ICT Infrastructure, Applications, Society and Education

Proceedings of the Annual Strathmore University ICT Conference 2006

Edited by

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MK, FA, & CN
Nairobi, June 2007

Acronyms

ADSL	Asymmetric Digital Subscriber Line
ATM	Automated Teller Machine
BA	Bachelor of Arts
BBIT	Bachelor of Business Information Technology
B. Arch	Bachelor of Architecture
BCom	Bachelor of Commerce
BEd	Bachelor of Education
B. Pharm	Bachelor of Pharmacy
BPO	Business Process Outsourcing
BSc	Bachelor of Science
CBA	Commercial Bank of Africa
CCNA	Cisco Certified Networking Associate
CHE	Commission for Higher Education
COMESA	Common market for Eastern & Southern Africa
DOT	Digital Opportunity Trust
EASSy	East African Submarine System
GDP	Gross Domestic Product
HEI	Higher Education Institutions
HTML	HyperText Markup Language
ICT	Information & Communications Technology
IEEE	Institution of Electrical and Electronics Engineers
IPTV	Internet Pay Television
JAB	Joint Admission Board
KEI	Knowledge Economy Index
KRA	Kenya Revenue Authority
KTN	Kenya Television Network
NRI	Networked Readiness Index
NSE	Nairobi Stock Exchange
NTV	Nation Television Network
RDF	Resource Description Framework
SADC	Southern African Development Community
SMEs	Small and Medium Enterprises
WOL	Web Ontology Language
XML	Extensible Markup Language

Welcoming address by Vice-Chancellor

Guests and presenters at today's event; participants; Ladies and Gentlemen:

It gives great pleasure to make a few opening remarks at this 7th Annual Strathmore University ICT Conference.

As many of you may have realized, the ICT conference has become a tradition to behold for Strathmore Community. We have come along way since the first conference was held in the year 2000.

The aim of this event is to enable students and professionals to interact with some of the major players of the industry in Kenya and to create awareness of the latest developments in ICT in Africa and the world as a whole.

This year's conference delves into the "*Emerging technologies and trends and the future of ICT sector in Kenya*"**.** As many of you may have noticed, there is a whole new wave of change across every sector of our society that has been precipitated by the ever changing information and communications technology in hardware, software, telecommunications, and related technologies.

Private sector as well as public sector is feeling the pressure of the emerging trends in ICT. Those of us in academia have had to change and embrace the new technologies in our research, teaching, and even the way we manage our institutions.

Looking at the list of presenters lined up for you, I see a galaxy of able and well selected speakers who will for sure dissect the theme conclusively. With this Strathmore University has lived to its desire to show the way not only in Accountancy and Management but also Information and Communications Technology (ICT).

It is my belief that this day will be a memorable one for many of you. I hope by the end of it, you will have gained as much as possible from these brilliant speakers lined up for you.

I wish you all a wonderful day of learning and interaction.

Prof John Odhiambo, Vice Chancellor, Strathmore University
9th September 2006

SECTION I:
ICT INFRASTRUCTURE DEVELOPMENTS

Improving Access to Technology for Economic Development

By
Bitange Ndemo, PhD

1. Introduction

In March 2006, Kenya published its first Information and Communications Policy (KIC 2006). The policy articulated the opportunities that Kenya had identified in the use of Information and Communications Technology (ICT) for social and economic development. In fact the vision statement of the policy was "to create an information society". There are many other countries that aim to leverage ICT for economic development. For example, President Paul Kagame of the Republic of Rwanda has been a champion in the use of ICT for economic development. Other African countries that have developed policies and strategies for effective use of ICT for economic development include Morocco, Egypt, Mauritius and South Africa. India is not only a user of ICT to provide business processing outsourcing (BPO) services to companies in developed countries, but is also one of the leaders in the software industry. Kenya has identified Business Process Outsourcing (BPO) as one of the strategic uses of ICT to support economic development.

Business Process Outsourcing (BPO) is one of the fastest growing segments of the IT services. For example, International Data Corporation (IDC) (http://www.idc.com), one of the leading research organizations, estimates that the global market for ICT will exceed $1.2 trillion by the year 2007. The Gartner Group, another leading research group, has observed that market perception for outsourcing has changed from a way to meet short-term financial objectives to a technique for achieving sustainable competitive advantage. The Deloitte Consulting group estimates that two (2) million jobs will move from the United States of America and Europe to cheaper destinations in the financial services business alone in the period 2006-2007. The global migration of service jobs due to outsourcing is estimated to be as high as four (4) million jobs.

Deloitte also forecasts that in the period from 2006-2010, 75% of the financial institutions and investment banks in the USA will move some tasks to low labour cost countries, with India as the favourite destination. In fact, global financial institutions will invest $356 billion in India alone for outsourcing projects (this is 30 times Kenya's GDP!). India will also capture 30% of the $400 billion outsourcing business that will be generated by the banking, financial, and insurance industry in the US by the year 2010.

Kenya's vision is to leverage ICT to become a "Regional Business Service Centre". This requires strengthening the three pillars of ICT: infrastructure, human capital, and marketing of Kenya as a BPO destination. This paper highlights how the government plans to strengthen ICT pillars during the period from 2006-2010.

2. ICT infrastructure pillars for BPO

The Government of Kenya has identified three key ICT infrastructure pillars:

- ICT hardware especially Personal Computers (PCs)
- Software
- Connectivity

The government is already collaborating with University of Nairobi, Jomo Kenyatta University of Agriculture and Technology, and Strathmore University, as well as the private ICT industry to develop and assemble cheap PCs. The government is also in discussions with leading software vendors such as Microsoft about software license costs. It is also exploring the use of open source software in educational and government institutions. The focus of the government, however, has been in the capital-intensive communications infrastructure that will provide the necessary affordable connectivity for businesses and other organizations in Kenya.

3. Affordable national and international communications infrastructure

International business and particularly the BPO service industry moves to countries and clusters with cheap, high-bandwidth, and reliable communications infrastructures. All of the countries that have been successful in attracting the BPO services have developed sophisticated telecommunications infrastructures.

It is estimated that Kenya has only 100 Mb/s of International Internet bandwidth compared to South Africa's 700 Mb/s. Additionally, all of the international Internet bandwidth is provided by satellite links which introduce undesirable delays and high costs. Other African countries like Mauritius, Morocco, Tunisia, are all connected to the global Internet using undersea optical fibre links that do not introduce the high delays. Apart from the delay, the cost of bandwidth is very high at an average of about $2,200 per Mb/s per month in Kenya compared to under $500 per Mb/s per month in other countries offering BPO services.

Kenya is therefore very uncompetitive in terms of Internet bandwidth both in cost and speed.

The Eastern African countries are unique in that they are the only ones in the world that have not yet been connected to the global undersea optical fibber network. The East African Business Leaders therefore created the East African Submarine System (EASSY) consortium in the year 2003 as a vehicle to finance the construction of the undersea optical fibber cable on the East African coast as shown in Figure 1. Unfortunately, progress on the project has been very slow because of divergent objectives among countries in the consortium and complexity of financing models. For example, the East African region is not homogenous and has unresolved ICT policy and regulatory issues, different ICT market structures, and multiple regional economic zones (East African community, COMESA, SADC). Kenya has been getting impatient because some of the other partner countries do not see the urgency of an undersea optical fibber and the associated loss of BPO opportunities.

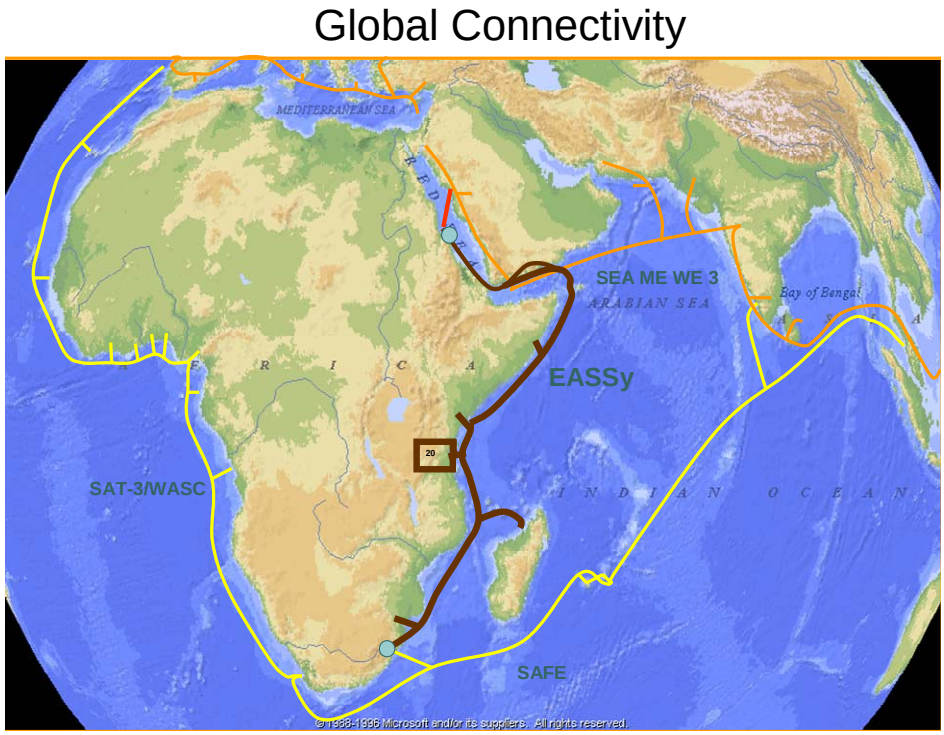


Figure 1: Proposed EASSY optical fibre link

Apart from the international connection using undersea optical fibre, the government of Kenya has also recognized the need to develop a national optical fibre network. Such a national high-speed backbone network would allow BPO companies to move away from Nairobi where labour; land and rents are

relatively high to cheaper areas outside Nairobi (e.g., Nakuru, Eldoret, or Nyeri). Figure 2 shows the proposed 5,000 Km national optical fibber link.

The government intends to implement the project in the next one year because it considers an optical fibber network to be similar to a national road network. At present the government is exploring different financing models for construction of the cable such as issuing ICT infrastructure bonds at the Nairobi Stock Exchange, establishing Public Private Partnerships and borrowing money from development financial institutions such as the World Bank.

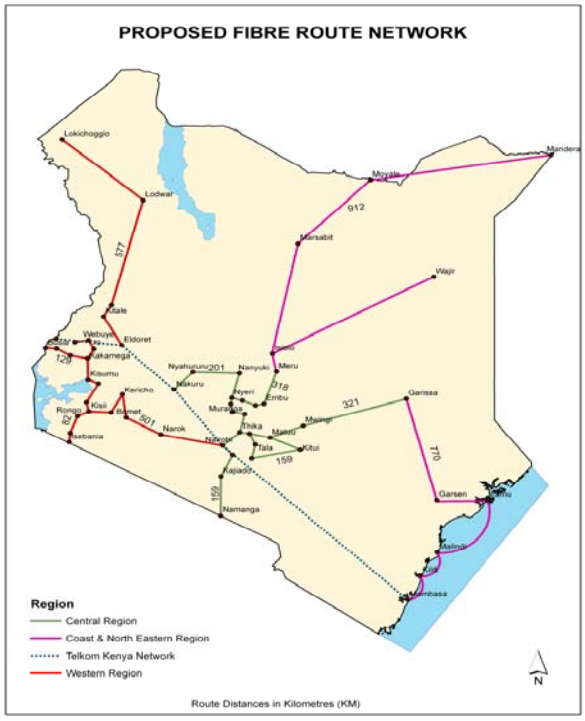


Figure 2: National Optical Fibre Backbone Network

4. Conclusions

In the Newsweek Magazine of May 2006, Fareed Zakaria wrote that "The 21st century will be a century of change. It is estimated that more things will change in the next 10 years than in the previous 100. Most countries are not ready for the dizzying change." Is Kenya ready for dizzying change? It is quite clear that decisive leadership in ICT and financing will be required. Governments will need local and international partners to develop infrastructure and to attract BPO industry into the country. Kenya already has some strength in terms of command of English, the language of international business, relatively large pool of university graduates in business and finance, and strong ICT academic

institutions. The government is planning to implement the ICT strategy at the dizzying speed of international business. Let us all be ready for the dizzy ride!

Reference:

KIC (2006) – Kenya Information and Communications Sector Policy, March 2006, Kenya Government Printers.

Author:
Dr Bitange Ndemo is the Permanent Secretary, Ministry of Information and Communications, Government of Kenya

Investing in Wireless Communications: POPOTE Wireless Case

By
Edwin Muthi

Abstract
Landlines are very much in demand as they are cost effective. Due to the difficulties experienced in obtaining landlines in the past, many Kenyans rely on mobile phones for their communication needs. This is where the Popote services come in handy. This paper presents how Popote Wireless filled in a niche and took advantage of this lucrative communication business.

1. Introduction

Popote Wireless is the brainchild of Eric Muthi and Edwin Muthi who got the idea of wireless landline communications in the United Kingdom and decided to come back to Kenya and make it a reality locally. While in Kenya, they partnered with Ian Kabiru and Fred Gatiramu. Initially the company was registered as EM Communications in 2000. Around that time the telecommunications sector, which had been closed in the previous years, was liberalized and small investors could now tap the lucrative sector.

After registration of the business, it took the four directors two years to set up the operations of the business. During this time, they engaged local investors and vendor financiers to capitalize the business. It was later licensed in 2004 as a Local Loop Operator. EM Communications was a holding company so they wanted a brand that Kenyans could identify with. After a thorough research exercise the directors came up with POPOTE as a brand name. They felt that this name was relevant both locally and worldwide. The brand name was appealing as it was easy to identify and pronounce. Initially the company set up was small but now the company's growth has been phenomenal with 80 employees now working for the company and 300 employees in its distribution network.

2. The Business Niche

Popote Wireless aims at supplementing Telkom Kenya's role of supplying landlines to meet the communication needs of Kenyans. Currently the landline supply is way below the demand from local Kenyans. It is currently at 1 percent which is below the world's average of 10 percent. What this means is that the current landline capacity or lines registered under Telkom Kenya is 500,000 - of

these, 300,000 lines are under voice utilization with Internet utilization at 50,000 points.

There is a gap in the communications industry and Popote Wireless is here to fill it. Landlines are very much in demand as they are cost effective and the type of technology that Popote Wireless has adopted, can potentially reduce local calls to 3/- per minute compared to the current cost of calling which is between 5/50 for local landline calls and as high as 50/- for some local mobile calls.

Due to the difficulties experienced in obtaining landlines in the past, many Kenyans rely on mobile phones for their communication needs. This is where the services offered by Popote come in handy. They make landline acquisition very simple as one gets instant connection with no waiting periods; also it enables the subscriber to surf the net with ease. This is a major plus as the communication needs of Kenyans are moving in that direction and in the future the Internet will be the main communication facility. In economic terms, a 1% increase in voice tele-density is US$ 250 GDP per person while the same in Internet tele-density is over US$ 500 GDP per person.

3. The Technology

In keeping with modern technology, an American technology known as CDMA (Code Divisional Multiple Access) is used at Popote Wireless as opposed to the regular GSM technology found locally. The main advantage of this technology is that it is low cost and uses radio frequency more efficiently. With the CDMA technology fewer base stations are required thus requiring a lower capital investment. This technology also has better data capabilities. This translates to lower costs and more efficiency. Due to these good qualities of CDMA technology, Popote Wireless is able to offer unlimited Internet subscription for a small fee of only 3,500/- Kenya shillings + VAT.

The Popote Wireless landline handset comes with its own PABX and offers limited mobility, but at very low prices. This equipment is extremely feature rich and has conference calling whereby one can have a meeting with several people on the phone. It comes in handy when one wants to communicate with several people simultaneously. Another feature on the handset is the VoIP that drastically lowers international calls to as low as 10 shillings which makes international communications very simple and affordable.

To make it more convenient to the consumer, Popote Wireless has introduced both post-paid and pre-paid billing options. Post-paid is whereby a customer uses the facility then receives a bill on a monthly basis. On the other hand pre-paid involves purchase of calling cards that are loaded first onto the equipment

before communication takes place. The handset costs are inclusive of VAT and one gets an instant connection similar to that of mobile phones.

The company's goal is to identify customer needs and make sure the product meets the needs of Kenyans. Today's consumer is very sophisticated and demands quality, excellent service. It is with this in mind that Popote Wireless invested in good customer care and set up a call centre that is there to take care of customers. They also recently launched vibrant advertisement that has been well received across the country. The company relies mainly on direct marketing and this advertisement has certainly boosted the company's sales.

4. The Challenge

The main challenge that Popote Wireless faced was raising the high capital that was required to set up the company. Most local banks were sceptical and reluctant to support as they are a start-up. Recruitment was another problem as getting the right calibre of staff with the right skills proved to be rather difficult at the beginning. The other hurdle was dealing with other operators in the industry. Initially the company had an agreement with Telkom to use their network at a reasonable interconnection rate but later on things changed when Telkom increased the interconnection rate above the cost of a local call.

Popote wireless is engaged in aggressive marketing activities such as demos and trade shows. The company recently participated in various trade exhibitions, conferences, and is also involved in road shows in residential neighbourhoods as part of their marketing campaign. The idea is to interact with people in the estates and educate them in this new wireless landline service. The wireless landline communication service fits snugly into the life of a busy individual as it enables him to plan his family and social life by having this basic communication service at an affordable rate with better performance and more features. It makes communication really smooth and easy.

5. Conclusion

All in all, the local ICT sector is vibrant due to the current liberalization and also an enabling environment has been created by the government. This is a classic example of how the government and private sector can work in harmony. ICT by nature of technology is always changing. Kenya has finally opened up to global trends.

Author:
Edwin Muthi, Executive Director, Commercial

Emerging Cellular Technologies and the Future

By
Alex Fares

Abstract

This paper includes information on various areas related to Global system for Mobile communication (GSM) which includes; GSM Systems Engineering and Network Management, GSM: Base Station Subsystem Engineering, GSM: Network Switching Subsystem Engineering, GSM: GPRS and EDGE Engineering, GSM: Satellite communication Engineering. The other issues discussed include a roadmap to M-commerce and globalization.

1. Introduction

Technology has enabled the exchange of information between men and machines through voice, image, data or multimedia which basically characterize future telecommunications infrastructure which is driving our society's dramatic transformation to information based economy

The availability of such an infrastructure enables the information that is used or passed to be simple, secure, reliable and cost effective.

In terms of service provision, regulators, Network Service Providers and equipment suppliers all aim at satisfying the telecom market demands based on the promise of providing the best services to end user, while at the same time stimulating the economy to produce more goods and services

Services as broadband communication can be availed through cable connections or radio waves.

The rapid expansion and developments in telecommunications, especially in industrialized nations, has transformed lives and impacted on traditional industries like, publishing, music and films in terms on how they carry out their business processes, making it the fastest growing sector in the economy.

The ability to distribute information in all forms has been in the recent years revolutionized by; speed, ease of transmission, limitless range and potential global accessibility.

Information and telecommunication technology has in effect impacted the society in various ways which includes:

- Dramatic transformation into an information based economy;
- Making the business more productive and competitive;
- It has opened up new possibilities for economic break through.

