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INFORMATION AND COMMUNICATION TECHNOLOGY AS A TOOL FOR MODERNISATION

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Abstract

It is argued that Information and Communication Technology (ICT) is a vital tool in Uganda's modernisation plans. Information Technology, Communication Technology, and their convergence into ICT are discussed. The use of ICT as a modernisation lever in five critical areas, viz: education, agriculture, delivery of health services, commerce and government is discussed.

Disclaimer: While the authors, one as a Commissioner and the others as employees, have knowledge of the policies and procedures of the Uganda Communications Commission (UCC), the views and assertions in this paper are purely personal and are not meant to reflect, explicitly or implicitly, the position of UCC on any of the issues discussed.

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1. INTRODUCTION

One of the main objectives of the current government is modernisation: modernisation of agriculture; modernisation of industry; modernisation of the money, etc. Implicit in all this is a desire to increase efficiency, productivity, and competitiveness for our private and public enterprises. One aspect that is not yet explicitly recognised by government is the need to modernise government itself.

Uganda needs to use various strategies as it tries to modernise. This paper addresses one of the strategies: the use of information and communication technology (ICT) as a tool for modernisation. Some emphasis must be put on the word tool here. It is important to understand and appreciate from the beginning that it is not a question of using ICT for the sake of it, but using it in instances where it can increase the pace of our modernisation. This means we must identify and start with those areas where ICT will have the greatest leverage factor in achieving modernisation. ICT is a lever in that we can achieve more with the same resources or, better still, achieve more with less resources. The major sectors where this can happen include education, agriculture, health delivery, commerce, and government.

This paper addresses the theme under the following subheadings:

- What is ICT?
- ICT in education
- ICT in agriculture
- ICT in health delivery
- ICT in commerce
- ICT in government
- The Infrastructure challenge
- Conclusion

2. WHAT IS ICT?

We nowadays talk about Information and Communication Technology, or ICT, because Information Technology (IT) and Communication Technology (CT) have converged to the extent that they can no longer be sensibly considered as separate. We shall start by looking at the genesis of this convergence.

2.1 Information Technology

We are always collecting data. The ages, heights, and weights of people in a group; the speed of a vehicle; marks scored in assignments; the number units from a production line; the population of Uganda. We therefore accumulate masses and masses of data.

This poses several challenges: storage; access; analysis; presentation. Analysis is critical in that it reduces data to information, based on which decisions can be taken. A collection of one hundred sets of marks is just data. If this is analysed to get averages and other statistics, information about performance is obtained. Poor performance leads to a management decision: investigate, establish the cause of poor performance; and take corrective action.

Over the ages, human beings have tried many ingenious ways of storing and processing information. Knots in ropes for storage; the spike abacus (still used) for data processing; and other less or more advanced techniques. It is not surprising that the most readily available counter, the digits on our fingers, led to the establishment of the count which goes to ten, and that still pervades all our systems. The count to ten and multiples thereof (decimal system) was convenient even when electrical methods of storing data came into fashion.

In electrical and electronic systems, it however became very unwieldy and expensive to represent the ten states implicit in the decimal system. On the other hand, it is very easy to represent a two-state, or binary, system using electrical or electronic devices. Counting using binary digits therefore came into vogue (for the technologists), especially with the advent of electronic storage and processing devices.

Complex processes of computation, analysis, and indeed thought processes, are broken down into very simple steps through programming. Programmers translate our high level needs into simple routines that a computer can execute - very fast.

We can therefore look at the computer as a very efficient abacus, albeit billions of times faster, and using binary instead of decimal arithmetic: A computer, by its very name, was originally just an arithmetic device.

The hardware, the software, the methods, and the know-how required or used in acquiring, storing, processing, and displaying data and information is collectively known as Information Technology, IT.

2.2 Communication Technology

For a very long time, telecommunication was about sending the equivalent of voice messages and alphanumeric characters over long distances. This initially required a physical medium connecting the two points between which telecommunication was required. The development of electronics and communication theory led to technologies that were able to transmit several signals on the same wire simultaneously. Telegraph and telephone cables were laid across continents and oceans. Telecommunication engineers relentlessly pursued their dream: ***the death of distance***.

