, universities are called to be more transparent and give students access to information and e-learning materials

Universities should appreciate their overall responsibility of creating a conducive environment that allows for the development of ICTs for national benefits.

 e- Learning must be customer driven and services oriented, meeting the needs of students and improving the quality of life. Ensuring the availability of minimum supply of ICT infrastructure and electricity (including solar and renewable energy) for back-ups in-case of blackouts should be considered an important part of those strategies. The universities should liaise with government of the day to lower the cost of PCs for targeted population groups, relaxation of import duties, tax breaks and assurance that investors can regularly repatriate their investment should be incorporated.

Universities should understand ICT and their implication to government and society at large. The Policy should unequivocally spell out the role of universities and the government in enhancing ICT.

As a Policy, Universities should:-
➢ Develop an e-Learning policy and legal framework.
➢ Ensure that every department develops and manages computerized information systems.
➢ Ensure that every university department has an updated informative and interactive website.
➢ Create an e-learning department to coordinate and rationalize efforts by university entities working on ICTs.
➢ Make e-learning services accessible to all students.
➢ Provide a systems security framework for e-learning
➢ Build capacity for e-learning.

ICT Support to Economic Development and Poverty Reduction

ICTs provide an opportunity for universities to address the digital divide, vision 2030 and reduce poverty while registering economic growth. Universities have seen the emergence of a vibrant ICT sector that significantly contributes towards country's gross domestic product (GDP). It is this ICT sector that should be built, in most cases, through public-private, universities and government partnerships.

ICT Department in Kenyan Universities

The ICT department must be strengthened since it affects operations of all other departments of the economy.

Policy Thrust to strengthen the ICT department in Kenyan Universities
➢ Develop and improve ICTs infrastructure for all departments of the university communications, academics and administrative.

> ➢ Encourage full utilization of existing communications infrastructure to reduce resource wastage.
> ➢ Implement an integrated and equitable framework for accelerated ICTs development and uptake.
> ➢ Increase bandwidth on the national backbone and international gateway(s) systems to enhance speed and efficiency of operations, this is done in conjunction with the government
> ➢ Develop supportive and enabling infrastructure to ensure equitable access to ICTs by all students, stakeholders, disadvantaged groups and communities around the Universities.
> ➢ Promote local production of ICTs products to ensure relevance of content and use of appropriate technologies that meet international standards.
> ➢ Establish institutional mechanisms to co-ordinate inter-organizational planning, policy-making and implementation of strategies to develop ICTs taking into account the convergence of broadcasting, telecommunications and on-line computer services.
> ➢ Implement measures to develop and retain skilled human resources in the ICTs sector.
> ➢ The Universities management to ask the government to rationalize the ICTs tariff structure to make ICTs more affordable and accessible
> ➢ Introduce and enforce stringent quality of service standards in the provision of ICTs.
> ➢ Create a conducive environment for investment through PPPs in the ICTs sector.
> ➢ Promote local research and development in software and hardware relevant to all departments of the University.
> ➢ Promote awareness and use of ICTs.

Cyber-Security Risks for Kenyan Universities

New risk factors and challenges to data and communications networks seem to be evolving as rapidly as the spread of high-speed Internet infrastructure. Among these compelling risks among others are:

Computer Worms and Viruses

Debilitating worms and computer viruses have demonstrated destructive capabilities for a number of years, as evidenced by the damage caused by such programs as Sasser, Blaster, Netsky, Welchia and Code Red.

Organized Criminal Activity

The booming growth of ICT-services has spawned new gray-and black-market opportunities that organized criminal elements are exploiting for huge financial advantage. Financial institutions, for example, have already experienced significant losses through "phishing" and "pharming" operations. The more significant the volume of revenues that flow over ICT-based networks, the greater will be the incentive for organized criminal elements to corrupt or economically exploit high-value data resources. A global "black economy" can, for example, generate financing for terrorism, as well as "off-budget" funding for military, police, or national security agencies of nation states.

Weak Links in the Global Information Infrastructure

Potentially, any market with a combination of high capacity PCs, broadband connections, and poor network security (typical of most home computers with permanent Internet connections) can be used to wreak havoc on ICT dependent infrastructure anywhere on the globe via the Internet backbone. Such weak links create significant vulnerabilities in inadequately protected university networks that are, unfortunately, prevalent in many developing nations. Such networks include both low-bandwidth and very high-capacity networks.

Hacker-Activists

Activists and protestors have proven themselves capable of temporarily disrupting ICT-based services of governments and international organizations.