On the other hand, even the Telecom equipment suppliers, who mostly have been operating in a competitive environment, can agree that the competition is getting tougher, stronger and more brutal.

Their strategy is to provide a complete range of technologies and products required to deliver the ever-demanding customer sophisticated requirements.

Using ITU.T definition, telecommunication services can be categorized as:

- Bearer services
- Teleservices and
- Supplementary Services.

Each of these services can be identified by the networks, which allows them to be treated differently.

Globalization of Technology
Today's telecommunications market segment is becoming increasingly global and major players are emerging in this market struggling to take a dominant position

This increasingly global business environment has been driving, and will continue doing so, to enable the globalization of technologies, and in particular, radio access technologies.

The selection of technology is likely to have an impact on the global strategy of each particular cellular operator.

Economies of Scale
There are aspects associated with the globalization trend that will likely be determining factors for the selection of technology. These aspects that are related to the benefits associated with economies of scale include:

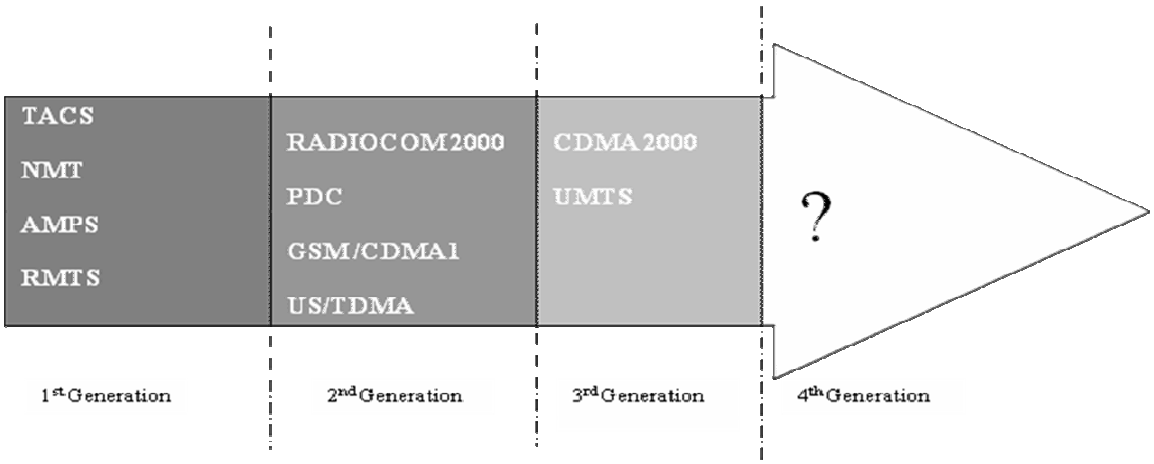
- Network infrastructure and mobile handset costs
- Speed of technology development
- Roaming and service continuity.
- Available service portfolio

2. Evolution of Telecommunications

Multimedia services are now gaining more importance including a huge number of applications ranging from Phone, video phone, telefax.

3G Evolution Paths:

Evolution paths associated with the existing 2G technologies Summary:



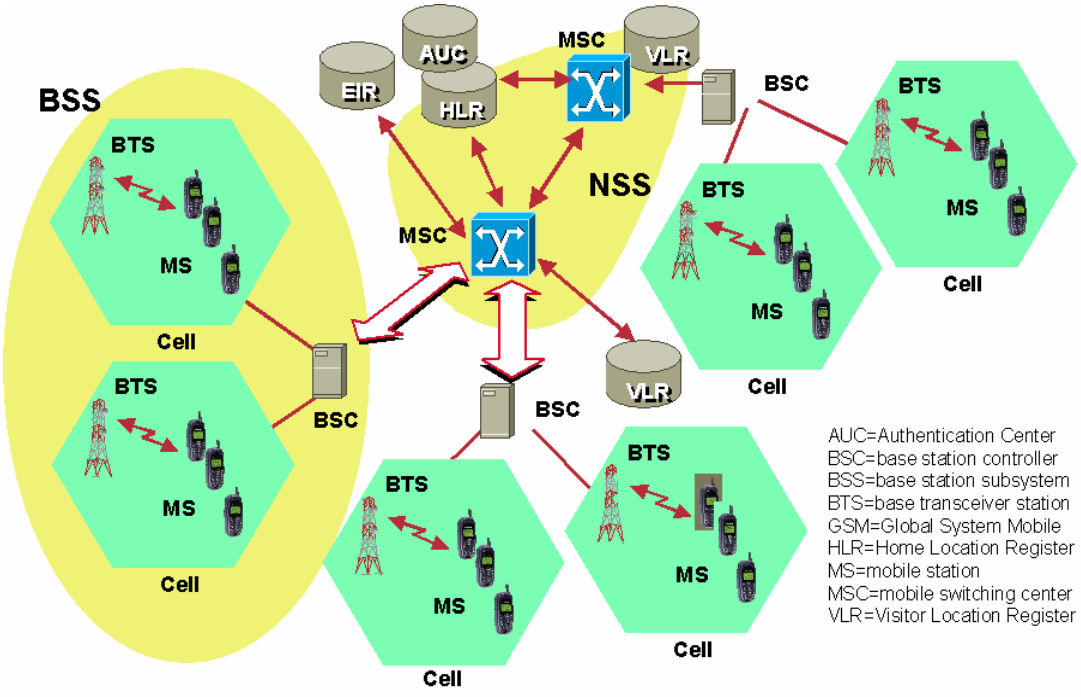
GSM Cellular network:

Within the GSM network, analog cellular systems are commonly referred to as first generation system.

The digital systems in use, such as GSM, PDC, CDMA 1, US-TDMA and 1S-136 form part of the second-generation systems.

These systems have enabled wireless voice communication in many leading markets. The customers are thus increasingly finding value in other services such as text messaging (SMS) and access to data networks (FAX) which is progressively growing.

GSM Cellular network:



3. Evolution of Telecommunications

The increasing reliability in telecommunication services, the industry is now faced with challenges of providing the necessary capacity for both backbone transmission infrastructure and the access network.

At the same time, the provision of new innovative multimedia and broadband services are geared to enable telecommunication operators to gain a foothold in the market and experience a rapid growth**.**

Blue tooth and the Cellular network

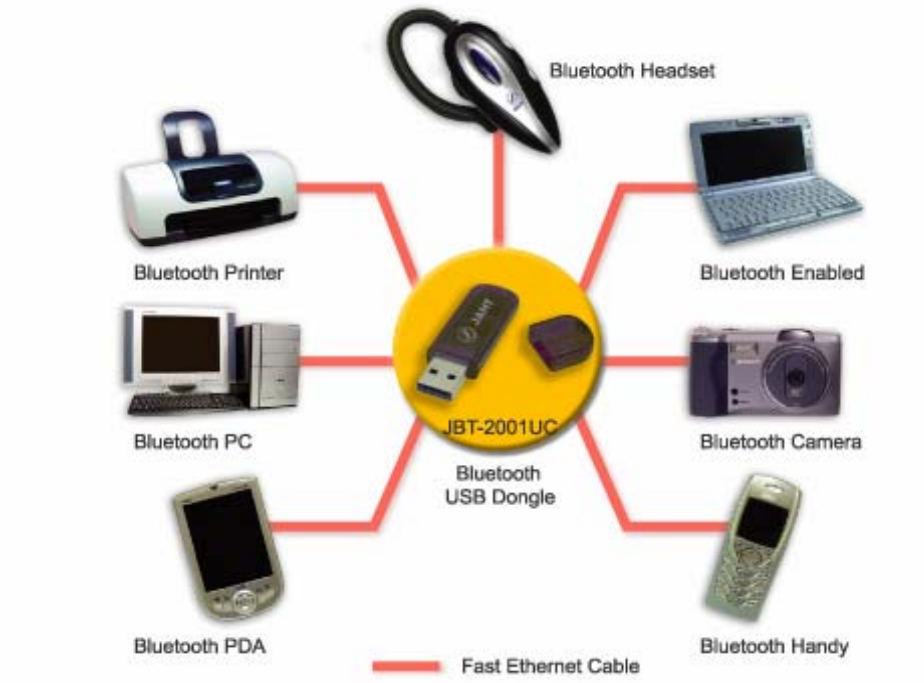
Bluetooth uses the Frequency Hopping spread Spectrum and is known to form ad hoc networks, which is also known as personal area networking (PAN).

Two transmission ranges have been defined for personal area networking with the limitation between 10m to 100m without a line of sight.

Bluetooth cell coverage area is thus small which makes it a costly value proportion for operators. This is due to the fact that it adds value but does not necessarily reduce costs.

Bluetooth applications:

Bluetooth technology can be used to connect various devices within its range as printers, PCs, Cell phones, printers, PDAs, cameras and other Bluetooth enabled devices. It allows sharing of resources, including files and access to the Internet.



WAP in the Cellular network

Wireless Application Protocol is a secure specification that allows users to access information instantly via handheld wireless devices such as mobile phones, pagers, two-way radios, smart-phones and communicators**.** This allows for a standardized communication between the mobile phones and the servers.

WAP uses client- server architecture. It is especially suitable for thin clients since it incorporates a relatively simple micro browser into the mobile handset.

Some of the corporate applications that are being enhanced and enabled with a WAP interface include:

- Remote Point Of Sale
- Remote Monitoring Such As Meter Reading
- Vehicle Positioning
- Corporate Email
- Paging
- Two way radio communication

I-mode

I-mode is a wireless internet service which enables mobile phone users to access mobile internet sites.

It provides a full-colour, always-on, packet-switched, Internet service for cellular phones offered by **NTTDoCoMo** (Nippon Telephone and Telegraph DoCoMo *docomo* which is translated in Japanese as, "anyplace you go" and the acronym in English is an equivalent to, "Do Communication Over the Mobile Network."

I-mode users are diverse, which include young people, middle aged and old people. It has been surveyed that there are more male i-mode users compared to their female counterparts.

GPRS & EDGE:

General Packet Radio Service (GPRS) is a packet-based bearer service that is being introduced on many GSM networks. The use of packet Switching means sharing of the same resources used by various mobile users, who are charged on the basis of the amount of data transmitted, rather than the connection time as WAP.

GPRS is a development of GSM and can be implemented by Mobile operators using their existing GSM network.

Advantages of GPRS

GPRS can be efficient as it allows customers to answer voice calls while in the middle of sending e-mails or viewing a WAP site. The data call is halted then picked up after the voice call with no extra charge being incurred.

EDGE (enhanced data rates for GSM evolution)

EDGE is a 2.5G initiative that is yet to be realized. It sits between 2.5G and 3G although it offers the potential for packet- based services providing data rates of up to 384 Kbps

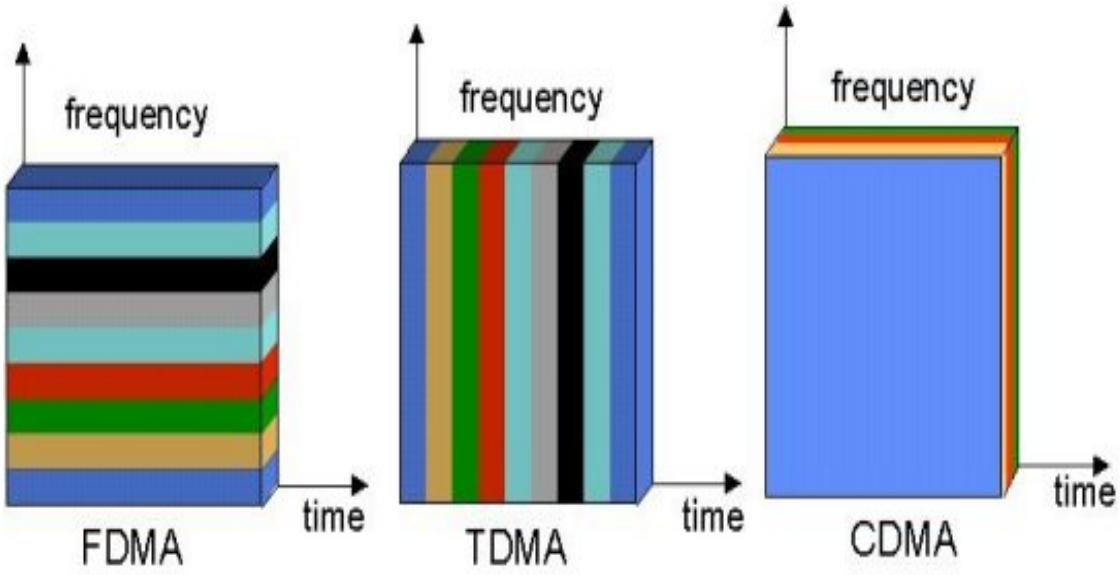
EDGE is easy to deploy and also offers high speed data packets.

CDMA

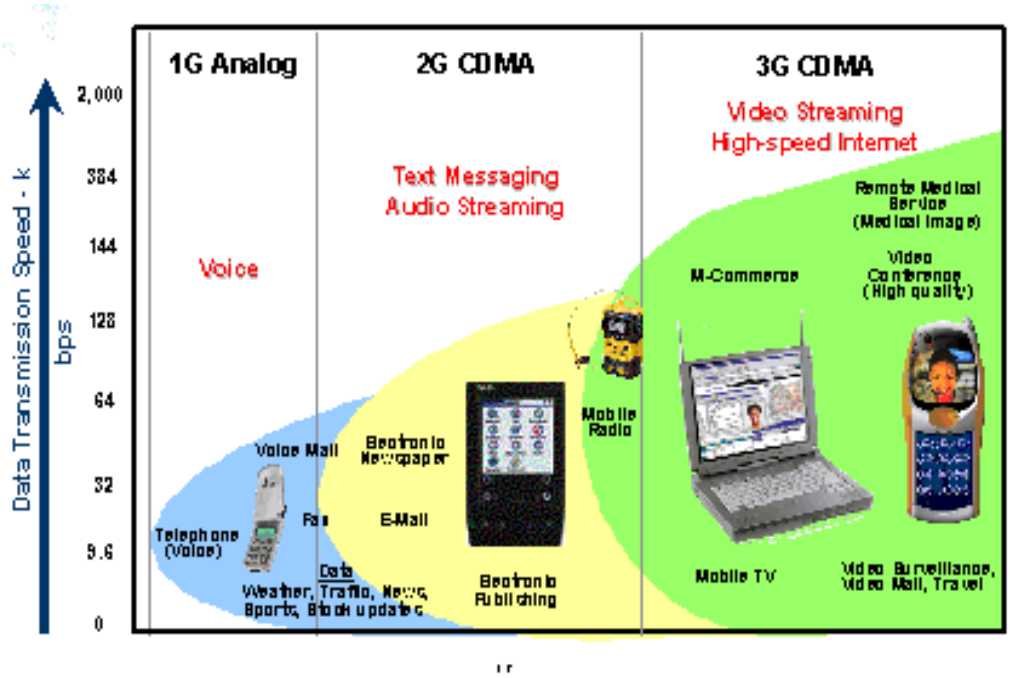
Code Division Multiple Access is a mobile technology that uses spread spectrum. It allocates for every channel, the entire spectrum all of the time, to allow for encoding of individual conversations. It scatters a radio signal across a wide range of frequencies

CDMA is the common platform on which 3G technologies are built small cell radius. It provides better capacity for voice and data communications and allows more subscribers to connect at any given time.

ACCESS SCHEMES:



Future Proof Technology:



The operators here have yet to grab the imagination of the market. Fortunately, mobile penetration is higher than the Internet penetration in every market, with the exception of the US, this fact might aid m-commerce, and this should help drive demand for m-commerce services.

As the world knows, we are moving from 2G to 3G through 2.5G (in some sense). One important issue to be visualized is the extent to which end-users are prepared to pay for the ability to transact business using their mobile device.

Payment plans have to be devised which are less susceptible to fraud.

3G infrastructure rollouts will take time especially for Africa, where it may start off in the year 2014 however, we need to adequately prepare customers for the impending changes in business world.

Crypto Smartphone

The crypto smart-phone uses a symmetric 256 bit cryptographic algorithm and Windows CE (Enhanced Real-Time) operating system. It has a platinum body. The Ancort logo and the navigation key are made of 18 carat rose gold; its navigation key carries 28 round cut diamonds. The leather carrying case with platinum trimmings and lock, when the case is opened, it plays music and the music can be changed to the client's choice.

The phone uses a powerful encryption technology to provide added security. The level of encryption will provide secure protection of information against kidnapping, technological blackmail, financial racketeers and corrupted state officials

Crypto Smartphone

4. Conclusion

The mobile phone has become part and parcel of life for many. It continues to be a key tool of communication. With the emerging technologies and ever expanding innovations, life promises to be even better for telecommunications technology consumers.

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SECTION II
ICT APPLICATIONS IN BUSINESS, GOVERNMENT AND EDUCATION

Increasing Role of Computer-Based Information Systems in the Management of Higher Education Institutions

By
Clement Nyandiere

Abstract

Trends across the world show a growing demand for information systems for educational institutions. Many of them have been running manual systems, pushing paperwork, for ages. They have had cumbersome working procedures and this has led to low productivity occasioned by highly inept manual systems. Many of the higher educational instructions (HEIs) have implemented one form of computer-based information system (CIS) or other to manage their academic and management needs.

But why are our HEIs turning to computerised information systems? There is a general demand on institutional managers to deliver high quality service; there is increasing need for management productivity; efficiency brought about by the systems; there is the increased recognition of information as an important corporate resource that is key to good decision making in a competitive and ever dynamic environment; and technology- hardware, software, telecommunications and related technologies- is now fairly priced and therefore more affordable to many institutions.

However, as the HEIs quest for information systems implementation, they face a number of challenges to overcome which include lack of awareness and mindset among staff; lack of top level management commitment thus bringing forth bureaucracies and red-tape in system implementation; lack of appreciation of ICT as a tool and not panacea for organizational transformation; poor strategy in making ICT responsive to the organizational vision and mission; lack of a systematic method of system implementation; lack of project ownership- all employees and users must be involved in system implementation; inhibiting initial costs of hardware and software and funding for sustainability and continuity in maintenance, replacement of equipment and emolument of ICT staff who maintain the systems, among others.

This paper identifies strategic management of organizations, strategic ICT planning, and integration of ICT in the management of HEIs as key ways of overcoming some of the challenges that HEIs face in their effort to implement systems in the institutions.

1. Introduction

Higher educational institutions (HEIs) across the world are facing new challenges ranging from management, staffing, finances, and now increasingly technology. Chacha, (2004) while discussing emerging issues in higher education in Africa indicates that trends show that the rise of new stakeholders, internal factors, globalisation and the rapid pace at which new knowledge is created and utilized provide major challenges to higher education institutions across the world and Africa in particular. He further identifies the key challenges of higher educational institutions as being, the drop in research and publication by faculty due to heavy teaching responsibility; poor leadership and management practices; poor remuneration of staff; diminishing financing; lack of quality standards to measure performance of the HEIs with their counterparts elsewhere; lack of jobs for graduates from the HEIs; gender inequality in favour of men; lack of further training opportunities; and lack of ICT capacity and utilisation in the running of the institutions.