Marconi demonstrated that messages could be transmitted through space by the use of electromagnetic waves, which are exactly the same as light, only that they cannot be perceived by our eyes. Radio and radio communication systems were born. Entrepreneurs seized the opportunity to branch off into the audio mass media – radio and television broadcasting. Signals could be transmitted around the globe. A tool for information gathering and propaganda dissemination was born.

The second world war, like all wars, was a great spur to developments in telecommunication and its usage. It had been theoretically demonstrated that an object at about 36,000 km above the earth would rotate at the same angular velocity, and therefore appear stationary. The Sputnik went up in the late fifties, though not as high. The idea of satellites became a reality. Satellite based communication systems were born, and the world became a smaller place. More, and more capacity is demanded by the people of the world. More and more satellites have been sent up, and still the capacity cannot expand fast enough. Satellite platforms are in addition very expensive.

A solution to the capacity problem appeared in the form of optical fibers. Made from the most ubiquitous material, sand (of a very high purity) optical fibers carry signals in the form of light pulses generated by lasers (optical generators and amplifiers). Pulses are generated at a typical rate of 1,000,000,000 pulses per second, enough to transmit 20,000 simultaneous phone conversations on a fiber less than one millimeter overall diameter. Hundreds of thousand of kilometers of optical fiber have been laid across the oceans and continents, providing the information superhighway. The dream of the telecommunication engineer has almost come true: In real terms, distance related costs are negligible compared to other network costs. ***Distance has died***.

Communication is not just about the channel. The telecommunication engineer worries about:

- Fidelity: is the signal received a true replica of what was sent?
- Efficiency: is the maximum possible amount of information being transmitted through the available channel?
- Cost effectiveness: Is the acceptable level of fidelity being achieved at the lowest possible cost?

The hardware, the know-how, the programs and the methods used in ensuring that the message is transmitted correctly, efficiently and cost-effectively are collectively known as Communication Technology, CT.

2.3 Convergence: information and communication technology

In the early days of the computers, total centralisation was the norm. Main frames would occupy some central location on say a campus, and the users would have to move to the computer. This was the IBM paradigm. The peak of this was around the late seventies and early eighties. Computers were therefore for academia (especially the science based), the military, and certain industries.

It was however recognised, even at this stage, that it would be convenient to access the main frame from a distance, instead of going with decks of cards to the main card reader. Dumb terminals were set up for accessing main frames where all the processing power resided. While the demands on the communication channels were modest, we can see here the beginning of convergence. Information technology requires communication channels.

At the same time, advances in communication technology called for complexity in signal processing never anticipated. A communication network required the abilities of data acquisition, storage and processing to operate. Communication technology needs information technology.

In the late seventies and early eighties, companies like Apple and others came up with a new paradigm: the ubiquitous computer, available to individuals: the standalone personal computer (PC) was born.

The environment was right: advanced techniques of data gathering and processing were developing; efficient ways of communication were being implemented; enterprises, both public and private were becoming global. Computing power could be widely afforded. It

was only logical that synergy be created between IT and CT. Each benefits from and reinforces the other. There is no point in gathering and rapidly processing information that cannot be transmitted as fast. There is no point in high capacity channels if they cannot be used to full capacity. IT and CT started moving together, and we now talk about ***Information and Communication Technology, ICT.***

Maybe we need a new name for the modern computer, because it is really no longer just a computer. It is also a communication terminal that can be used as a telephone, a facsimile (fax) or a video communicator. It can be used as a typewriter, an entertainment center, a house help, a guard, and a spy. All in one box.

3. ICT IN EDUCATION

Let us now look at the first sector that will have a great impact on modernisation: education. Trying to modernise say agriculture in an uneducated society, or to modernise industry when there is a shortage of skills, is an uphill task doomed to failure. There are two issues to be considered under education:

- Access to quality instruction
- Methods of instruction

3.1 Access to Quality Instruction

Uganda has embarked on UPE, and will soon have to address Universal Secondary education. The greatest challenge here is lack of a sufficient number of competent teachers to ensure that students get maximum benefit from the universal education programmes. We must set up systems where we can do more with less. The logical approach is that we provide distance learning through whatever ICT facilities we have, so that even classes in remote and poor rural areas can benefit from quality teachers.