Rapid Evolution of Information and Communication Technologies

Changing technological developments, such as Internet protocol (IP) technology, are radically changing the way that backbone telecommunications services are provided. The increased interdependence between providers of backbone services and providers of services dependent on this backbone creates multiple entry points for network security breaches. Similarly, peer-to-peer technologies that allow millions of end-users to become service providers (e.g., by sharing music and other files) create similar opportunities for security breaches

A Network Model for Cyber Security for Kenyan Universities

A well-balanced cyber security policy framework is highly complex. Such a policy framework has no bounds or limits—geographical or jurisdictional. It necessarily encompasses a full spectrum of business, societal, and governmental interests. Although cyber security policy will inevitably address grave concerns about national and

global security, as well as well-organized criminal activity, it is fundamentally about creating the very underpinnings of stable economic growth and open, transparent, just, and vibrant societies

A "network model"—essentially, a communications network—illustrates how actors in the public and private sectors can work together to manage future cyber risks. Rather than focus on institutions and functions, the focus is on processes, procedures, and information flows within these sectors. In other words, the framework promotes thinking in terms of functions, rather than titles or national or international institutions.

The focus on information flows is intended to help policymakers and other stakeholders visualize the systemic, inter-related nature of cyber security and how the actions of individual entities are likely to impact the decisions and responses of other participants in the network. It should be noted that such a model may require significant changes in traditional roles of intelligence and (inter)national security agencies, requiring them to operate on a more collaborative, inter-institutional basis.

The network model is based on three types of nodes or groups of stakeholders (policymakers, policy implementers, and operational personnel), which exchange three types of information on cyber-security: assessments, responses, and policy. Information exchange occurs both among the nodes, as well as between individual nodes and their peers in outside organizations at all levels. The model operates in the same way at four different levels, as risk management generally has the same components, regardless of whether it is conducted at the level of a firm, industrial sector, nation, or international organization. First, it requires communications across "universities" boundaries. Second, it requires information exchange between stakeholders at different levels in one university and with other universities regarding threats that have been encountered and handled. Third, procedures for handling such incidents are required and, fourth, legal or law enforcement sanctions may need to be applied.

At the national level, the major network "nodes" are central coordinating bodies, telecommunications regulators and e-economy ministries, intelligence agencies, law enforcement bodies, and national and governmental Computer Emergency Response Teams (CERTs) and Information Sharing and Analysis Centers (ISACs).

The implementation node in the international model is comprised of individual national ministries (telecommunications, intelligence, e-economy, and defense ministries, together with law enforcement bodies) and the operational level of national firms (including software and hardware vendors), CERTs, and national defense organizations. To this effect universities liaise with the government to look at network models for implementation of nodes.

ICT for the situation for Rongo University College

ICT is one of the foundations for economic development in the Medium Term Plans of Kenya's Vision 2030, with the theme, "strengthening the foundation for a knowledge economy". ICT is a critical tool in Rongo University College's vision of knowledge based economy, which aims at shifting the current industrial development path towards innovation where creation, adoption, adaptation and use of knowledge as the key source of economic growth are key. As a foundation of University College's innovation plans, ICT department would be concerned with:

- Upgrading the University College's ICT infrastructure ;
- Improving University College service delivery;
- Providing wireless access to Internet to student through Wi-Fi hotspots on campus;
- Encourage and increase student ownership of laptops through subsidized costs
- Developing the ICT industry; and
- Upgrading ICT capacity.

Rongo University College is adopting the global ICT project life cycle of concept, initiation, planning, execution and closure in all her ICT projects.

The University College will develop university ICT resources such as the data centre, wide area network (WAN), and ICT units in departments into commercially-viable, managed services which are "sold" to even the neighboring institutions around the University College. To show for this Rongo University College invented a gadget that is used both as speed governor to check on over-speeding vehicles and overloading vehicles that could instantly stop the vehicles altogether in-case of over-speeding and overloading.

There is need for Kenyan universities to benchmark their ICT programmes and pay particular attention to the progress made by other Universities in developing countries. India and Malaysia are good examples to study.

Several Universities in India, have embraced e-learning principles and ICT models and have gone down to village levels where villagers through Information Centres have access to communication facilities, information on land, training, payment of bills, local data sources, etc.

Conclusion

ICTs are enablers for economic growth because of their crosscutting nature thus affecting all sectors. Adoption and proper utilization of ICTs will lead, among others, to increased yields and quality production of goods and services. ICT industry can be resourced, properly managed and mainstreamed into a significant contributor to GDP.

Cyber security is essentially about managing future risk and responding to current and past incidents and attacks. This article has offered a highly decentralized communications model for processing risk-management information about critical information infrastructures, one that can be applied at both the international and national levels. The urgent task ahead is to identify the key information flows that are required for cyber security and to establish linkages among the various organizational entities that can best collect and use this information

The results of the regression analysis show that ICT development has a positive and significant effect on the education standards. Moreover, applying the ICT development sub-indices, this study finds that ICT Use and ICT Skill might have positive effects on education and economy but the effect of ICT Access is not clear since its corresponding coefficient is not statistically significant. Therefore, we can conclude that ICT induces outcomes that leads to higher economical values and raises the scientific level of Kenyan Universities. In this situation, policy makers should aim at increasing the level of ICT development through increasing its indicators including fixed and mobile telephone lines, international and national Internet bandwidth, proportion of departments with a computers and Internet access, Internet users, fixed and mobile broadband Internet subscribers, adult literacy rate, secondary, tertiary and university gross enrolment ratios.

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