As noted by Chacha, ICT utilisation in HEIs has been key concern with many of the institutions having implemented various systems to help them manage information resources for better management of the institutions. He however notes that with the swiftness of ICT developments, their increasing spread and availability, there is need to tap the ICT potential to enhance data collection and analysis, and to strengthen management information systems in HEIs in Kenya (and by extension Africa).

This paper analyses the emerging trend of implementation of information systems in HEIs, appreciating the role ICTs playing in HEIs management, strategies for implementation of the systems, challenges HEIs face in the implementation of the systems, the way forward to successful implementation and management of the systems.

2. Why ICTs in HEIs management?

Since the 1980s the business environment has changed dramatically. Information and communications technology has revolutionised business organisations bringing forth new ways of doing business that are innovative, efficient and more effective. Organisations today confront new markets, new competition and increasing customer expectations hence the need to efficiently manage the information about competitors, their products, market trends, customer demands and technological developments (Laudon, 2000).

Through the emergence of fast and powerful computers, networks and infrastructure, delivery of immediate and relevant information enables policy-makers in an organisation to make quick and accurate decisions (Newmann, 1994). Laudon (2003) while commenting on the role of information systems in organisations indicates that ICTs provide tools for data collection, analysis, storage and dissemination to support decision making in organisation.

University environments are equally changing in the technology front. Arising from his studies of Universities in Philippines (Asia), Acosta (2004) notes that quick and accurate decisions of HEIs managers require readily available and relevant information thus making ICT a vital tool in today's business world providing tools for information collection, storage, and management to facilitate communication and decision making processes. He points out that HEIs too, must cope with the emerging trends of competing on the ICT platform, thus they need to continually assess their current status, and that of their competitors to formulate and manage their own strategies if only to stay abreast with the latest challenges of the information age.

ICTs play and will continue playing an important role in HEIs management. Katz (2001) quotes EDUCAUSE president, Brian Hawkins, who in 1999, in his paper *Technology, Education, and the Very Foggy Crystal Ball* asserted three propositions about the impact of ICT on higher education, that is,

- that the new technology affords exciting opportunities for more effective teaching;
- that the new technology offers scalability that is greatly needed;
- that the new technology will transform higher education beyond what we know it to be today

Technology has provided exciting opportunities for teaching including the recent e-learning initiatives in addition to transforming HEIs operations.

ICTs in higher educational institutions have come about from developments in corporate businesses where ICTs have been incorporated into organisational functions to improve their performance. As Tusubira & Mulira (2005), having extensively studied operations of Makerere University (Uganda), argue that at the organisational level, the integration of ICT in organisational functions has been brought about by three main factors: **increased efficiency**, **cost effectiveness**, and **competitiveness**.

Increased efficiency

The efficiency brought about in universities can be realised in areas of easy access to student and staff records, data on assets of the institutions as well as efficiency in front office operations and management of key processes like admissions and examinations (Tusubira & Mulira, 2005).

Katz (2001) asserts that the information and communication technology (ICT) infrastructure is likely to influence and even shape the nature of higher education institutions and the practises of faculty and administrators. Faculty, parents, staff and students are demanding more information from the HEIs inform of grades, loan payment and tracking, class registration, and contract administration thus expecting information systems of HEIs to operate automatically, integrated and accessible to users 24 hours a day, 7 days a week, 365 days a year.

Katz also points out that information resources and tools can be invoked to help guide increasingly complex and consequential institutional decisions through tools provided by the systems. HEIs are investing in systems that make it relatively easy and cost effective to acquire, store and manage volumes of information about institution's stakeholders.

Strathmore University, Kenya, recently implemented an academic management system together with a library management system to facilitate management of academic processes. According to Martin Wanjohi, the ICT Director, the system has been designed to provide quick and easy access to management information. When fully operational, the academic management system will increase the productivity of staff involved in all academic departments. It will also improve the overall management of the university.

The ICT director summarises the rationale for the new systems at the University as the need for: increased administrative efficiency and academic processes; improved information management – better record keeping and availability of information; to automate manual processes –for example the library; to improve value delivery – e.g. extending interaction and access to information beyond the class using E-learning, also lecture room automation which would allow lecturers to use audiovisual aids conveniently and also pull any information from anywhere in the world to enhance class presentations; and provision of management information – improved availability of information for management, information on the desktops of managers.

Florida Agricultural and Mechanical University (USA) has an enterprise which integrates the business processes in all departments and functions as a single computer system. All students, faculty and staff are affected by the system. The university's website lists the following as benefits from the system: replaced aged

campus systems with one system for all; automated steps from start to finish; provided greater access to data and better reporting tools; reduced errors in transactions; provided easier and faster response to changes in federal and state regulations; refined policies and procedures; facilitated information sharing across departments; and has provided opportunity for implementation of self service features. The system assists students to apply for admission via the web, view application status, register for classes, make direct payments, monitor degree progress, view grades, view account balances, among others.

Cost effectiveness

Technology- hardware, software, telecommunications and related technologies are now fairly priced and therefore more affordable to many institutions. Wanyembi (2002), in his doctoral thesis entitled *improving ICT management in public universities in Kenya* points out that the strong interest in the adoption of ICT emerged in sub-Saharan Africa for three reasons: one, the revolution in ICT that has resulted in computer systems- hardware and software- becoming cheaper, and therefore, more widely affordable. Two, the substantial value added utility of ICT in the provision of, and access to, information services for improved planning and organisational management becoming more widely recognised. Three, international development agencies and donor countries have exerted significant pressure upon many governments, institutions of higher learning and other recipients of their aid to adapt extensive use of ICT to improve their work performance and organisational management.

Golola (2005) while writing on the role of the ICT unit at Inter-University Council of East Africa (IUCEA), points out that the swiftness of ICT developments, their increasing spread and availability, the nature of their content and their reducing prices, are major implications for teaching and learning, research, libraries and information services, and university management. The ICT Unit of IUCEA is currently involved in helping member universities from East Africa to implement various systems. In an attempt to enhance the quality of education in the region, the ICT unit has embarked on a number of initiatives, on behalf of it member universities, to tap the potential of ICT to enhance data collection and analysis, and to strengthen management systems in educational institutions; to improve access to education by remote and disadvantaged communities; to support initial and continuing professional development of stakeholders; and to provide opportunities to communicate across classrooms and cultures, Golola points out.

Competitiveness

Alter (2001) notes that organisations invest in information systems because they believe the systems will make a difference in the way the organisation conducts its business- processes and functions, basically giving the enterprise competitive advantage. Competition among various businesses is the main force behind strategic moves that each enterprise takes. Academic institutions, are not spared from competition and therefore need to make strategic moves, especially taking advantage of information technology.

Munguti (2001) points out that the changes in the business environment have made a demand on enterprises to be competitive in their supply chain; shorten throughput time; reduce stock to a minimum; improve product quality; provide more reliable delivery date and good service to customers; and to efficiently co-ordinate global demand, supply, and production in an effort to be competitive. While this may not necessarily apply to HEIs, the institutions have the challenge of ensuring that their processes are faster, less cumbersome and that the academic processes are designed in such a way to facilitate faster data collection and dissemination for management decision making.

For Wanjohi (2006) information systems bring about faster and better decision making given the unlimited access to high quality and well maintained information resources. He adds that competitiveness can also be seen in the return on investment (ROI). ROI though hard to quantify for many institutions could be seen from the cost savings in paperwork, loss of important documents always on transit in manual process, and the increased staff morale. Systems get the institution to a level of elegance and pride, which can be seen, for example, through online access to records such as examination grades for students, access to learning material through an electronic learning environment.

According to Acosta (2004), institutions of higher learning, like all other businesses, need to continually assess their current status, and that of their competitors in order to come up with a plan, formulate and manage their own strategies if only to stay abreast with the latest challenges and intense competition posted unto them especially in the information age.

For Glazer (1993), successful firms have invested in ICT like everyone else but have differentiated themselves by viewing the management of information produced by these systems as being of paramount importance. As these organizations identify the relationship between corporate and ICT strategies, they use information to integrate and manage links between the two- the corporate and ICT. Such organizations succeed because of their ability to differentiate themselves from their competitors, especially on the ICT platform. Supporting this viewpoint, Parker *et al.* (1988) maintain that justification for an

ICT application links to one of two conditions: either it improves the performance of the current organization or it improves the outlook for new business opportunities and strategies of the enterprise.

Hammer (1990) points out that the best rationale for acquiring ICT is strategic alignment of the business and the resultant benefits. Alter (2001) adds that ICT is worthless unless it is used in business processes.

Wanyembi (2002) notes that colleges and universities in Kenya, like other business organisations, have felt the pressure to invest in computer-based information systems to manage their business processes and more so manage the vast amounts of data they handle. Accordingly, information and communications technology (ICT) resources in Kenya continue to increase in numbers, value and sophistication as more and more institutions invest in new technology.

HEIs are also turning to computer-based systems as tools to differentiate themselves in the education market place. Some of the HEIs are increasingly turning to ICT as a differentiating, and marketing tool, to provide quality services. Strathmore University, for example, is a private university with aspirations to offer quality education in an environment of freedom and responsibility. The university aspires to offer an all round education supported by highly developed information technology infrastructure. Thus having a good university information management system is a key indicator of quality service provision (unpublished Strathmore University Statutes, 2004).

3. Taxonomy of HEI Information Systems

Information management in HEIs, like many other institutions, is shaped by the demands of various entities that interact with the institutions both from within and from outside. Tusubira & Mulira (2005) indicate that in a university, the core business processes are learning and research, while finance and human resource management are support functions.

Wanjohi (2006) notes that information management within HEIs focuses on staff, students and resources management. The information products include student details, that is, personal information of students; personnel (staff) information which includes records of employees in various cadres; and academic details of courses on offer in various academic departments, curriculum, examination details, professors taking various courses, relevant books and journals and all relevant academic information necessary to enhance the core business of a university- teaching and research. There is also financial information relating to fees payments, expenditures, and donations.

HEIs that have or are implementing computer-based systems take different strategies, but the most common is a combination of strategies. There are those that internally develop their applications. This assumes the institution has enough capacity- finances and staff to undertake computerization projects. The demerit for this is usually poorly developed and implemented systems. If institutions want to guarantee quality, many go for off-the-shelf packages while others contract specialist developers to implement the systems. In the last few years too, we have seen institutions go for freeware or what are commonly called open source applications. They customize these systems to their needs and where it is done well, there are no regrets. For example, Strathmore University has successfully implemented a freeware library system this year.

Ayoo (2006) in his report on the East African VarsityNet, a project of the Inter-University Council of East Africa (IUCEA), indicates that a number of universities already have information systems handling students' data/ records, some based on open source systems, others on proprietary software bought off-the-shelf, others donated by international partners. He further notes that many of the systems donated by international donors are experiencing support problems especially after donors left the scene perhaps due to lack of local expertise to continue with maintenance of the systems.

4. Challenges to Implementation and Use of CISs

Many of the HEIs face a number of challenges in their quest to implement information systems to manage processes in their institutions: Using the case of Makerere University (Uganda) Tusubira & Mulira (2005) capture the challenges of ICT integration in HEIs thus:

- lack of awareness and mindset among staff leading to unqualified resistance and wanting to be stuck to the old ways of working;
- lack of top level management commitment thus bringing forth bureaucracies and red-tape in system implementation;
- lack of appreciation of ICT as a tool and not panacea for organizational transformation;
- poor strategy in making ICT responsive to the organizational vision and mission, with the thinking that ICT can set direction for an organization;
- lack of a systematic method of system implementation- integration of ICT in HEIs needs to be fully conceptualized and defined before implementation;
- lack of project ownership- all employees and users must be involved in system implementation;

- Inhibiting initial costs of hardware and software and funding for sustainability and continuity in maintenance, replacement of equipment and emolument of ICT staff who maintain the systems.

On his part, Chacha (2005) while commenting on ICT training in higher educational institutions in Africa notes that there has been insufficient training and re-skilling of end users as well as technical staff that support the systems in HEIs. This is coupled with the inability of many institutions to recruit and retain qualified information systems staff.

For some institutions, technological complexity is a challenge with the real challenge being the security concerns for the data and the systems, especially where students have to access the institutional systems. Wanjohi (2006) points out that without proper controls, students can hack into the system and a change on examination grades, fees balance status or other modification can have serious ramifications on the institution.

O'Brien (1999) notes that system implementation is not just a software project, but also an organisational change project. The projects call for co-operation, teamwork, and planning for organisational change and are difficult to do when senior management is too busy to give the project adequate attention. The projects bring about massive organisational changes as they consist of many functional modules that can span the whole organisation and yet share a database.

Laudon (2000) introduces the staff layoff challenge that could lead to morale problems. The integration of departments leads to reduced need for many staff to man operations hence leading to staff layoffs. The institution may lack resources to compensate employees over their job lose and it is a painful experience to have to let go some staff that have worked with the institution for many years. Therefore, managers must anticipate resistance to information systems, especially when business process reengineering has to be undertaken.

5. Successful implementation & management of Information Systems in HEIs

From the challenges identified above, it emerges that information systems and ICTs implementation in HEIs if not well handled can lead to heavy investment without corresponding organisational benefits. As Tusubira & Mulira (2005) would point out, HEIs in Africa should have mechanisms of implementing information systems by optimising scarce resources- funds, skills and technology- to implement and sustain robust infrastructure that supports education and training.

Successful implementation of systems for HEIs should focus on three key areas- **strategic management**, **ICT strategic planning**, and **ICT integration in HEIs.** The author uses Figure 1 below (his own creation) to show the relationship between the three concepts:

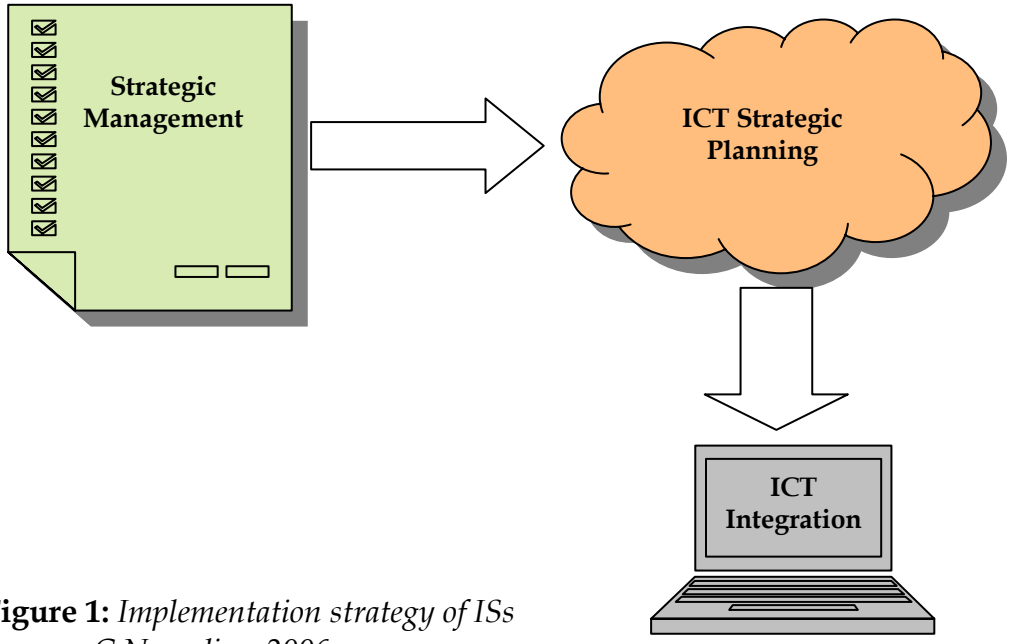

Figure 1: *Implementation strategy of ISs*
Source: *C Nyandiere,2006*

Strategic Management

Laudon (2003) notes that ICT is a strategic investment for any organisation. Strategic management of organisations implies a conscious and coordinated management of organisational activities, processes and resources for greater returns. This requires strategic planning to develop long-term objectives for the entire organisation and business units and to specify strategies for acquisition of resources needed to accomplish objectives. Robson, W. & David, F (2004) point out that strategic planning establishes broad, long-term objectives of the firm and assesses the institution's current position relative to these objectives, considering opportunities and threats presented by the environment. This entails analysis of

strengths, weaknesses, opportunities and threats (SWOT analysis). Strategic planning also outlines the organisational structure and total resources needed to implement the plan, and plans for the implementation process.

With strategic planning at organisational level, top level management commitment to ICT implementation and definition of the appreciation of the role of ICT as a tool rather than panacea for organisational transformation is explained and understood, Tusubira & Mulira (2005). The two argue that with strategic planning, it is possible to create ownership of ICT projects by getting stakeholder groups to think through the shortcomings of the organisation and recommend where ICT can be taken on board as part of a complete package of organisational transformation and thus providing for ICT strategic planning.

ICT Strategic Planning

Newmann (1994) argues that to enhance strategic management, businesses do implement strategic information systems. These systems, which are an outcome of information technology strategic planning, support or shape a business unit's competitive strategy. ICT strategic planning, whose outcome is an ICT policy and master plan, makes ICT responsive to the organisational vision and mission, providing systematic methods of implementation through organisational ICT policies, and creating ownership of projects hence leading to sustainability and long term returns from ICTs (Tusubira & Mulira, 2005). The authors further argue that a well defined and owned ICT policy and master plan is a prerequisite to successful mobilisation of funds, both internally and externally, for system implementation.

ICT Integration

ICT today is one of the most critical tools in higher education. Acosta (2004) points out that ICTs permeate every aspect of the HEIs from the first contact a student has with its website (or admissions office) through the myriad systems that manage and provide access to its information; to the desktop computer — now such a fundamental part of the daily life of nearly every faculty and staff member; the intricate web of fibre optic cables that link these computers together and connect them to the world of digital information; the supercomputers that carry out the massive computations that underpin simulation and modelling; and the wired classrooms, dormitories and student laboratories, which are now such fundamental components of the educational process.

Integration of ICT in an organisation's functions is a complex process which needs to be fully conceptualised and defined before implementation to avoid

dissipation of resources through implementation of unrelated or uncoordinated projects (Tusubira & Mulira, 2005). With their experiences of Makerere University, the authors argue that there is need to quantify the requirements of the institution starting from number of students and staff, the extent of physical infrastructure, ICT resources and systems already in use. This sets the direction, functions and boundaries as well as targets of ICT in the organisation, providing a framework for the development of specific projects aimed at increasing efficiency and cost effectiveness. The authors further argue that, the ICT policy and master plan alluded to above should reassure employees, fearing job loss, by catering for training and retraining and opening up new opportunities for them. They need to recognise that they are part of the information system and therefore major stakeholders.

6. CASE: X University

X University (XU) is a private university in the outskirts of Nairobi with a student population of 1,000 and a work force of about 100

Among the technical problems being experienced at the time of study included:

- Accounting and registration/ records were incompatible and therefore not integrated;
- Registrar's system was old and unadaptable thus academic and financial record keeping and billing was inefficient, and information therein inaccurate;
- There was lack of quality management information and lack of sufficient technical and ICT management capacity;
- Lack of clear policies and management framework for acquisition and replacement of hardware, software purchases and licensing, security of ICT resources, ongoing assessments of new technology;
- Investments in ICT had not been coordinated or guided by clear plans linked with the achievement of College goals.