At the high end, we would have multi-media live multi-casting of lessons. At the medium level, the lessons would be pre-packaged as videotapes and distributed to schools. Apart from children, teachers, who would offer local mediation, would benefit from watching their more able colleagues in action. At the low end, lessons would be transmitted via FM stations, with the local teachers offering a greater level of mediation.

We must note that at a higher level (tertiary institutions and beyond) there can be similar benefit through sourcing of selected courses internationally or conducting web based courses jointly with external institutions,

3.2 Methods of Instruction

The buzzwords nowadays are *technology-enhanced interactive learning (TEIL)* and *edutainment*. The old pedagogical paradigm of the tutor/lecturer as a source of knowledge and students as recipients of this knowledge is outmoded. Students must now come to the center and take charge of their learning. The tutor/lecturer is now just a guide. Self-paced interactive learning must become the norm. Tutors/lecturers must get out of the old mind set, which is the biggest challenge, and learn the new approaches and techniques.

By making our educational content web based, we shall enable a larger number of students to get access to higher education. This will increase the impetus for modernisation. The tutors/ lecturers will also be freed from the inefficient methods of instruction, so that time spent interacting with students is focused on giving them guidance where they really need it.

Some of the initiatives in using ICT in the delivery of education in Uganda are given in Annex 2. Makerere University is however briefly mentioned here because the author has specific experience with it. The University has embarked on a project that will see all its graduates, regardless of discipline, come out ICT enabled within the next two years. All staff are also going to be trained so that they are able to produce web based courses. There will be an increasing level of web based interaction with students.

4. ICT IN AGRICULTURE

Agriculture remains the backbone of the Uganda economy, and government is right in making agricultural modernisation one of its main areas of focus. Cultivators, small farmers, and large farmers all need reliable and timely information on:

- Weather patterns, including short and long range weather forecasts that are a lot more specific than the meteorological department currently puts out.
- Market information. There should be predictions about price trends in the short and long term for our agricultural inputs and produce. There should be timely and accurate information about the best markets (local and international) for produce at any time.
- Extension services. There should be information about proper farming techniques as well as the best crops and crop varieties for different areas of Uganda. There should be information about diseases and other factors that adversely affect production, and the best way of handling them.

Through remote sensing and geographical information systems, combined with local expertise, we should be able to deliver timely information on rainfall patterns, both short and long range. Collection and dissemination of market information should be handled by both the Ministry of Agriculture, the Ministry of Tourism, Trade and Industry, and by Local Governments. Agricultural extension information is available in unbelievable quantities in Uganda from research institutes under or associated with NARO. What is needed is conversion of this rich content into a suitable form, and dissemination. All these are areas where the use of ICT would achieve a lot. We can again have a high end, relying on multimedia multi-casting, or a low end, with FM broadcasts and community radios.

There are already some initiatives in this direction in Uganda, and these are summarised in Annex 2.

5. ICT IN HEALTH DELIVERY

The ultimate objective of modernisation is not simply higher efficiency, returns, and more money in the bank, but improvement in the quality of life. This should be reflected through better nutrition, better health, lower infant mortality, and higher life expectancy. The delivery of health services plays a vital role in this.

Just like education where there is a shortage of teachers, we face an acute shortage of doctors and other health workers who can offer curative intervention, especially in the rural areas. Just like in agriculture, we need extension services in educating our population about diet and disease prevention as well as treatment. We need to demystify the use of drugs for common ailments like malaria, cough, etc. We need access to expertise not available in Uganda. We need to *do more with less* if we are to improve the wellbeing of our society in the face of limited resources. We need to use ICT as a lever in delivering health services.

Xrays could be transmitted via public or dedicated networks. Remote diagnosis and tele-consulting (from full multi-media to simple voice) are possible. CT scans can be examined by specialists based anywhere in the world. An expert surgeon can observe and guide an operation from a long distance. All this is being done elsewhere. All this can be done in Uganda.