Findings from the study

Following the study to identify the ICT needs of X University, the findings below emerged:

A total of 17 managers were surveyed. From their responses, they saw ICT as a tool which should be at the service of all basic functions of the University. ICT should help organize and improve on XU's efficiency especially management of admissions, finance, examinations and library resources.

Table 1. Justification of Implementation of Computerized Systems (N=17)

Indicators	n	(%)
Need to better manage information resource	15	(88)
Innovative ways of doing business	3	(18)
Competitors had implemented similar system	1	(6)
Industry/World trends in education	11	(65)
User demands	6	(35)
Critical to University's operations	16	(94)
Overwhelming benefits from the system	6	(35)

Source: X University Survey 2006

Table 2. Benefits of computer-based systems as Perceived by Management (N=17)

Benefit	Mean/ 5
Integration of functions hence improved management	4.64
Improved information management	4.64
Access to information from all departments	4.35
Reduced costs of operation	4.17
Increased worker productivity	4.23
Competitive advantage over other Universities	3.52
Good customer care	4.29
Improved processes management and control	4.52
Overall Mean	**4.30**

Source: X University Survey 2006

Conclusions and recommendations from the survey

From the study, it was concluded thus,

1. ICT was a tool for management and teaching as opposed to a source of competitive advantage for XU. ICT will therefore remain at the operational and support level.

2. User departments were not convinced about the quality, reliability and accuracy of information provided by the current systems. They assessed most of the systems as being poor in the areas of integration, security features, and strategic advantage.

3. There was inadequate exposure for staff and students on what ICT could do for them and by extension the University.

4. ICT activities needed to be addressed through laid down guidelines. It emerged that XU did not have an ICT policy to take care of among other aspects purchases, replacement, back-up, access and security of data and equipment.

It was thus recommended that the university invests in an integrated academic management system to facilitate management of academic processes- student admission and registration, lecturer management, fees payments management and examinations processing.

By the time of writing this paper, XU was in the processes of implementing an academic management system. Managers of XU were keen on ensuring good implementation of the system and were looking forward to a well run university

7. Conclusion

Looking forward to the future, many HEIs will automate and integrate most of their processes- they will be more paperless, more efficient, and competitive. Key stakeholders will be able to obtain all information from the set of systems implemented and accessible from institutions.

Demand on institutions to give quality service is likely to continue escalating for both public and private academic institutions. More and more institutions will see the need to invest in a good information management system, even primary and secondary schools.

There is likely to be a collaborative approach, such as the VarsityNet Project (Ayoo, 2006), to the acquisition and implementation of the systems, especially to help mitigate costs. It is the author's opinion that costs are likely to continue in downward trend. The end result of investment on computer-based information systems in HEIs will be better management of these institutions as any other corporate business.

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Government Services Online: Report Card

By
Andrew Limo

1. Introduction

The transformation of Government services from the paper-based, over the counter channels to alternative fully online and transactional modes will take time and resources.

Implementation of electronic Government or e-Government is a key element of Kenya's Economic and Recovery Strategy, 2003-2007.

The government is spending huge amounts of money on Information and Communication Technologies, ICTs, in order to save millions of shillings of wasteful spending on paper and duplications of services. Such technologies include computers, mobile phones, the Internet and even Radio and television.

E-government is a citizen-centred approach to governance that aims to reduce the frustrations citizens undergo in search for government services. It is a fundamental element in the modernization of government to address the dynamic needs of the citizens, businesses and even foreigners.

2. Emerging trends and ICT usage for government

The computer era-the days of the mainframes and later PCs-has now given birth to a more essential process to humanity-Communication. Communication, unlike computing is about applications and networks. A few years ago, telecommunication and computing devices started converging in a way that weaved together the personality, family, business, nation and the world. These technologies also ushered in a new knowledge-based economy, where the power of *bandwidth* rather than the computer power, is the driving force. For Kenya government to remain effective and relevant in service delivery, it must adapt its institutions and processes of governance to the opportunities and the challenges of the knowledge-age.

Most of us still hold a view of a public sector that is not responsive to the requirements of an information society. The public service has suffered many a ridicule. They used to say that when you ask a civil servant to "double click", he/she would make two short and sharp sounds with the mouth.

The laughing stock, if ever they were, are no more. I recently met a senior police officer who was a system engineer in the US before returning home. There are now more competent public servants in Kenya listening to technology and making it real. It is now possible to check school results from the ministry of Education website, download tax forms from the Kenya Revenue Authority website and police P3 forms from www.kenyapolice.go.ke. An official from KRA's technical team once told me that he would notice some activity on their Simba Online clearing system as late as 2am! What does that mean? Kenyans, people like you and me, were clearing goods online at non-traditional hours and probably from the comforts of their homes. E-services means offices are open 24/7. There are many more services being transformed in line with this emerging phenomenon. Initially we had even projected in our strategic plan to have an online voting option for 2007 elections. Of course that is a goal we may not achieve in the stipulated time.

The road to e-Government is not going to be an easy ride though. There is expensive infrastructure to be put in place and people must be trained on how to use computers and the Internet. Above all the technology must be affordable. One of the greatest challenges for e-government is how to get everyone buy into the new way of doing business. As they say change is always resisted. When countries like India introduced the use of technology, it was met by some resistance. But when Indians saw that they could make money from technology, they changed and became protagonists of the same.

Directorate of e-Government, in collaboration with Postal Corporation of Kenya recently embarked on a countrywide Information, Education and Communication programme. It was hugely successful. The programme, which targeted civil servants, aimed at stimulating interest in basic tools of communication like email. Like KRA, we do see some activity on our servers as well. I have received emails from people as far as Bungoma who confess to not having "seen the Internet" prior to our going there.

For e-Government to succeed there must be a strong commitment and leadership. There is a cabinet committee on ICT that meets regularly to evaluate and strategize on programmes being implemented. Over 130 new staff were recruited last year and posted to e-government units in the ministries. To further enhance capacity building, training is being conducted across the cadres-from senior officers to drivers.

Efforts are being made to build Local Area Networks within government ministries and departments. A design for a WAN has been completed and once it is built, it should be easy to communicate across government departments in Nairobi over the common core infrastructure.

3. Local Area Networks undertaken in 2006 and completed by end of June 06

	Building	Ministry/Dept	Capacity of PCs
1	Ardhi	Lands & Housing	1,521
2	Harambee House	OP, DPM	620
3	Transcom House	Transport	718
4	Works House	Public Works	518
5	Vigilance	Police HQs	457
6	Judiciary	Law Courts	370
7	BIMA House	Finance	530

Source: *E-government baseline survey August 2006*

It should now be evident that the government is determined to transform service delivery channels and at the same time create an enabling environment for new knowledge-based economy.

By creating the enabling environment, the government is also giving people the tools of collaboration that they need in the twenty-first century global economy. We now have four or five registered Call Centres. KenCall at Embakasi has been operating for sometime now. It is giving young people an opportunity to work for foreign companies while at home.

The government, with the support of development partners, is helping rural communities in far flung areas like Tabaka, Kisii, use ICTs to market soapstone artefacts. These are great opportunities that students from Strathmore and other institutions can help exploit further by designing more e-commerce platforms. You will have to be innovative to survive in this very competitive world.

The beauty of it all is that the Internet gives everybody an equal footing regardless of race, religion or location. What will make a difference are your skills, your aptitudes and your attitudes as well.

4. Conclusion

China joined the WTO in 2001. With many companies in the west "offshoring" and "outsourcing", China soon became a business destination for the West. Technology made is easy for companies to shift production to cheaper

destination and then get the goods into a global supply chain. China now exports more to the US than next door Mexico.
That is globalization. You should dread it if you don't have the skills to participate in it. You should thank God for it if you do (Friedman, 2005). Watch out it could be the Russian from Siberia who will take your job. Lois Pasture said "Fortune favours a prepared mind".

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Spreading the ICT Gospel With Cisco Network Academy Program

By
Shahab Meshki

1. Introduction

Educators and policymakers agree that student learning occurs best when high-quality curriculum, instruction, and assessment are standards-based, aligned and reinforcing each other. The Cisco Networking Academy Program is NOT just a virtual class or an online course. The Cisco Networking Academy is a dynamic educational program that teaches students relevant technology skills. This increases students' competitiveness in the global marketplace and opens doors to different employment opportunities. The Academy program provides students with the Internet technology skills essential in a global economy. It prepares students for the demands of the workplace and leads to continued education and learning.

The Academy program creates opportunities and contributes to countries' development through IT education and skills development. The short-term and long-term impact in communities that are created contributes to a global economy through IT education by empowering underserved populations with high quality IT education, promoting social and economic opportunities. As a result, local business have skilled workforce for a higher productivity and community sustainability.

2. Cisco's Solution: The Cisco Networking Academy Program

Public Private Partnership between Cisco, governments, educational institutions and NGOs are created to teach students how to design, build and maintain computer networks thereby equipping them with the skills to be economically active in an area of employment vital to the new Internet economy.

2.1 History of Cisco Networking Academy Program

The Academy program was launched in October 1997 with 64 Academies in the United States. A Cisco initiative helped schools design practical, cost-effective networks, but they lacked the financial and human resources to maintain them. Cisco worked with instructional designers and educators to develop a curriculum to teach educators and students how to design, build and maintain computer networks.

Students, after completing the Academy curriculum, gained practical skills and real work experience. The program rapidly expanded to become an IT career development program. Academies quickly spread to schools, colleges and universities, and other not-for-profit educational institutions around the world.

2.1.1 Partnerships Worldwide

The Academy program is delivered through educational institutions around the world like Universities, technical schools, community colleges, high schools, community based organizations and others. Content is developed and maintained through IT industry leaders like Cisco Systems, Hewlett-Packard, and Panduit.

Fluke on the other hand, provides state-of-the-art test equipment for Academy labs at discounted rates, while CompTIA provides certification and job placement opportunities for Academy students.

Cisco has partnered with education, business, government, and community organizations around the world to ensure that Academy students have maximum opportunities for success inside and outside of the classroom. Successful partnering is a key component of the e-learning model, where content providers, educators, suppliers, and students are all important members of an educational ecosystem. Cisco believes that partnering is a key success factor in the Internet Economy and has made partnering one of its top priorities. To extend its strength in the education field, WWE has been engaged in building a strong ecosystem since its inception.

2.2 Why is the Program Important?

The program is creating short-term and long-term impact in communities, one student at a time. Cisco is giving back to the community – not just because it is smart for the business, but because it's the right thing to do. Cisco Systems creates social and economic value. The Networking Academy program demonstrates that information technology is changing education

2.3 Consistent Quality Around the World

Standardized curriculum ensures consistent quality globally. All Academy students, in any country, receive the same high quality education. Instructor-led

online curriculum and hands-on labs. Measured through skills-based exams and online assessment

Quality is an important component of the Academy program and Cisco ensures quality in the program. The curriculum, training, certification, and on-going support ensure consistent quality among Academy programs around the world.

Instructors receive professional development on an ongoing basis through the Cisco Academy Training Centres (CATCs), and Train the trainer (train instructors), etc. Table 1 presents the curriculum and certification mapping for the students.

Table 1. Curriculum and Certification Mapping

Curriculum	Certification
CCNP 1-4	CCNP
IP Telephony	*"Cisco IP Telephony Specialist"*
Network Security	Cisco Firewall Specialist
Fundamentals of Wireless LANs	Cisco Wireless LAN Support Specialist
CCNA 1-4	CCNA
HP IT Essentials II	CompTIA Server+ (when combined ITE 1 curriculum)
HP IT Essentials I	CompTIA A+

Source: *Cisco Systems*

2.4 Potential Career Paths: Foundation for Most Careers in the Information Economy

A student that went through the program has many different potential career paths. S/he can follow a Network Design and Administration path where s/he can be a:

- Network Administrator
- Network Engineer
- System Administrator
- Network Analyst
- Internet Network Specialist

A Telecommunications Industry path where s/he can be a:

- Cabling Installation Technician
- Telecommunications Technician
- Cabling Installation Coordinator

A Technical Support Professional path where s/he can be a:

- PC Support Specialist
- Help Desk Technician
- Network Technician
- Hardware Installation Coordinator
- Software Applications Support

Or Programming and Software Engineering career path where s/he can be a:

- Visual Programmer
- Programmer/Analyst
- Software Applications Analyst
- Quality Assurance Analyst
- Technical Writer

3. Cisco Networking Academy Program: Impact Since 1997

There are currently more than 11,000 academies running the Cisco Networking Program in 155 countries worldwide. As of the moment, more than 1.9 million students are already trained by more than 32,000 instructors in 9 different languages. The total number of exams taken is more than 48 million. Figure 1 below presents the participating students by region. The US is the single largest NetAcad Country. It is the second largest Region behind Western Europe. Other countries throughout the world that have a mature NetAcad program are also experiencing a decline in Participating Students and Academies, while Africa is the fastest growing Region – 45% YoY growth.

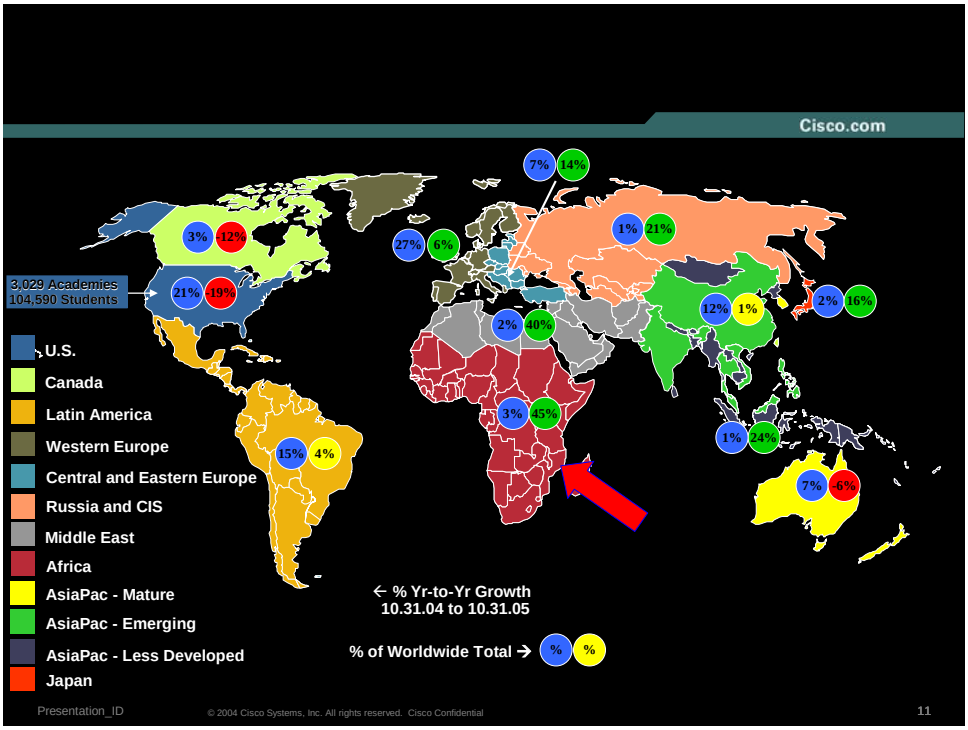


Figure 1. Participating Students by Region (450,000+ Students)
Source: Cisco Systems, 2006

3.1 Equalizing Opportunity

E-learning, the combination of the Internet and education, eliminates barriers of time, distance and socioeconomic status. The Academy is crossing Digital Divides around the world by establishing Academies in disadvantaged regions and recruiting target populations. Cisco is not alone and our partners make key initiatives possible:

The LDC initiative partners with international development organizations and has established 90 Academies in 32 of the world's poorest countries. The Gender initiative supports the recruitment and retention of women at all Academies. An Academy in the country of Jordan is helping women gain economic independence. Academies have been established in economically disadvantaged regions with attention to recruitment and retention of minority groups. Curriculum supports learning for persons with disabilities.

3.2 Networking Academy Program in Africa as of June 2006

In Africa, there are more than 250 Academies and 14,600 participating students in Sub-Saharan Africa with a 40% Yr/Yr Growth. In Kenya alone, there are 14 academies, 12 local academies and 2 regional academies. The total number of

students participating in IT Essentials, CCNA, Wireless, and Security in July 2006 is 1,696.

In East Africa, there are 60 academies with 14,394 students participating in July 2006. Of this total number of students, 28% are female. There is also high enrolment of 53% Fiscal Year 2005 enrolling in IT Essentials, CCNA, Wireless, Security, and CCNP.

The following are the participating countries in East Africa: Eritrea, Ethiopia, Kenya, Rwanda, Seychelles, Uganda, Burundi, Djibouti and Tanzania.

4. Conclusion

The current model in our education system is that children will go to primary and secondary schools then proceed to higher educational institutions and/or professional training. It was expected that there are many skilled workers available to do the jobs in the industry. However, over the past many years, this is not the case. Very few skilled workers were available. Cisco Academy is filling in the gap. Many who didn't manage to enter university, including those who finished university and remained unemployed are getting these skills to make them productive and competitive in the job market.

Author:
Shahab Meshki, Regional Director, Middle East and Africa

e-Banking in Kenya: Practical lessons to be drawn from Commercial Bank of Africa

By
Isaac Awuondo

1. Introduction

Electronic Banking is an umbrella term for the process by which a customer may perform banking transactions electronically without visiting a brick-and-mortar institution (FinCen, 2000). It is the use of electronic means to deliver banking services, mainly through the Internet. The term is also used to refer to ATMs, telephone banking, use of plastic money, mobile phone banking and electronic funds transfers.

Common embodiments of e-banking include the following:

- Mobile/SMS Banking
- Telephone Banking
- Electronic funds transfers
- Self Service (PC) Banking
- POS Banking (Credit and Debit cards)
- ATMs
- Interactive TV
- Branchless Banking
- Intranet

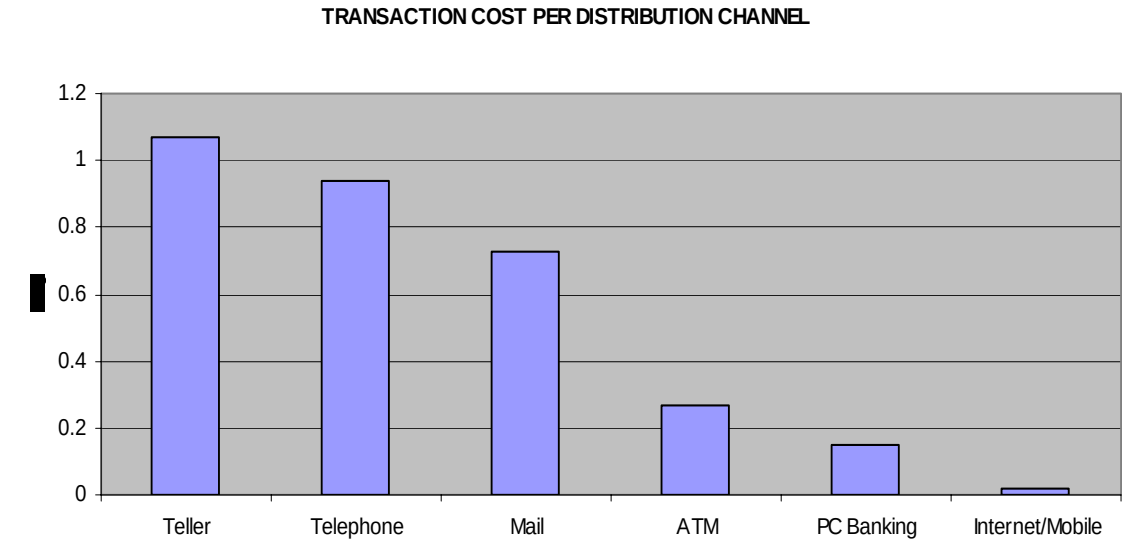
Information Technology (IT) offers banks the potential to dramatically reduce operating costs and improves the quality of management information hence making banking more profitable.

IT has been, and continues to be, the core focus of Commercial Bank of Africa's operations and strategic direction since the early 90's. Over the period the bank experienced:

- Rapidly changing customers' needs and preferences
- Competitive forces and product differentiation strategies
- Need to enhance of Customer Relationship Management
- Pressure to reduce transactional and operation costs and pass the benefits to customers.

2. The huge potential of technological innovation

An assessment of banking sector operations indicates that Internet banking has been growing steadily. Most of the bank's operations are around the tellers and telephone but there is a remarkable growth in Internet/ mobile banking as the graph below shows.



Source: BAI

3. Major advantages

Internet Banking (cba@net) provides one with opportunities to transact wherever and *whenever it suits you - 24/7*

- Access their account information and transactions.
- Possibility to make electronic funds transfers.
- View, download and print statements.
- View CBA's up-to-date daily exchange rates.
- Transfer funds between your personal accounts
- Provides an Easy set-up and a user-friendly and secure environment. The system uses PIN and phone number combinations to ensure maximum security.
- User support from highly trained and experienced customer service teams.

4. Challenges to growth of e-banking

E-banking despite its promised goodies has a number of constraints that have to be overcome:

- Security: Majority of the customer shy away from E-Banking services due to security concerns. There is struggle to strike a balance between convenience and security.
- Human face: According to some analysts, customers still value personalized and responsive services from their bankers.
- Ignorance: "on average 30% of bank customers do not even know whether their banks provide online services." (BBC News).
- Computer illiteracy among majority of the population is still significantly high especially in Africa.
- Poor and/or lack of technological infrastructure and reliable power supply.
- Lack of proper legislation governing e-transactions and general growth of e-banking.
- Preference to paper money, as opposed to "virtual" cash in transactions.
- Designing products that offer a balance between competitive pricing and functionality.
- Keeping abreast with dynamism of customer needs & innovation

5. Conclusion

e-banking at CBA offers a unique opportunity to reach a higher number of our target customers without necessarily increasing physical branches and enhancing our product offering through innovation.

Despite all the challenges mentioned, more customers are now switching to e-banking as means of banking.

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Section III
ICT EDUCATION

Emerging Trends in Information and Communications Technology Education in Kenyan Universities

By
Meoli Kashorda, PhD

Abstract

Information and Communication Technology (ICT) degree programs in private and public universities remain very popular and attract very good students. In recent past, there has been an increase in the enrolment in ICT degree programs in the traditional areas of computer science, electronic engineering, computer engineering and in the newer areas of information systems and software engineering. This paper identifies some of the local and global drivers of this demand. It then uses the open networking model to analyze the future demand for ICT graduates. Using the model, the paper concludes that the focus of Kenyan universities should be in the academic areas of computer science, information systems and electronic engineering. In order to have an impact on the Kenyan economy and the ICT industry, there is an urgent need for universities to seek professional accreditation of the different ICT degree programs and therefore achieve international standards of quality. The paper recommends adopting the E-campus concept to develop a world-class learning environment for students and faculty that overcomes the low penetration of ICT in Kenya. Although ICT profession will remain popular because of the increasing use of ICT applications in businesses and governments in the region, the challenge for the universities is to attract, retain and develop doctoral-level ICT faculty.

1. Introduction

In the past 5 years, there has been an increase in the number of Information and Communication Technology (ICT) degree programs offered by Kenyan universities. For example, all of the 13 private universities in Kenya that have been chartered or given interim letters of authority by the Commission for Higher Education (CHE) offer ICT degree programs. The existing public universities continue to introduce new ICT degree programs and to expand the existing ones. The increase in total enrolment means that there is a strong demand for degree-level ICT education in Kenya. However, the author is not aware of any labour market analysis data that the universities have used to start or expand the ICT degree programs.

Apart from the ICT degree programs, most universities now offer some general information technology (IT) courses to all of their students (graduate and undergraduate). This means that there has been a deliberate effort to ensure that

all university graduates are "computer literate" or "IT literate". Some universities also offer diploma level ICT programs and other non-degree IT programs. Such IT course offerings are outside the scope of this paper.

In this paper, we use the term ICT (or IT) degree program to describe programs in computer science, computer engineering, electronic engineering (includes telecommunications), software engineering and information systems. This is consistent with the "big IT" umbrella term adopted by American Accreditation Board for Engineering and Technology (see http://www.abet.org) which accredits ICT degree programs [1]. These ICT professional degree programs have very clearly defined global model curricula developed by the academic and professional communities. For example, the Joint Task Force on Computing Curricula established in 1991 by the Association of Computing Machinery (http://www.acm.org), the Association for Information Systems (http://www.aisnet.org), and the Computer Society of the Institution of Electrical and Electronic Engineers (http://www.computer.org) has developed guidelines for computer science and information among other degree programs [2, 3]. The model curricula define the learning outcomes and content of the ICT professional degree programs and universities and there is an expectation that universities would minimally comply with the guidelines.

The convergence of computing and telecommunications has also resulted in the convergence ICT degree programs, referred to as the "small IT" degree programs by ABET. These are often called B.Sc. in IT degree programs and contain content from the different degree programs (e.g., information systems and computer science). The author is not aware of any country or accreditation body that has developed professional accreditation criteria for such new programs. This is a work in progress among many professional bodies and even at ABET [1]. This paper will therefore address emerging undergraduate ICT education issues of the "big IT" degree programs that have well defined professional standards and accreditation criteria.

We note that all of these IT programs (big IT or small IT) are being offered because there is a strong global demand for IT professionals. For example, some developed countries, notably, the US, UK, and Germany, have introduced special Visa terms for IT professionals who wish to migrate from developing to the developed countries. This paper will highlight the global knowledge economy drivers for the strong demand for ICT education and the development of ICT education standards. Other local drivers of the demand for ICT education include the rapid growth of the telecommunications and Internet infrastructure, increasing use of computer-based information systems in large medium, and small-sized enterprises in Kenya and in the region.

We introduce a layered method of analysing the relative demands of the different ICT degree programs and recommend some possible areas of focus for universities in Kenya. Although assessment of ICT degree programs offered in Kenya is outside the scope of this paper, anecdotal evidence suggests that most of the ICT degree programs do not meet global professional accreditation standards. This is troubling because of the global nature of ICT professionals. There is therefore an urgent need to conduct detailed assessment of all ICT degree programs offered in Kenya to identify areas of weakness and suggest some remedies.

This paper is organized in the following way. Section 2 identifies the key drivers of the high demand for ICT education in Kenya and in other parts of the world. In Section 3, we use the open networking model to analyse the local and global ICT education opportunities and the implication for ICT students, graduates and universities in Kenya. Section 4 highlights the key indicators of the quality of ICT degree program (faculty, students, and learning environments) and the urgent need for professional accreditation. In Section 5, we describe the E-campus innovation that could provide a world-class learning environment for ICT students in a country with low Internet and ICT penetration levels such as Kenya. Section 6 contains our conclusions.

2. Drivers of the Strong Demand for Professional ICT Programs in Kenya.

2.1 Current demand for ICT degree programs

As we mentioned in the introduction, all of the universities in Kenya have either expanded their ICT degree programs or introduced new ICT degree programs in the past 10 years. The Joint Admission Board (JAB) admits government-sponsored students into public universities. The 10,000 students admitted into public universities by JAB last year represent only 14.7% of the total student population who were admissible into university that year based on the national university entrance examination. The JAB admission data of 1999 presented on Table 1 shows that demand for B.Sc. in Computer Science and in Electronic Engineering, measured using the first choice applicants against available spaces, was very high in the 1999/2000 and only "A" students could get admission into the programs. We note that in 1999, only computer science and electronic engineering degree programs could be classified as ICT degree program in 1999 in the public university system. The 2006 JAB data shows that new ICT degree programs in computer engineering, software engineering, telecommunications and information technology, and computer technology are being offered in the public universities. At present, only the private universities offer degrees in information systems at the undergraduate level.

Table 1: JAB popularity of degree programs by first choice in public universities

ACADEMIC PROGRAM	**Univ #1**		**Univ #2**		**Univ #3**		**Univ #4**		**Univ #5**		**Univ#6**	
	CAP	Cho-I	CAP	Cho-I	CAP	Cho-I	CAP	Cho-I	CAP	Cho-I	CAP	Cho-I
BA	500	204	400	053	-	-	250	002	300	039	080	002
B.Sc												
B.Ed (Arts)	290	129	150	031	210	051	120	014	200	033	060	002
	340	166	400	242	-	-	160	020	300	072	160	006
B.Ed (Sci)	-	-	180	168	-	-	160	030	060	070	050	009
B.Sc (CS)												
B.Sc (Agric)	030	180	-	-	020	029	025	012	-	-	030	071
Law	120	016	-	-	-	-	050	004	120	016	-	-
	120	495	-	-	-	-	-	-	040	139	-	-
Medicine	120	666	-	-	-	-	-	-	040	166	-	-
Nursing												
B.Ed (Music)	030	236	-	-	-	-	-	-	020	124	-	-
B.Ed (French)	-	-	025	016	-	-	-	-	-	-	010	000
	-	-	040	018	-	-	-	-	-	-	040	001
B. Com	200	679	-	-	-	-	030	030	070	263	120	068
B. Arch	030	095	-	-	020	048	-	-	-	-	-	-
BSc (El **University #2**ect.)	060	143	-	-	030	175	-	-	030	042	-	-
B. Pharm	040	249	-	-	-	-	-	-	-	-	-	-

Source: 1999/2000 JAB data

In general, students base their career decisions on the potential job market as reflected in job advertisements in the local media, the career paths of the alumni or others in the same profession as well as general perceptions of the future career prospects of some professions. The perceptions are not always based on concrete market analysis data. The high demand for ICT programs recorded by all universities in Kenya suggests a positive perception of ICT careers.

Universities on the other hand should base their decisions on the type of degree programs they offer, labour market analysis data, and global industry trends. At this time, we do not have data to show how universities are making decisions to introduce or expand ICT degree programs. It is even possible that universities are using the perceptions of the student body or their faculty without any underlying data analysis. This will not be acceptable in the future.

Although labour market analysis data are currently not available (the last study done by CHE was in 1994 and is now outdated and was not widely disseminated), it is still possible to forecast demand based on certain industry indicators as well as global trends. We suggest that forecasts based on such industry and global trends are necessary for reviewing ICT curricula and also in making decisions to start new ICT degree programs. We identify four factors that will influence the decisions on ICT education in the future, namely:

1. The rapid growth of the telecommunications and Internet infrastructure in Kenya and in the East African region
2. The increasing automation of businesses and government processes in Kenya (i.e., implementation of E-business and E-government strategies).
3. Globalisation and the global knowledge economy that forces all countries to achieve a high degree of networked readiness in order to be competitive.
4. Convergence of computing and telecommunications

In the following sub-sections, we briefly describe how each of the above factors will influence the demand and the curricula of future ICT degree programs.

2.2 Growth of the telecommunications and Internet infrastructure

The Kenya Communications Act of 1998 liberalized the telecommunications sectors in Kenya. In 1999, Kenya had only 17,000 mobile subscribers. In July 2006, there were close to 6.5 million mobile subscribers according to the Communications Commission of Kenya (CCK), the national communications regulator (http://www.cck.go.ke). This has required huge investments in the telecommunications infrastructure by the mobile network operators.

Apart from the mobile network infrastructure, there has been an increase in the number of wireless voice and data access networks offered by the fixed operators. There are now over 70 licensed Internet Service Providers in Kenya and at least two operational local loop operators (http://www.cck.go.ke). The public data network service infrastructure continues to expand and by August

2006, there were 3 optical fibre links from Nairobi to Mombasa operated by three different companies.

The broadcasting sector has also grown dramatically since 1998. There are many FM radio stations and many TV stations. Each of these TV or FM stations needs ICT graduates to operate. This is an area that will continue to grow especially as electronic media houses start developing locally relevant content (http://www.cck.go.ke).

It is thus clear that the growth and expansion of the telecommunications infrastructure in Kenya and in the neighbouring countries will only be sustained by a large supply of ICT graduates from local universities. In the future, we expect all the telecommunications operators and broadcasters to provide value added services based on networked applications as a way of increasing their revenues. Such networked applications will be developed by specialized ICT graduates. This will further increase the demand for information systems and computer science graduates. The ICT graduates will be required to design, install, and maintain the telecommunications infrastructure and to develop new innovative networked applications for businesses and government.

2.3 Implementation of E-business and E-government strategies

Most of the 50 companies listed on the Nairobi Stock Exchange (NSE) (http://www.nse.co.ke) have created fully networked organizations and have automated their mission-critical business applications. For example, companies in the financial sector have high degree of ICT readiness and have well-established ICT departments. Many state corporations also continue to automate their business processes and will need skilled ICT graduates to maintain the ICT infrastructure, develop applications and maintain the mission-critical applications.

All the companies are currently developing applications to support interactions with their customers and suppliers. This will mean they will need more computer science and information systems graduates. Electronic engineers will also be required to maintain the networked infrastructure of the companies.

Although the small and medium enterprises (SMEs) have not embraced ICT as much as the large companies, this is expected to be the area of growth in the future. SMEs require relatively cheap software solutions and will depend on local innovative software developers to automate their processes. Again, information systems and computer science graduates with software development skills as well as business skills will continue to be in high demand in this sector. As

always, SMEs that export products or import their inputs have a greater need to automate their operations [4].

Apart from the E-business strategies of the private sector, the government of Kenya released an ambitious E-government strategy in 2004 [5]. Although implementation has been slow because the networked infrastructure was not in place, it is expected that there will be a huge demand for E-government applications and for ICT professionals to maintain the mission-critical E-government applications in the period 2006-2010. The ICT industry in Kenya is also expected to expand once full implementation of E-government strategy starts. Again, we expect a large demand of ICT graduates in all areas but especially in electronic engineering, computer science and information systems.

2.4 Convergence of computing and telecommunications

Digital technology allows convergence of media (print, radio and television) with telecommunications and computing (hardware and software). The digital convergence leads to the following:

a. The convergence of the telecommunications, broadcasting and Information Technology industries (now referred to as ICT industry or sector)
b. The convergence of services and markets (e.g., Internet service providers can also create content for broadcasting)
c. Increasing overlap of telecommunications and content and/or broadcasting regulation.
d. Increasing overlap of exit requirements of ICT degree programs

The increasing overlap of the ICT degree programs means that universities must continue to review ICT curricula and to engage the industry in such curriculum reviews. It also means that some innovative universities will continue to create new hybrid degree programs that will serve the emerging needs of the industry.

One major challenge of the changes in the industry and convergence is the need to develop post-graduate lifelong learning and graduate degree programs in ICT. At present, only three universities in Kenya offer postgraduate degree programs in ICT and this is expected to be an area of growth in the future.

2.4. Globalization and the knowledge economy

Although it appears that it is the local conditions that will determine the type of ICT degree programs offered in local universities, it is also a fact that ICT profession is global and is "portable". ICT is also one of the pillars of the emerging global knowledge economy. That means that the E-readiness or ICT readiness of countries will determine their competitiveness in goods and services. There will also be competition for ICT graduates and programs. ICT skills will be in demand in other parts of the world. ICT graduates could also develop products for other parts of the world because of globalization as happens in India.

Universities therefore need to understand the global trends driven by the knowledge economy because that will affect their ICT faculty and the quality benchmarks of their ICT graduates. The World Bank Institute has identified the four main pillars of a knowledge economy [6], namely:

a. **Economic and institutional** pillar, which provides incentives for the efficient creation, dissemination and use of existing knowledge
b. **Education pillar** that develops an educated workforce that can use knowledge effectively
c. **Innovation pillar** that ensures that global knowledge diffuses into the nations and adapts it for local use and creates new local knowledge.
d. **Information and communication technology infrastructure** (ICT) pillar that facilitates the effective communication, dissemination and processing of information.

We note that the ICT pillar is required to support all of the other pillars, especially the innovation pillar.

The World Bank now measures and ranks the competitiveness of nations using the knowledge economy index (KEI) and the knowledge assessment methodology (http://www.worldbank.org/kam). In a knowledge economy, the development and competitiveness of countries will depend on their ability to leverage local and global knowledge. It has been shown that the KEI is directly proportional to the Gross Domestic Product (GDP) of a country. Developed countries have a relatively high KEI as shown in Figure 1. Thus, emerging economies will have to develop their ICT human capital and infrastructure in addition to other pillars of the knowledge economy in order to remain competitive.

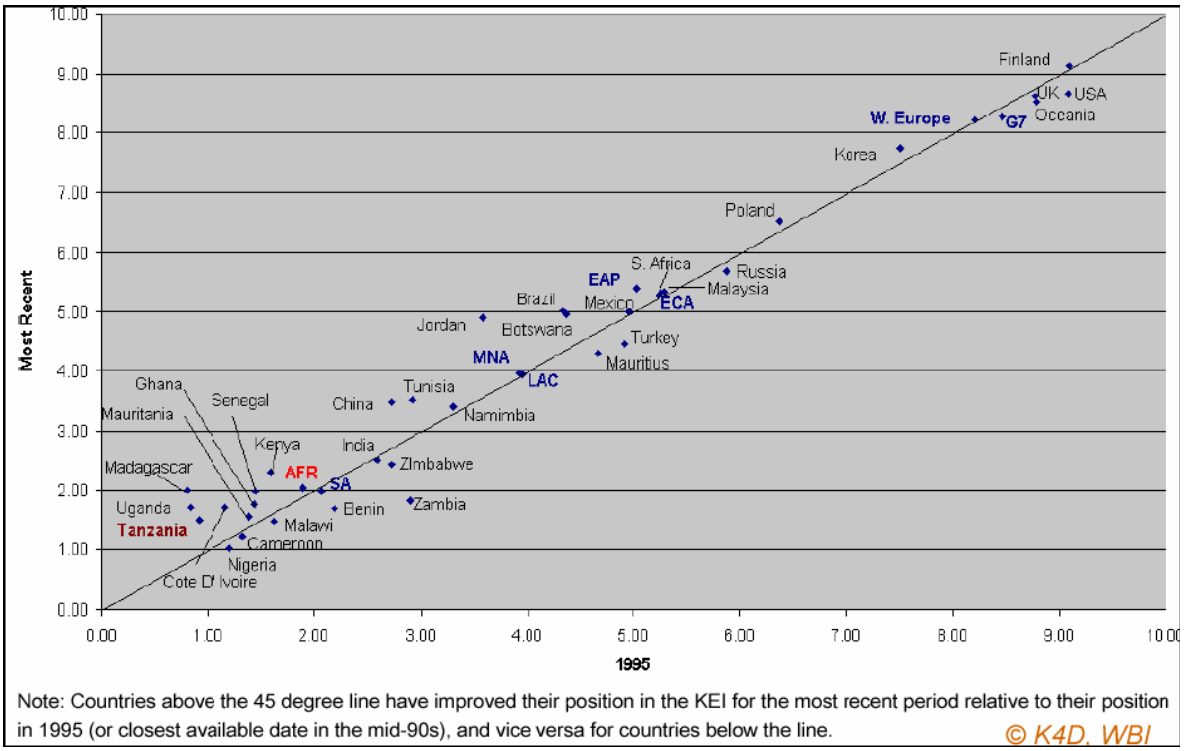

Figure 1: Global Map - Knowledge Economy Index

Note that Kenya had a KEI of only 2.2 while Finland has a KEI of nearly 9.00. The KEI tracks the GDPs.