Initiatives in the health sector in Uganda are also given in Annex 2.

6. ICT IN COMMERCE

One of the greatest challenges Uganda faces is adapting to the global e-commerce environment. Modernisation pre-supposes that we have trading partners. Modern trading requires that one can locate the goods that one desires, negotiate, close the deal, and pay - without leaving one's computer or multi-media phone. Our efforts in modernising will be wasted if the current trading gap is not addressed: Hardly any of our trading enterprises is on the web. The few that have web pages have set them up more for informational than transactional purposes. Our banking sector is not set up to handle even local e-commerce.

The world and all the goods therein, ranging from sugar to an aeroplane, is literally at one's finger-tips as soon as one logs onto the internet. Uganda is not in that world, and therefore Uganda cannot market its products.

We cannot exploit our tourist destinations. Yes, they are exploited by others who advertise them on the web, receive the bookings, and cream off most of the profits with just a few direct costs coming to Uganda - mainly hotel accommodation and meals.

When it comes to efficient internal and external trading, we do not need ICT simply as a lever to improve performance. ICT is the vital lifeline without which Uganda will stop existing on the world market - except as a small destination for some limited goods and services.

Initiatives in e-commerce are given in Annex 2.

7. ICT IN GOVERNMENT

The sustainability of development in the current environment requires good governance. Government must be democratic, transparent, accountable, and efficient. How does the government of Uganda measure up in terms of these criteria?

The People of Uganda made their clear statement about transparent and accountable governance through Article 41(1) of the Constitution:

"Every citizen has a right of access to information in the possession of the State or any other organ or agency of the State except where the release of the information is likely to prejudice the security or sovereignty of the State or interfere with the right to the privacy of another person"

Only Parliament can prescribe the information that can be interpreted as *" likely to prejudice the security or sovereignty of the State or interfere with the right to the privacy of another person"*

Having a right really means that government is obliged to provide access. Even without this requirement, we know that ***in the interest of efficiency and cost-effectiveness***, government should have easy, accurate and timely access to information that government possesses. All of us know how difficult it is for government to get access to information that government has. Ask any judge, minister, Permanent Secretary, or indeed the President. One of the continuing miracles in Uganda is that our public and private institutions do function at a**l**. This is especially true of government. For avoidance of placing the blame elsewhere, we must recognise that we gathered here are government.

Government has gone far in divesting itself of many roles, recognising the well stated fact that ***"The government of business is not the business of government"***. Government must now modernise itself if it is going to preside over modernisation. ***We cannot have a dinosaur presiding over a jet fleet.***

Government must set up an intra-governmental data network with on-line corporate data bases and integrated information systems. Such data-bases must be accessible, sooner than later, by the citizens of Uganda. Government must put citizens at the center of government by enabling their easy access to information as stated by the constitution and simplifying citizen-government transactions. Government must be run like a modern enterprise if it is to preside over modern enterprises and a modern economy. There is no way all this can be achieved cost-effectively without using ICT.

Like in other sectors, there are some isolated efforts in government (see Annex 2). However government is an enterprise. It can only be as efficient as its most inefficient arms. The little that has been done has hardly any impact.

8. THE INFRASTRUCTURE CHALLENGE

One of the biggest challenges we face in Uganda in using ICT as a tool for modernisation in Uganda is the limited permeation in infrastructure, especially in the rural area. This is being addressed through enabling regulation, through roll-out obligations for the national operators, and through the Rural Communications Development Fund (RCDF).

An application was made to the International Development Research Corporation (IDRC) of Canada for the funding of a base line, policy, and strategy study for the RCDF. This was conducted during the second half of 2000 at a cost of Canadian Dollars 192,000 from IDRC and Shs 50 million from UCC.

The cumulative levy from service providers is supposed to reach $5.88 million by 2003. The current estimate for various initiatives including public telephony access at each sub-county in the country (not covered by roll out obligations), and an internet point of presence at each district, is $7 million by the end of 2002. UCC is in the process of negotiating for additional funds that will help it to achieve this ambitious objective.