Thus, the need to increase investments into the firm-level and national-level ICT infrastructures and applications will continue to increase demand for ICT graduates. However, there is still a need for a university in an emerging economy to determine the relative importance of the different ICT degree programs. For example, should a university offer both computer engineering and computer science degree programs and what should be the relative enrolments? Students entering universities also need to make decisions about the demand for specific degree programs without the benefit of market analysis data.

In the next section, we show how a layered model of the ICT industry could be used to determine the relative sizes of different ICT degree programs (e.g., electronic engineering or information systems). A layered model requires a detailed understanding of industry trends and country-level opportunities in the ICT sector. We note that any errors in determination of sizes of degree programs will mean wasted resources for both the university and the students.

3. Analysing Emerging ICT Education Opportunities Using the Open Networking Model

Table 2 shows the open networking (ON) model [7]. We have adopted the model to estimate the relative sizes of the different ICT degree programs using emerging ICT industry structures.

Table 2: Open networking model

Networked Applications E-mail, fax, telephony, videoconferencing, TV. E-games, Web browsing, Web casting. Interactive education, interactive TV, Image server.
Interoperability (Middleware) Name servers, security, Privacy, Directories … Intelligent agents, distributed processing environments …
Internetworking – Internet Layer 3 & 4 TCP/UDP end-to-end transport, IP/RSVP flows Operating systems
Digital pipes and hardware (TCP/IP Layer 1 & 2) Computing services: Computing hardware and devices Telecom services: POTS, ISDN, ATM, Wireless … TV services: CATV, DSB, VOD, Data pipes (LANS, Leased lines, Modems)

3.1 Data pipes and hardware layer

The bottom layer of the ON model provides the foundational computing and telecommunications services. This includes the computer hardware and associated memory, the data pipes used to carry digital data, and the local and wide area network infrastructures. The skill set required in this layer is provided by electronic engineers, computer engineers, and telecommunications engineers. However, some computer science graduates also work in this area because of the pervasive and embedded computer systems that are software driven.

The supply of digital pipes and hardware is dominated by a few very large companies. For example, Intel dominates the electronic device market for processors, memory, and digital signal processing chips. Manufacturing of the electronic devices and hardware is mostly in the Far East countries of China, Taiwan, and South Korea. It is unlikely a country like Kenya could compete in

this area. It is therefore unlikely that the demand for the electronic engineer will be very high and also there would be a big difference in the areas of specializations in Kenyan universities.

Apart from the computing and telecommunications devices, the ICT industry in bottom layer is also dominated by system integrators who develop the telecommunications and computing systems. Although there are more players at the system level, the ICT industry is again dominated by a few very large corporations. Examples include Siemens, Philips, Nortel, Cisco, Ericson, and Nokia that supply the radio and optical fibre links, telephone exchanges, routers, base stations, and mobile devices. Although manufacturing opportunities are possible for developing countries with low labour costs, China and other Far East countries are already ahead of African countries in this market.

The ICT professionals trained in these areas in Kenya would therefore be employed to install, configure, and maintain the complex telecommunications networks and systems. The skill sets for supporting such complex ICT infrastructures is provided by electronic engineers, computer engineers, and computer scientists in smaller numbers. These are the same ICT professionals required to maintain the firm-level ICT infrastructures. We therefore expect that there will be a high demand for ICT professionals in these area but the areas of specialization would have to be appropriate to the industry needs in Kenya and the region. For example, no need to train the engineers for VLSI design and manufacturing when job opportunities in those areas do not exist. However, the foundational components of the curricula would still be similar to that offered in developed countries.

3.2 Internetworking layer

The Internetworking layer is similar to the Internet Protocol (IP) and Transport layers in the TCP/IP protocol suite. The internetworking layer is now dominated by Internet protocols for voice, data, and video services. The skill set in this area is again provided by electronic engineers (includes telecommunications engineers), computer science, computer engineering, and information systems degree programs. Since these ICT skills are required by both the infrastructure providers (e.g., Safaricom and Kenya Data Networks) as well by individual firms that need to be networked, we expect a strong demand for these types of ICT graduates.

We note that it is relatively less expensive to develop ICT graduates to work in this layer. The main investments for universities are in hiring and retaining quality faculty and in specialized laboratories.

3.2 Interoperability or middle-ware layer

This is the layer that allows different networked applications to interoperate. There are only a few dominant middleware products (e.g., CORBA-based middle-ware products). This is a software intensive area. The skills set required to work effectively in this area are acquired in computer science, software engineering, and some specializations of electronic engineering. Our considered view is that in Kenya, it would be better to train broader-based electronic engineers rather than computer engineers. That means it would be unnecessary to invest in specialized computer engineering facilities.

3.3. Networked applications layer

This is the area that needs the largest number of ICT professionals because of the large number of customized networked applications that need to be developed. Although a few software companies still dominate some of the mission-critical software applications (e.g., Enterprise Resource Planning dominated by SAP), specialized ICT professionals are required to set up and support the complex systems. The relevant ICT degree programs for working in this area include information systems, computer science, and software engineering. We estimate that a much larger number of information systems professionals are required in this layer because of their deeper understanding of business processes and strategies. Although the ICT infrastructure required to support an information systems degree programs is much cheaper than that for electronic engineering or computer science, it is much harder to recruit and develop ICT faculty in the information systems area.

In order to train ICT professionals for each of the layers of the ON model, it is necessary to establish world-class training facilities. This is a challenge because Kenya has a relatively low level of E-readiness when measured using the Networked Readiness Index as Table 3 illustrates. NRI measure the readiness of individuals, businesses and governments to benefit from ICT developments.

Table 3: Networked readiness index (NRI) ranking for 2004 and 2005

	USA	Kenya	South Africa	Mauritius
2004 (out of 102 countries)	4	75	37	47
2005 (out of 115 countries)	1	91	34	45

Source: World Economic Forum

How is it then possible for universities in Kenya to provide ICT education at the same level of quality as countries with high NRI ranking such as the US (NRI ranking directly proportional to the GDP of countries)? The next section introduces the innovative E-campus concept that could be used to develop "islands" of world-class ICT infrastructures to overcome the limitations of a low NRI ranking. Some universities in Kenya and many universities in India have followed this model with very good results.

4. The E-campus Innovation and Quality of ICT Education

In this paper, an E-campus is defined as an information system enabled campus [7]. The components of an information system include the networked infrastructure, the automated business procedures and processes, and the people who develop, maintain, and use the systems for their work. In a typical university campus, this would mean a fully-networked campus, with networked mission-critical applications teaching, learning, and managing a university, and qualified ICT workforce and professionals.

An E-campus ensures that a university as a community acquires a high degree of e-readiness even when the country has a low-level of readiness. Graduates of such a university would then be the change agents in the institutions they join after graduating (e.g., governments, educational institutions, or SMEs).

The networked infrastructure component of an E-campus is relatively cheap to set up because of the falling prices of ICT products. However, since an E-campus still requires a relatively high bandwidth connection to the global Internet, this increases the operational costs. For ICT education, it turns out a very high speed connection is not always required especially if most of learning resources are placed within the E-campus.

The networked application and the ICT professionals' components of the E-campus are also relatively expensive and increase the operational costs. However, it has been determined that 5% of the revenue of a university with 3,000 students would be sufficient to set-up and maintain a world-class E-campus. This is affordable by most universities in Kenya. An ongoing E-readiness survey of universities in Kenya will derive the appropriate level of funding for an E-campus.

5. Quality of ICT Degree Programs

5.1 Professional accreditation of ICT degree programs

As explained in the introduction, the "big IT" degree programs have global curricula guidelines that have been developed by the global academic community in collaboration with the umbrella of professional associations and accreditation boards. Thus, there is a universal understanding of what needs to be taught in a computer science or information systems degree programs. The key motivation for developing international model curricula is the fact that ICT professionals could work anywhere in the world and outsourcing of software development and ICT manufacturing is now a well established industry.

The danger is that a university in a developing country does not need to comply with the professional standards, especially because the ICT industry is not highly developed in such countries (nobody really will complain). For example, it is estimated that India produces 280,000 engineering graduates per year but only 25% meet international standards [Newsweek article). This is a great waste of resources. In Kenya, anecdotal evidence from local industry suggests that there is some dissatisfaction with depth of technical knowledge of the ICT graduates who wish to develop advanced networked applications or to operate the complex telecommunications infrastructure.

One way to ensure compliance with global standards is to seek professional accreditation of ICT degree programs. For example, the Institution of Engineering and Technology (IET) accredits universities offering ICT degrees. Accredited programs then attract high quality faculty and students. For example, Vellore Technical University in India is a private university that is now accredited by IET.
This makes it easier for ICT graduates to find jobs in India and in other countries. (see http://www.iee.org/professionalregistration/accreditation/International

Directory of Accredited Degrees –Issue9.pdf). ABET accredits ICT degree programs in the US but institutions outside could also apply for accreditation.

5.2 Assessing the quality of ICT degree programs

In general the quality of an ICT degree program could be expressed by the following formula shown on equation (1):

Quality of ICT education = QS * QF * QL * QC ---------- (1)

Where QS = Quality of the students
QF = Quality of the faculty
QL = Quality of learning environment (E-campus)
QC =Quality of the curriculum

Notice that the formula is multiplicative and all the variables must be of high quality. The author is not aware of any assessment studies that have been conducted in Kenya to rank or establish the quality of ICT degree programs. There is an urgent need to assess the status of ICT degree programs using the above framework.

It is also a fact that none of the ICT degree programs are now professionally accredited by the international professional associations and institutions. This could be the reason why certification courses offered by Microsoft (MCSE) or Cisco have become popular with ICT graduates and industry. The Computer Society of the Institution of Electrical and Electronics Engineers (IEEE) has introduced the Certified Software Development Professional Program for software developers but this is not yet popular in Kenya (http://www.computer.org/portal/pages/ieeecs/education/certification). This certification would be required by ICT professionals who intend to develop software for global markets or for mission-critical application where the engineering discipline is necessary (e.g., medical or financial applications). There is also no certification for the more complex telecommunications and networked applications infrastructure that will be needed in the future. It is our considered view that Kenyan universities and ICT departments should seek professional accreditation using global standards since the ICT profession is global in nature.

In order to develop accreditation standards in Kenya, it will be necessary first to assess the status of ICT education in Kenya in terms of learning facilities, qualifications of faculty, and the learning outcomes achieved by the ICT graduates. The author is currently involved in a research project to establish the status of ICT education in Kenya.

6. Conclusions

The demand for ICT graduates continues to grow because of the growth and expansion of ICT infrastructures and application in Kenya and in the region. Many businesses and the government are expected to continue automating their business processes. Advertisements in the local and international media show that there is a strong demand for ICT graduates in all areas and this is probably driving the demand for ICT degree programs.

Consequently, all Kenyan universities have introduced at least one "big IT" degree program in the areas of information systems, computer science, electronic engineering, software engineering, computer engineering, and other variations of ICT degree programs. Most of these programs are developed without explicit reference to the model curricula developed by professional ICT associations (e.g., ACM, AIS, and IEEE) in collaboration with the academic community. In many cases, the programs are structured in ways that are similar to similar programs in other countries especially UK, US or Japan. The author is not aware of any structured participation of the local professional associations and industry in the development of ICT degree programs.

In some cases, the curricula of some of the older ICT degree programs in electronic engineering or computer science have not been reviewed in response to global trends. Neither have the teaching labs been modernized nor the older ICT faculty trained in emerging technologies and teaching methods. Anecdotal data suggests that many ICT degree programs are not achieving the desired learning outcomes in general and this could affect the innovativeness of the graduates. There is therefore an urgent need to develop local accreditation standards using a participative process involving the Commission for Higher Education as the accreditation body, professional ICT associations, and local industry, and ICT departments in universities.

Apart from the local drivers for demand for the high demand for ICT graduates in Kenya, this paper has shown that the emerging knowledge economy will increase the demand for ICT graduates in the future. The convergence of telecommunications and computing is also driving changes in curricula and a proliferation of the converged "small IT" degree programs that do not yet have clear accreditation standards and criteria.

One of the problems for ICT students, graduates, and universities is to determine the relative needs of different ICT skills and knowledge elements. This paper has used the open networking model (a layered model) to show that Kenyan

universities will need many more computer science and information systems graduates than say computer engineering graduates. The problem is that there is a shortage of ICT faculty in all these areas who have the relevant academic qualifications as well as professional industry experience. At present, only the University of Nairobi has a doctoral program in computer science and information systems but it only graduates an average of 1 PhD per year. Universities in Kenya could adopt the consortium method to develop doctoral faculty in Kenya similar to model used by the African Economics Research Consortium (http://www.aercafrica.org) that pools educators and researchers in economics from all over Africa to train doctoral students.

Apart from developing ICT faculty, universities in Kenya will have to create world-class specialized labs for educating innovative ICT professionals. Industry-university links could support such facilities. We have shown that the E-campus model can be used to overcome the limitations of the low networked readiness index ranking of Kenya and the neighbouring countries. That is, the low NRI ranking is actually an opportunity for Kenyan universities because it means fast growth of the ICT sector in the foreseeable future.

The ICT profession is portable and global. It will continue to attract the best students. Universities need to offer the best ICT education to the bright students because of the impact on performance of businesses and government.

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Developments in Participatory Methods for Software Design and Development

by
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Abstract

This paper briefly discusses the concept of Participatory design. Whereas the embodying research is in software engineering and development of large enterprise information systems, this paper discusses the general concepts of participation from a perspective of a developing country's possible gains from embracing this methodological approach. In line with the theme of the conference "Emerging technologies and trends and the future of ICT Sector in Kenya" the content is abridged to reflect the wide spectrum of the audience in the conference.

1. Introduction

When one thinks of ICT technologies and possible future scenarios for the ICT sector in Kenya, one actualizes the building of the sector in terms of applications in diverse areas, proliferation, implementations and use of information and communication technologies; tapping to reap all possible benefits and results from a plethora of ICT activities. Any researcher would take the main challenge in this understanding to be that of building use capacity in the country and summarize this as integration of technologies to the society, to all day-to-day chores as a way of life. For this to be realized, the view to be adopted is that of technology as an enabler and a great support for our human satisfaction. Whereas technology spread is unstoppable, when we get to personal human aspects of benefiting and feeling the benefits of technology, among other aspects, the issue of ownership comes out very strongly. A fulfilling and satisfying ICT sector is therefore one that has the aspect of ownership of solutions as part and parcel of the society.

The consequence of the above-described phenomenon is a call to embrace change. This is a change that is both technical as would be visualized by embrace of technologies but also in the socio-human dimensions of our society. This frames my presentation to the special domain of socio-technical understanding of technology's role in society. The drive for this view can be summarized in three statements:

1) ICT anchors in a society of human beings. The very existence of communication technologies derives its definition from a society of human beings;

2) ICT's consequences eventually become a phenomenon of the society. ICTs applications and embrace in society are in the observable facts of the society. The incidences of ICT application provide a frame for defining existence of ICT in a society;

3) ICT design and development in a society needs to be viewed as interventions in reality of the society's life.

As a consequence of this view all aspects of technological embrace and use in a society needs to be inclusive and responsive to the status quo of the society. The way to a technological embrace that takes the society as the point of departure has been fronted as through a participative process. It is from this view that the study described takes the title of participatory design.

2. Participatory Design

Participatory design is used here to mean approaches and methodologies whose point of departure is the current or future user of the artefact under development. The artefact in this case could be IT or development. The users are central actors in the design and development processes playing the roles of informing, consulting and collaborating with the technology experts as they (users) play the role of domain experts. They co-determine artefact and workplace development in a process that places a lot of emphasis on mutual learning.

The components of a participative and collaborative setting can be summarized in terms of the goal, the orientation and the nature of the process adopted. The goal is improving quality of life with a focus on servicing the intervention and not on technology. The orientation is collaborative though negotiating specific focus and goals with a call to familiarize oneself with another domain of expertise. This calls for understanding and respecting the technology domain by the users and the designers seeking to understand and respect the user domain. The process is iterative where ideas are generated from real work situations and these ideas are evaluated and discarded or explored further. This enriches the process with mock-ups, prototypes and design scenarios of real use. When conceptualised in terms of a project setting, the setting can be summarized as building relationships and appending the project (plus its results) to a context. This involves building the right team, building familiarity across another domain

of expertise and carrying out a contextual enquiry that is represented by design at work.

Participatory design has its origins from projects that were carried out in Scandinavia in the late 60s and 70s. Trade unions were interested in how technology would affect their working conditions and interests. There were projects involving industrial workers whose expertise in the jobs was a great input to the success of the technology projects. Later similar projects were carried out in office work settings, notably in government institutions, health and general administration, as the projects spread to other regions, the participation approach was used in diverse settings and industries. The consequence of the participation setting from these projects was the development of policies, control structures and infrastructures that support social inclusion of all actors that get influenced by new technologies in one way or another. Democratisation and spirit of inclusion in work places and work settings got established. It is worth noting that as the basic principles of participation were applied in different regions context specific approaches were developed. The two major developments so far are the socio-technical approaches in Europe that emphasizes collective resource allocation and the North American joint approach that emphasizes technical and efficiency specifications of the projects.

3. Conclusion

For us as we take sometime to discuss the future of the ICT sector in Kenya, we need to reflect on our practice with the objective of coining a methodological framework for practicing PD in our settings. This needs to be informed by understanding and respecting our social dimensions, striving for spaces of expression in work settings in a manner that supports articulation of 'our' solution. We need to address the issues of attitudes to other domains of knowledge with the intentions of harmonizing exchanges as supported by our social structures in place. We have a challenge to not only embrace technology and build infrastructures but also to build our socio-technological identity based on our context.

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Semantic Web Technology: The Foundation For Future Enterprise Systems

by
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Abstract

The semantic web is an extension of the current web in which data and web resources is given more meaning by incorporating metadata. The incorporation of metadata leads to an improved utilization of web resources by software applications, which will be acting on behalf of human users. In this paper we introduce the semantic web technologies, specifically RDF, RDF Schema and OWL that have been recommended by the W3C. Particularly, we encourage the Kenyan web developer to use these semantic languages in addition to HTML in their projects.

1. Introduction

The wide adoption of information and communication technology innovations has brought a lot of benefits. In particular, the World Wide Web has changed the way we work, and access information. It has placed information at our fingertips. But this information is designed for human readers. The machines that store and presents this information to us cannot understand or interpret it.