The strategy will most probably be based on minimum subsidy competitive bidding for set roll-out targets, targeted at areas that are clearly not viable in the short run. There would also be non-competitive small grants to schools, small private sector operators (tele-kiosks) and NGOs with good proposals. The final policy and strategy decisions will be taken by UCC during before June 2001.

One interesting finding from the study was that the rural population are willing to pay, and indeed do pay a mark up above normal rates for access in areas where one would consider commercial operation not viable. This was demonstrated by supplying a Euroset and an antenna to a businessman in a remote area and monitoring his income). By providing franchises to business people as an additional source of income, sustainable access can be provided to many areas.

The urban areas have fared comparatively well as shown by the data at Annex 1. By liberalising the sector, permitting independent regulation, and pulling government out of operations, government is rapidly realising its objective of sector growth through private capital. It can therefore be stated with some confidence that while the availability of infrastructure will be a bottleneck in using ICT as a tool for modernisation, it is a decreasing constraint that should not deter Uganda's progress for long.

9. CONCLUSION

There is increasing recognition in Uganda of the need to use ICT so that we can achieve more in modernisation with our limited resources. There are now many efforts through both public and private sector initiative in this direction. The challenge is for government to move to center stage in the utilisation of ICT in its modernisation plans. The greater challenge is to us as engineers, scientists, and administrators who are at the center of the decision making processes of government to ensure that this happens. We should not be afraid of moving slowly: we should only be afraid of not moving at all.

ANNEX 1
SECTOR INDICATORS SINCE 1996

Table 1 gives comparative figures in terms of service providers, customer base, and current service coverage since October 1996.

While it is clear that there has been a lot of growth in the sector, the totals have to be carefully interpreted. Many people who have fixed lines, for example, also have a line at home, and a mobile phone. Secondly, most of the services are concentrated in the urban centers. Thirdly, there are only 240,000 or so communication ports for more than 20 million Ugandans: less than 1% of the population can access telecommunication services at any time. Multiple usage, especially in public and private enterprises as well as government offices, does increase the actual number of people with access to telecommunications probably to million or so.

All the three cellular network operators are using GSM 900MHz technology. The 1800MHz band has just been opened up.

The cellular networks have been a boon to rural communications. As they attempt to cover the main road corridors and small towns, they have achieved signal availability to many rural areas so that the only hindrance to immediate communication is the availability of a hand set. It is evident that in the short to medium term, this will be the cheapest way of availing services to many rural areas without incurring direct infrastructure costs.

The synergy of the large number of private FM stations and the growth in telecommunication services availability in the democratisation process must be recognised. Live phone in radio programmes are very popular in Uganda and have increased the transparency and accountability of government to the public. Public officials, including cabinet ministers and the President, have had to respond to issues raised literally by anybody live on radio programmes.

TABLE 1

TELECOMMUNICATIONS SECTOR COMPARATIVE FIGURES FOR OCT 1998 AND FEB 2001

Comparative Summary of the Communication Services Sector, 1998 and 2001

	Service Provided	DEC 1996	OCT 1998	DEC 1999	FEB 2001
1	Wired telephone lines (UTL)	45,145	55,749	57,913	58,880
2	Fixed wireless lines (MTN)	Not Operational	447	148	932
3	Fixed wireless pay phones (MTN)	Not Operational	0	*200*	1650
4	Mobile cellular subscribers (MTN, Celtel, and UTL)	3,000 -Celtel	12,000 *Celtel: 8100 MTN: 3900*	72,602 *19,074 – Celtel 53,528 – MTN*	188,568 *MTN: 146,634 Celtel: 32,934: UTL: 10,000*
5	Internet/ email subscribers (dial-up)	500	1300	4150	4469
6	Internet/ email subscribers (wireless)	4	8	98	1229
7	National Telecommunications Operators	1	2	2	2
8	Mobile Cellular Operators (CelTel, MTN, UTL)	1	2	2	3
9	VSAT International Data Gateways (Includes UTL and MTN)	2	3	7	8
10	Internet Service Providers	2	7	9	11
11	Public Internet Access Providers (Cafes)	0	3	18	24
12	Public Payphone Licenses	1	7	12	18
13	Private FM Radio Stations	14	28	37	100
14	Private Television Stations	4	8	11	19

15	Private Radio Communication Licenses	453	530	688	770
16	National Postal Operator	1	1	1	1
17	Courier Service Providers	2	7	11	10

Table 2 shows the growth in internet access based on the available international data capacity. Gateway operators increase this according to demand Internet access so it is a fairly correct indicator. The table does not include UTL's planned capacity (1mbps) supposed to come on line any time.