One way to change all this is to provide the information in such a way that machines can understand, so that it would be possible to develop software agents, who act on behalf of users, can carry out practical and autonomous task. This is the vision of the Semantic web as laid out by Tim Berners-Lee, James Hendler, and Ora Lassila in 2001 [3]. In their definition, they explain that the semantic web is intended to be "an extension of the current web in which information is given a well defined meaning, better enabling computers and people to work in cooperation".

The well defined meaning is added to the web by means of metadata. The metadata is given in formal standardized format which can be interpreted by machines. The W3C recommendation [16] is based on the use of Extensible Mark-up Language (XML) for syntax and Resource Description Framework (RDF) and its related vocabulary RDFS for meaning. To facilitate reasoning about meaning of resources and it trustworthiness the web ontology language OWL has been recommended.

In this paper, we will introduce these standards that are now W3C recommendations, and urge the Kenyan web developers to embrace them. The rest of the paper is organized as follows. In next section, we introduce layered approach to achieving the goal of the semantic web. Next, we look into more details the RDF concept, and the related vocabulary RDFS. We then describe in section 4 the semantic web ontology layers' language OWL. In section 5, we look at the current usage of the semantic web, and outline the theme of our effort at Strathmore University. Section 6 summarizes our belief on the usefulness of these technologies in the context of the Kenyan market. We then offer a conclusion.

2. The Semantic Web

In the current web, the content is designed for human consumption. The main focus is on documents. This is based on the concept that a document or media can link to any other document (or different media). It is difficult to find, present, access, or maintain available electronic information on the web. The languages used to create the web such as HTML tend to focus primarily on document structure and document presentation. Little or no attention is given to the representation of the meaning of the content itself, i.e. the (domain-specific) representation of the subject of the document.

The semantic web address these shortcomings by using technologies such as RDF, OWL and data centric XML. The requirements and the design issues formulated for the semantic web are implemented in the layers of technologies and standards shown in Fig. 1. According to this architecture, the semantic web is to be built in an incremental fashion.

We will introduce in this paper the main standards that have been endorsed by W3C as of Feb 2004, the Resource Description Framework (RDF) with its companion standard (RDFS) and the Web Ontology Language (OWL). The top layers Proofs and Trust are now being addressed by academic research and is outside the scope of this paper.

The semantic web ground itself on available standards for referring to entities; the Uniform Resources identifiers (URIs) [8] and encoding of character symbols i.e. Unicode [24]. For syntactical purposes, it uses web technologies like Extensible Markup Language (XML) [6], XML Schema standards [13] and XML Namespaces specification [7].

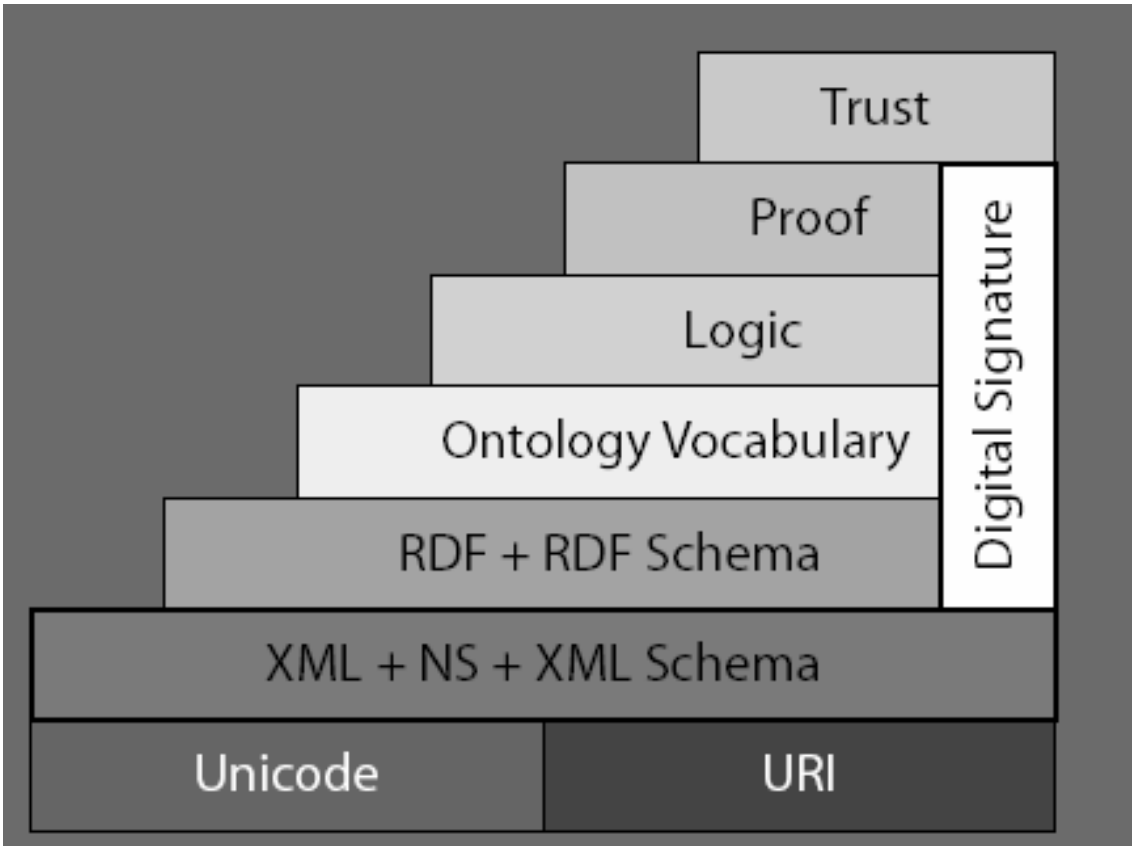

Fig. 1: The Semantic Web Layer Cake (Berners-Lee, 2000)

3. Resource Description Framework (RDF)

The semantic web aims to give meaning to resources and the cornerstone of this is the Resource Description Framework (RDF). RDF is a language for representing information about resources in the World Wide Web [20]. It is particularly intended for representing metadata about things that can be identified on the Web, even when they cannot be directly retrieved on the Web.

a. RDF data model and syntax

Resources are described in terms of properties and property values using RDF statements. RDF statements are a triple consisting of resource, property and value typically referred to as (subject, predicate, object). RDF uses URI to identify resources. The RDF specification defines a graphical representation for RDF descriptions as graphs. A description is a labelled graph with the subjects and objects as nodes and the property as an arc originating from the subject. A particular description about resource includes a number of statements, for

example in Strathmore University, we know that Dr. Freddie Acosta has written a paper titled Problem Based Learning Methodology, and he has an email address as well as a home page. Figure 2 graphically depicted the scenario as an RDF graph.

The RDF specification provides a textual representation using XML syntax [2]. Other notations for serializing RDF also exist, e.g. N3 [3], Tutle [?]. The RDF/XML serialized form of the graph in figure 2 is shown in Figure 3.

b. RDF Vocabulary Description Language

The RDF vocabulary description language [8] also called RDF schema, defines a modelling language on top of RDF. RDFS is a language for defining vocabularies intended for use in RDF statements. RDF Schema vocabulary consists of classes and properties, which can be used to define term hierarchies. Properties are defined with range and domain qualifiers. The schema

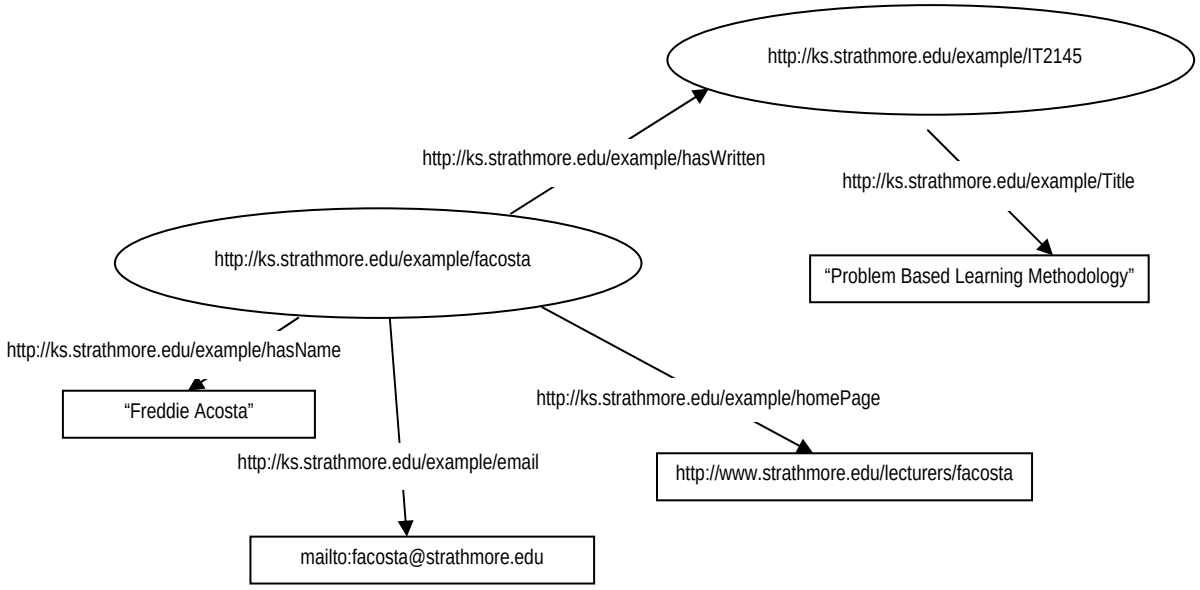

Fig. 2: An RDF graph

allows for the expressions of set memberships of individuals or objects in property and class extensions.

We can use RDFS to describe application specific RDF vocabulary. To describe classes, we make use of inbuilt RDF schema resources rdfs: Class and rdfs:subClassOf. Similarly the schema allows us to define properties (which are instances of rdfs:Property) with the corresponding global and range restrictions. Figure 4 shows the definition of classes and properties based on our example.

```
<?xml version="1.0" encoding="UTF-8"?>
<rdf:RDF       xmlns:rdf="http://www.w3.org/1999/02/22-rdf-syntax-ns#"
           xmlns:rdfs="http://www.w3.org/2000/01/rdf-schema#"
           xmlns:strath="http://ks.strathmore.edu/example/">
<rdf:Description rdf:about="http://ks.strathmore.edu/example/facosta">
           <strath:homePage
rdf:resource="http://www.strathmore.edu/lecturers/facosta"/>
           <strath:hasName>Freddie Acosta</strath:hasName>
           <strath:email rdf:resource="mailto:facosta@strathmore.edu"/ >
           <strath:hasWritten rdf:resource="
http://ks.strathmore.edu/example/IT2145"/>
</rdf:Description>
<rdf:Description rdf:about="http://ks.strathmore.edu/example/IT2145">
           <strath:Title>Problem Based Learning Methodology</strath:Title>
</rdf:Description>
</rdf:RDF>
```

Fig. 3: An RDF/XML serialization of the graph of fig. 3

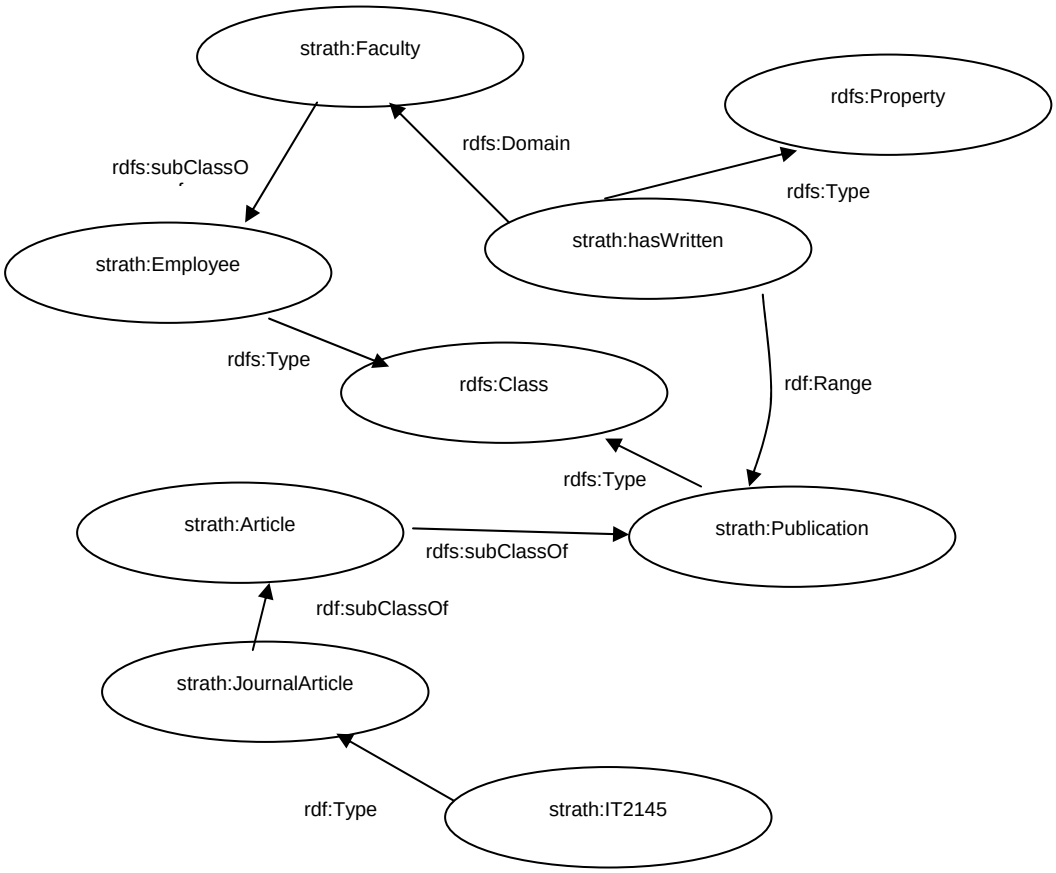

Fig. 4: RDFS Class hierarchy

4. Web Ontology Language

The expressivity of RDF and RDF Schema is deliberately very limited [21]: RDF is limited to binary ground predicates, and RDF Schema is limited to a subclass hierarchy and a property hierarchy, with domain and range definitions of these properties. Though RDF Schema provides a language for describing the vocabulary of RDF data, the requirements for a modelling language for the semantic web required a richer and more expressive vocabulary language. To come forward with such a language, the Web Ontology Working Group chose Description logics [?] as a logical basis of for an expressive ontology language. The Web Ontology language (OWL) can be considered as a particular Description Logics.

Ontology

The term ontology originated from Philosophy, where it means a description of the nature of being. Gruber [15] defines ontology as a explicit specification of a shared conceptualization. Ontologies can be viewed as models that represent an abstraction of a domain in a formal way, such that parties are able to agree on the abstraction and reuse the model in their own (web) application.

An important feature of an ontology is that you can reason about the knowledge that is modelled. Antonious & Harmelen [1] states that for ontological knowledge, we may reason about:

- Class membership. If x is an instance of class C, and C is a subclass of D, then we can infer that x is an instance of D.
- Equivalence of classes. If class A is equivalent to class B, and class B is equivalent to class C, then A is equivalent to C, too.
- Consistency. Suppose we have declared x to be an instance of the class A and that A is a subclass of $B \cap C$, A is a subclass of D, and B and D are disjoint. Then we have an inconsistency because A should be empty, but has the instance x. This is an indication of an error in the ontology.
- Classification. If we have declared that certain property-value pairs are a sufficient condition for membership in a class A, then if an individual x satisfies such conditions, we can conclude that x must be an instance of A."

A helpful tool for reasoning is automated reasoning support. Deriving such knowledge can be made mechanical. Automated reasoning support can:

- check the consistency of the ontology and the knowledge
- check for unintended relationships between classes
- automatically classify instances in classes

Building upon RDF and RDFS is the Web Ontology Language (OWL) [12] which is a richer and more expressive vocabulary for define semantic web ontologies. OWL layers on top of that the ability to reason and make inferences about data. OWL is layered on RDF and RDF schema and uses RDF's XML syntax. OWL documents, termed OWL ontologies are RDF documents.

OWL Language

OWL builds on a rich technical tradition, of both formal research and practical implementation on ontology languages, including SHOE [17], OIL [14] and DAML+OIL [11].

Ideally, OWL would extend RDF Schema, which is consistent with the layered architecture of the semantic web. The desire to simply extend RDF schema works against obtaining more expressive powers and efficient reasoning. This prompted the Web Ontology group of the W3C to define OWL as three different sublanguages:

- OWL Full: This is a language with maximal expressiveness. It is unlikely any reasoning software to support OWL Full.
- OWL DL: OWL Description Logic is a subset of OWL full with some restrictions on the languages' expressiveness while retaining computational completeness (all conclusions are computable)
- OWL Lite: This is a subset of OWL DL that only allows for simple constraints and classification hierarchy. An advantage of this language s that it is both easier to grasp for users and easy to implement

Ontology developers are usually urged to adopt the OWL language that best suits their needs. The features of each OWL species is fully defined in [25]

5. Application of the Semantic Web

Several application of the semantic web exists. The current target area for many groups is data integration. In many companies (and across corporation), useful information is spread across many, disparate, hard to integrate databases. By encoding data in a common model we can make statements about when things

are really the same (because they have the same URI. We can also use ontologies and inference to more effectively link two disparate sources of knowledge.

Semantic Web technology can be used to produce active components that use the semantic web infrastructure to offer users intelligent services. These semantic web-enabled services will support information access and e-business. This technology will provide mechanization in service identification, configuration, comparison and combination.

The semantic web technology can be used to facilitate knowledge management. Typically, useful information is scattered across an organisation in a variety of locations and stored in a variety of formats. We can use the semantic web to integrate disparate sorts of information from different places. The information can be enriched not only by the creators but also by the consumers, who just by the act of using the knowledge held would add value to it. The use of semantic web technology in knowledge management is one of the key themes of the Knowledge Systems research group at Strathmore University.

Other applications include building of social networks and intelligent web search in which the search is based on concepts and not keywords as currently implemented by search engines.

6. Discussion

The principles of the semantic web can be applied just as appropriately to the information assets of an organization. It is our belief that enterprises have a great deal to gain from the application of semantic technologies to manage and process the information they hold. We also believe that just as the corporations adopted Internet-based technology for internal networks in the form of "intranets," so too will they adopt semantic Web-based technologies to their internal systems.

These systems will require the resources to be annotated with meaning, based on the semantic web languages. To facilitate the sharing of information from diverse systems, ontologies will have to be built. As opposed to the previous scenario when you needed a domain specific language, it would be advisable to develop ontologies using the W3C recommendation, OWL. When the principles of the semantic web have gained widespread acceptance, we foresee that new applications will be based on the standards that we have described in this paper.

As a developer, in addition to the traditional web application development languages, you will need to be well versed in RDF, RDFS and OWL, on the

minimum OWL Lite. Vendors will strive to make this transition for you easy. Tools are already out in the market that enables you to use RDF using your favourite programming language. A guide on such toolkits is provided in [5]. An example is the java API for RDF called Jena [9]. Jena is available for free download from (http://jena.sourceforge.net/). A well known tool for creating and editing ontology is the protégé [2] from Stanford University. Recently, an OWL plug-in was released for the software.

It is envisioned that the data held in relational and object-based database management systems should also be available for semantic web applications and DBMS developers will release products that support RDF. An example is Oracle cooperation product Oracle 10.2g [22].

7. Conclusion

The global village is here and the Kenyan developer is part of the village. We have the infrastructure that is required to support the semantic web vision. The diffusion rate of technology is now faster unlike the past. We need to seize the opportunity to help define the Kenyan content, and not wait for solutions from other parts of the world. Free open source tools are readily available, and as a developer, you should be ready to make your hands dirty. Play with these tools and do not wait for permission for the head of IT function to create ontologies. The semantic web is here. You should make it happen.

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Section IV
ICT USAGE IN SOCIETY

Information Technologies for Disadvantaged Communities

By
Joseph Maruti

1. Introduction

Information and Communication Technologies (ICTs) are an integral and even indispensable part of our lives today. ICTs play a big role in different aspects of our lives, making communications easier and more efficient. Many of us take these technologies for granted but there are still places in this country where people have never even seen a telephone let alone a computer.

The term 'digital divide' is used to describe the gap between those who can effectively use new information and communication tools, such as the Internet, and those who cannot. A more detailed definition of this phenomenon is given by the Global Information Infrastructure Commission[1]. "… the digital divide refers to a collection of complex factors that affect whether an individual, society, country or region has access to the technologies associated with the information economy as well as the educational skills to achieve optimal application of those technologies."

It is clear from this definition that to fully exploit the benefits of ICTs, one must possess the necessary skill sets needed. Providing the members of marginalized communities with the basic skill sets that will allow them to access and effectively use ICTs will go a long way in creating bridges for this gap.

But we should not be naïve in thinking that ICTs offer a magical solution to the problems associated with poverty. Digital Opportunity Trust in their book, *People, Potential and the Power of technology: Connecting the DOT*, make an interesting observation that captures the spirit of human capacity building in the area of ICTs.

Much attention in recent years has been invested in the effort to 'bridge the digital divide'. The imperative to 'build on-ramps to the so-called information super highway, and enable access to those who lack the means', has become a top priority of the global development movement. Perhaps owing to the magnitude of how the issue is observed from a global perspective, there is often a mystical quality to what ICT-for-Development really means. Really, it comes down to

[1] GIIC Analysis of the Digital Divide, PowerPoint presentation, October 2000 www.giic.org

connecting individuals with their unlimited potential that is unleashed by the use of technology.

Therefore the goal of capacity building in disadvantaged communities is to offer them the skills and that will open up a world of opportunity for them to better their lives, their businesses and their communities.

Digital Opportunity Trust's (DOT) flagship initiative is the Global NetCorps (GNC) Programme. Global NetCorps was designed to be a global, sustainable, in-country capacity building Programme that trains youth to have a social and economic impact in their own communities by training others in the use of information and communications technologies (ICT).

The pioneering programme in Jordan conducted a best practices research and from it was generated a set of guidelines that have consequently illuminated the way forward for subsequent country programmes to ensure their successes.

The critical success factors when designing and implementing an ICT driven Capacity Building programme for disadvantaged communities are highlighted below:

2. Capacity Building: Critical Success Factors

Understanding and Respecting Local Gender Realities

In Kenya, just like in many developing countries; women have borne untold discrimination in how they carry about their day to day activities in and outside their communities. This calls for special remedial measures to ensure that the same trend does not emerge when delivering Capacity Building training in ICTs in marginalized communities. Indeed, in Jordan, when appropriate measures were put in place it emerged that ICTs were presenting a never before explored opportunity for women to participate undeterred in the advancement of their communities.

Local Ownership

Building capacity cannot be implemented successfully without a strong sense of vested ownership by local stakeholders. This requires that ownership should be established during or prior to programme design. All direct and indirect stakeholders and beneficiaries need to have ownership of the design, the implementation process and the results of the programme or initiative. Besides the interns, who are all recruited locally and are therefore a fully-embedded first point of diffusion; the GNC Programme is aligned to national priorities during its

planning phase through mechanisms that ensure the government ministries, civil society and private sector are engaged in the visioning process.

Demand-driven Response to Community Needs

As sophisticated as capacity building programmes may seem, they are not exempt from being governed by the basic commerce laws of demand and supply. This principle reflects that the priority issues of each region and community must be reflected in the programme products. It would be pointless to develop curriculum supporting Micro, Small and Medium Enterprises among pastoralists and then turn around and hope to deliver it among the fishing communities. Conversely, capacity building programmes must add real value to the lives of the intended beneficiary communities if the members of the community are going to invest towards the acquisition of these skills.

Regional/local champions playing a critical role

The nature of Capacity Building programs calls for their promotion by selected members of the community we have dubbed 'Champions'. Champions are respected, committed, influential individuals at regional and local levels who actively support and promote the cause of capacity development. Their involvement in a programme confers priority and credibility to it. Do not be startled at the number of people that would take a particular self-enrichment course, for instance, or read particular books just because 'Oprah has read it, or Oprah recommends it'. The local Champions would play a similar role among their own community when implementing a capacity building product such as GNC programming.

Involvement of local stakeholders and the power of convergence

Convergence has very strong connotations around having Voice, Video and Data over one channel. It ensures maximum use of available bandwidth. GNC programming also ensures maximum use of available resources (logistical, human as well as financial) in furthering the impact of these programmes. The key here would be to leverage partnerships of like minded people and organizations to further the common cause of bridging the digital divide. For instance, when implementing an ICT capacity building program like GNC, it would be important to identify organizations/institutions such as tele-centres in close proximity to the target beneficiary community and roll out programming there. As opposed to beginning to seek finances to build a brand new computer lab that may not come with the goodwill of the community and that then pose serious risks when considering fiscal sustainability of the computer lab and hence the program.

Capacity building involves cascading processes
Models such as the training of trainers and dissemination of information are effective ways to create the needed multipliers. Spill-over effects from other GNC programmes suggest that the programme keeps on giving, as one trained person trains more – family members and friends through volunteer networks

This programme repeatedly demonstrates that if one person is trained, this one person will educate many. Once made aware of the power of computing, this knowledge had clear spill-over effects in everyday life – buying a computer, using the Internet to maintain and expand social and knowledge capital, incorporating ICT into business practices, starting a business using ICT, and/or for training others. In addition to impacting on people's professional lives and business practices, NetCorps training has clear spill-over effects in terms of encouraging those involved to make an investment in computing.

Participation takes time and resources
Participation is time-consuming and requires considerable effort. It is a long-term process that cannot be achieved through single meetings or discussions. Time and resources need to be dedicated during development of the initiative, including extensive organized consultations with stakeholders to agree on the components and implementation arrangements. These are processes critical in achievement of the above point on local ownership.

3. Conclusion

Computers, Internet, Printers and faxes would remain practically worthless to the larger masses even if each village in Kenya had a state-of-the-art cyber café until such a time as the villagers themselves have had their capacities built or have been sufficiently **empowered** to use these technologies to make their day to day activities more efficient. And if they have, the sky is the limit.

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ICT Trends and Their Role in Shaping the Media Industry in Kenya

by
Chaacha Mwita

1. Introduction

> "Three thousand years from now, when keen minds review the past, …our ancient time here at the cusp of the Third Millennium, will be seen as the start of a major new historical epoch. In the years roughly coincidental to (the first major ICT-related IPOs), humans began animating inert objects with tiny slivers of intelligence, connecting them into a global field, and linking their own minds into a single thing. This will be recognised as the largest, most complex and most surprising event on the planet. Weaving nerves out of glass and radio waves, our species began wiring up all regions, all processes, all facts and notions into a grand network. From this embryonic neutral net was born a collaborative (media) interface for our civilisation."[2]

What is described here is part of a continuing narrative that begun many years ago — definitively in 1895 when Guglielmo Marconi first experimented with radio signals opening up our world to what became known as wireless technology, which has since then set the pace for media development worldwide, including Kenya.

Then, wireless technology could only transmit sound (voice). Today, more than a century later, not only has wireless technology advanced enough to transmit text, it transmits pictures — motion and static — as well in various formats and dimensions in real time. What has made this revolution — one that has not spared even the poor Third World — possible is commonly referred to as *convergence*.

In his enlightening book *The World is Flat,* Thomas L. Friedman captures this phenomenon thus:

> The flat world platform is the product of the convergence of the personal computer (which allowed every individual suddenly to become the author of his or her own content in digital form)

[2] Kelly, Kevin, *Wired*, August 2005 issue.

with fibre optic cable (which suddenly allowed all those individuals to access more and more digital content around the world for next to nothing) with the rise of work flow software (which enabled individuals all over the world to collaborate on that same digital content from anywhere, regardless of the distances between them.)[3]

2. Living the future

Hand-in-hand with convergence, has been the multiplicity of media. While the former gave consumers of media the power to decide, the latter gave them the power to share. Thus, raising mobiles aloft, they did not just talk and text, they snapped, shared and reported the world around them.[4]

Not only has this demystified the media, it has made the media more responsive to customer demands. Thus, for example, in Kenya, both *Standard* and *Nation* have a "breaking news" short message service (sms) to those who subscribe to it. And these subscribers forward such breaking news items to their circles of friends without the media house's permission.

These developments have also enabled consumers to be part of the news gathering process. They call television (TV) and radio stations to report from the field or correct erroneous information; they create and watch their own programmes at home; they browse the web for just what they want and share it among their own networks and so on.

It is no wonder then, that media houses around the world, including our own, are beginning to spare some of their best journalists for new media such as websites and SMS direct services. Initially, this was not necessarily the case. Online journalists were dispensable before. Not any more.

On radio and TV especially, I am sure you are aware of live programmes. Phoning into programmes to make contributions have become the order of the day with some regular contributors being nicknamed 'Serial Callers'. The multiplicity of FM stations, especially, has led to better coverage of events with some stations running live outside broadcasting of some events.

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[3] Friedman L.T, *The World is Flat: A Brief History of the Twenty-First Century*, 2006, Farrar, Straus and Giroux, New York, USA.

[4] BBC NEWS: http://news.bbc.co.uk/go/pr/fr/-/1/hi/technology/4566712.stm
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All these would not be possible without ICT developments. What's more, the revolution continues: The mass consumer has at his or her disposal many more gadgets with greater capacity to record, store and share content. They are increasingly challenging those who have traditionally provided them with content — be it news, music, or movies. In short: Us the media. And make no mistake — even Third World countries like Kenya are feeling this revolution.

Generally, circulation figures have not been going up for many 'proud' newspapers and magazines. Consumers are increasingly doing it on their own. But a few innovative and responsive papers are registering growth — both on and offline. Purely for reasons of modesty, I'll not say where the paper for which I work falls.

Around the world, as a recent report by London's *Economist* revealed, ICT trends are making the newspaper business difficult. It says:

> Of all the "old" media, newspapers have the most to lose from the Internet. Circulation has been falling in America, western Europe, Latin America, Australia and New Zealand for decades (elsewhere, sales are rising). But in the past few years the web has hastened the decline. In his book *The Vanishing Newspaper,* Philip Meyer calculates that the first quarter of 2043 will be the moment when newsprint dies in America as the last exhausted reader tosses aside the last crumbled edition.[5]

The same is happening to advertising revenues. They are also shifting online. In the west in the last ten years, newspaper advertising revenues have dropped by six (6) percentage points while it is increasing on the Internet. People generally spend less time on the newspaper than before and newspapers are employing ever fewer people.[6]

Why is this happening? Because ICT has changed and continues to change the way people access and use information and entertainment content.

In Africa, the *African Executive* – a weekly online magazine covering only issues relevant to Africa and development with a subscriber base of 21,000 readers and

[5] The Economist Newspaper Ltd, The Economist: Who Killed The Newspaper?, Volume 380 Number 8492, September 2006, London, UK.
[6] ibid

250,000 hits a month — is a good example of how online journalism is taking on traditional print journalism.[7]

The *African Executive* argues that mainstream African papers have been starving readers of the in-depth useful information Africa needs to grow. Up to mid-last year, the *African Executive* had 3,000 subscribers, a number that shot up late last year. And there are many more 'specialised' websites focussing on issues their owners and subscribers feel newspapers are giving short thrift.

The lesson here is simple: Techno-tools are not dumb funnels for the same paid-for content from mainstream media; they are powerful tools for socio-political expression and reportage. The consumer is turning into the citizen with a meaningful role to play.

Today, amateur cameras capture events before any media camera can. It has also become the celebrities' nightmare for they cannot make a step without risking being captured on camera.

Think about it: Would the so-called Githongo tapes been possible without ICT? Would they have reached London before Kenyans are aware of them without ICT? With ICT everybody is the best investigative journalist they can be.

But even as everyone is trying to render me jobless by becoming a journalist, almost every company — riding on the crest of ICT trends — is trying to become a media company. They have websites that rival ours, often carrying beyond the usual company news and information; they poach the best journalists in the market to run their information outfits; they sponsor news segments on prime TV and some — like Barclays Bank Ltd — actually do have great programmes produced by their own staff.

As the BBC once put it: "The changing nature of news offers a diversity of voices, sources, and choice... and lets anyone join in global and local conversations."

In Kenya, as in the rest of the world, this has put a demand on the part of the media to ensure their audiences have access to quality and trusted sources of news and information — and this is a good thing.

New media and connectivity are therefore definitely shaping the production and distribution of media and the nature of communication in our society. The most important point to note here is that every society, with its own needs and norms,

[7] www.africanexecutive.com

resolves the tension between availability and use of communication technology differently.[8]

Since media is business and has to survive and possibly thrive, what do media companies have to do to survive the twin demands of convergence and multiplicity of media devices?

The answer lies in *The New Market Leaders* by Fred Wiersema:

> (They should) give much greater weight to the one success factor absolutely critical in the New Economy: An organisation's ability to attract valuable customers both now and in future. This is vital because today's most serious business challenge doesn't involve implementing new management techniques, raising capital, or any of the familiar bugaboos of recent decades (all has been done — TQM, restructuring, benchmarking, mergers and so on). Today's most serious business challenge is a scarcity of customers.

As we have seen, the media is not spared this scarcity. Indeed, what Wiersema is recommending for businesses here, is something the media had already graduated into in order to survive: Living in the future. In Kenya, we are even miles ahead. That is why we have already reported on the 2007 General Election before it is even announced. We cannot give you yesterday's news because radio, TV and mobile phones have beaten us to it. And those who might be tempted to think we are sensationalising things had better wake up to the 21st Century, a century ruled by ICT, a century beginning in which only two types of newspapers will survive: the highbrow and the entertainingly populist. Everything in between will go.[9]

The best example of living in the future is the BBC's recent announcement of details of the anticipated reorganization designed to make the "Creative Future" content strategy a reality. The mission is to concentrate on emerging technologies, playing a leading role in finding and developing new ways for audiences to find and use content.[10]

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[8] LaRosa C.R, Shaping Media: Evolution through Communication Technology, Hamilton College, Hamilton, USA.

[9] The Economist Newspaper Ltd, The Economist: Who Killed The Newspaper?, Volume 380 Number 8492, September 2006, London, UK.

[10] www.paidcontent.org/ more-on-bbc-restructuring-new-future-media-and-technology-division

3. Diversifying to Survive

But there is something more radical than living in the future that is happening to media companies due to ICT trends: This is spawning entirely new businesses unrelated to the gathering, processing and dissemination at a fee of information and entertainment content.

> So media houses are launching profitable new ventures that are only indirectly related to journalism. Schibsted (a Norwegian newspaper firm), for instance, started an online slimming club… The Online Daily Telegraph of Britain sells readers everything from goose-down pillows to Valentine's Day topiary baskets to insurance.[11]

And hence in Kenya you have *Standard* and *Nation* collaborating with supermarkets to send Kenyans in the Diaspora Tusker beer packs and Unga during Christmas, as well as receive and pass on to their relatives here at home messages of goodwill — something hitherto reserved for the postal corporation. I am sure many of you also know that *Nation* — a media company — transports parcels — the domain of a courier company.

So powerful is the influence of ICT on the media in Kenya today, that the phenomenon of mobile workers has been accepted as the norm. Media houses are trying to make their journalism more local. Thus, media houses have invested in mobile journalists ("mojos" in the West although the term has not caught on here) with wireless laptops who almost permanently work outside the office.

That is how come you can see that clip of a 5.00pm bar brawl from Mombasa during your 7.00pm news. That is how come you view the Orange or Banana rally in remote villages soon after they happen. That is how come you will read a paper in Kisumu in the morning as you board a bus to Nairobi, but when you get here you see the same day's edition looking different — carrying news for a completely different audience.

These days, newspapers actually do cover parliament, sports, field events etc in real time. As soon as the story is done, at the click of a button it is in the newsroom for processing and the "mojo" is to other things.

Globally, the successful media companies are those that have embraced ICT and are using it for business. That is why Google — a search engine — is the leading media house in terms of news content aggregation. That is why, *Standard* online

[11] opcit

is the leading news site in this region[12] — we use simple, friendly yet advanced tools that make our website easy to load and navigate.

Other results of ICT trends is greater, often strange, collaboration among media houses. For example, during the World Cup, you will remember the necessary collaboration between Kenya Television Network (KTN) — a private broadcaster — and Kenya Broadcasting Corporation (KBC), a public broadcaster to beam the live matches to millions of homes in Kenya. The same happened during the so-called "Great Debates" in October and November last year.

4. Technology shaping media today

Due to time and space constraints, one cannot exhaust an exposition on this matter. Allow me, therefore, to briefly outline technology that is shaping the media today, mostly in the west, but inevitably, though to a less extent here.

Internet Pay TV (IPTV). Still being refined, it will play a key role in re-shaping the TV experiences for end users with interactivity, multiple digital streams and High Definition TV becoming the household standard during this decade. IPTV will especially offer increased control of what is being watched, when, by whom and how much. This is particularly important for parents who want to protect their children from violence and other inappropriate content and would like to control how much money they spend on an individual basis. Personal profiles also entails that individuals can receive information and advertisements only relevant to them. Three hoorays for technology!

Asymmetric Digital Subscriber Line (ADSL). This technology allows you to use the whole bandwidth of a standard telephone copper cabling to receive TV and other content. The last mile capacity bottlenecks are solved with the introduction of ADSL to support multiple simultaneous TV streams.

Digital TV: The introduction of digital television has caused significant increase in the number of channels operating. It allows for maximised clear coverage. That is why KTN and NTV are now almost national broadcasters with clear signals reaching far corners of the country.

Other ICT technologies that continue to impact the media are mobile TV, mobile radio, blogs, and video streaming — which will be very helpful in next year's election.

[12] Alexa.com, google.com and yahoo.com

5. Conclusion

In conclusion, ICT and media trends around the world, and in Kenya too, predominantly focus on commerce and technology. The question for us is: Is that how it should be for a country like ours besieged as it is by myriad socio-political problems? In my opinion, in Africa ICT and media trends should focus more on the social and economic impact of the development of appropriate technology, the dissemination of information and the rapid deployment and penetration of communication systems for better access to information. Here, I am talking about harnessing ICT and media to make ours a people-centred and inclusive information society. This, in my view, should be the future of ICT and media in Kenya. And this lies squarely in the domain of national policy.

Thanks to all of you for the opportunity to share these thoughts with you.

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