TABLE 2
TOTAL DATA UPLINK AND DOWNLINK CAPACITY

	UPLINK	DOWNLINK
1998	256kbps	384kbps
1999	640kbps	768kbps
Feb 2000	1.2mbps	1.7mbps
Feb 2001	4.088mbps	5.216mbps

ANNEX 2
ICT INITIATIVES IN UGANDA

Education

SchoolNet Uganda Project

The World Bank project called "World Links for Development" provides internet connectivity and training for teachers, trainers, and students in developing countries. By linking schools in Africa to other schools around the world teachers and students can communicate, share resources, and exchange learning materials with ease, facilitating collaborative learning. In Uganda, this initiative is implemented through the SchoolNet project. Currently, VSATs are being installed in selected schools around the country to serve as pilots.

Leland Initiative

The USAID Leland Initiative is an effort to extend full Internet connectivity in the country in order to promote sustainable development in sector such as agriculture, education, and health. The strategic objectives of the Leland Initiative are to: promote policy reform so as to reduce barriers to open connectivity; to assist with full internet connectivity; and assist private sector ISPs to develop their industry; and enhance Internet use by the locals. The computer network currently being set up at Makerere University is part of this initiative.

Agriculture

Acacia Project

This Acacia sponsored project is aimed at setting up a multipurpose community telecentre to enhance rural development through information exchange in agriculture, health, education, weather, commerce, and culture. The aim of the project is to increase the access of the rural communities to information so as to facilitate their productivity, and improve on the standard of living of the locals. While these telecentres are a step in the right direction, they have been largely publicly funded, and have not reached levels of self-sustainability, in a large part due to absence of commercial motivation within their management structure. Telecentres that have been set up under the Acacia project include Nakaseke, and Buwama telecentre.

FoodNet

FoodNet is a USAID lead initiative dealing with agricultural research and development. The main focus is on market-oriented research and sales of value added agricultural products. Overall project goal is to strengthen regional capacity in value added, agro-enterprise technologies for increased income, improved nutrition and sustainable food security in Eastern and Central Africa. In Uganda FoodNet researches on, generates and distributes technologies which can facilitate increased and sustainable production of cassava and banana/plantain commensurate with national needs

Health

Mulago – Mengo Telemedicine Project

ITU's Telecommunications Development Bureau has spearheaded a Telemedicine Pilot Project between the University Teaching Hospital Mulago, and Mengo Hospital. Using telemedicine specialists in one hospital can assist relatively less experienced doctors at the other hospital in making diagnosis and administering treatment. Full benefits of this project have not been realised because of inadequate maintenance of the link between the two hospitals, and failure of heath worker in the two hospitals to shift paradigms and embrace this technology.

HealthNet

The HealthNet project employs satellite, telephone, and Internet technology to serve the heath communication and information needs for Uganda. The Project Mission is to improve heath by enhancing connectivity among professionals in the field via electronic communications and exchanges of information in the areas of public health, medicine, and the environment.

Commerce

Virtual Handicraft Exhibition

Electronic Commerce is a quick, easy, and cost effective method trading in a wide variety of commodities. It brings together demand and supply because of the easy access to information about the availability, price, and demand for commodities. Craftsmen in Uganda, Senegal, Botswana, and Zimbabwe are now marketing their products worldwide through the UN International Trade Centre's "Virtual Handicraft Exhibition". A general lack of awareness, and faith in the system has not allowed most Ugandan craftsmen to take advantage of the Virtual Handicraft Exhibition.

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