
Information and Communication Revolution – The MakNet

The MakNet – Making ICT Work for Makerere

Students are very good at coining slang and jargon that suits any situation and occasion. Therefore, it did not come as a surprise when the ICT revolution started spreading across the university campuses in Africa in the late 1970s and early 1980s, gaining momentum in the late 1990s, that students started referring to their professors as “digital” and “analogue” professors. As I discovered later, a digital professor meant one who could use a computer with ease and was able to surf the Net. An analogue professor could neither use a computer nor go online. As the ICT revolution started pervading almost every aspect of the university’s business, calling a professor worth his or her salt analogue was derogatory. It meant that you were archaic and if the students had a choice, they would shun you. It is interesting to note that although in the early beginnings of the new technology most of the staff at Makerere were still very much analogue. Makerere University has always kept abreast of the computer technology. The trend was set in the late 1960s when the university acquired its first mainframe computer, the ICL 1920A, which was housed in the Department of Mathematics. At the time, computing and the then emerging discipline of Computer Science were the preserve of mathematicians, engineers and physical scientists. Then, computing was about number crunching and complex mathematical calculations. To use a computer to solve a problem, you had to write your programme, a laborious exercise that required a good grasp of the programming languages in use at the time. FORTRAN was the programming language of choice for the mathematicians, scientists and engineers while COBAL was mainly for the world of finance. FORTRAN was a precise language with complex rules and grammar, which took time to master. Other languages such as PASCAL came later but

they were equally unfriendly to the ordinary user. You could say that at the time, computers were not as user-friendly as they are today.

For many years, the complex nature of computer programming had created the belief that only exceptionally gifted students could study Computer Science. Indeed, some of the best computer scientists to come out of Makerere in the early 1970s, students like Rotalo Mutooro and Joseph Kavulu, were some of the most brilliant mathematicians Makerere has ever produced. Both graduated with the best first class honours degrees in Mathematics before branching out into Computer Science. I am sure it was a disappointment to the university that after obtaining a PhD in Computer Science in the UK, Dr Mutooro chose to work with one of the big oil companies operating in the Middle East. In the same way, after graduation in 1972, Joseph Kavulu joined the Shell Oil Company where he stayed until he retired in the mid-1990s. They were expected to form the nucleus staff of a future Computer Science Department. Back then, we never imagined that someday in the near future, the computer would become user-friendly to everyone and would eventually replace the good old manual and electronic typewriter as an everyday office tool, and that the e-mail would make written communication as instantaneous as a phone call and take much of the mail business from the Post Office; that we would have unlimited access to an unimaginable volume of information posted on the Internet daily, read our favourite local dailies online wherever we are in the world, tune in to our favourite local FM radio station, even when we are in Antarctica, download our favourite music and do our shopping online; that even books and scholarly journals would be published in electronic form as e-journals and e-books and be accessible at the touch of a button; that one day we would be referring to books and other written documents as hard and soft copy, the printed one being the hard copy and the electronic form being the soft copy. The ICT revolution has taken the world by storm and in the process has turned it into one big global village. Even the names used to describe the technology have been changing as rapidly as the technology itself. Once known simply as Computer Science, the nomenclature changed to Information Technology (or IT for short). When the e-mail and the Internet became powerful tools of communication, the name changed again to Information and Communication Technology (or ICT). I am sure we have not yet seen the last of the new and fancy nomenclatures to describe this rapidly evolving and revolving technology.

Although I have no patent to my credit, perhaps because I quit Science rather prematurely, new ideas and doing things the innovative way always fascinate me. My first computing experience was in 1973, when one of our brilliant lecturers at Makerere – the Oxford-trained Peter Childs – introduced us to FOTRAN programming in our final undergraduate year at Makerere. However, because we were busy preparing for our final examinations, we never paid much attention to

what appeared to be a fascinating but mind-boggling subject. We went only as far as writing simple programmes, using those old one-box, one-character coding sheets. Those sheets were the hallmark of FORTRAN programming. From the coding sheets, the data was punched onto special cards. A technician normally did this for you. A deck of these holed punched cards contained the entire programme the computer was supposed to execute. Very big programmes were stored on rolls of magnetic tape. The computer had a special facility for reading the cards and tapes and translating the data into machine language. Next, the computer executed your programme to the end if it was error-free. Programme execution always ended wherever the computer detected an error. You would be lucky if your programme was executed to the end without a break. A break meant you had to go back to your coding sheets, find the error, correct it and punch a new card. In those days there no monitors, mouse, hard disks, USBs, etc. The computer printed the results as hard copy on large scrolls of green-ruled music paper. To a beginner, FORTRAN had its frustrations. The language had too many routines and sub-routines which required you to get every sequence right. However, once you mastered its grammar, programming became simple and enjoyable. Unlike today, in those early days, every computer user was also a programmer.

My second exposure to computer programming came in my second years as a PhD student at Queen's University, Belfast in 1975. If I remember correctly, the exercise was about writing small programmes in FORTRAN to calculate the frequencies of spectral lines in molecular infrared spectroscopy. Our programmes had to be very short, because they had to be run when the big users – the Engineering and Computer Science students were changing the magnetic tapes. Much as I found the exercise hard, I had to do it and get it right. This was also the beginning of linking computers together in a network, to enhance the computing power. The IBM mainframe at Queens was linked to the more powerful University of Manchester mainframe computer across the Irish Sea through a especially dedicated telephone line. Likewise, through an infrared link, the Faculty of Engineering in the Ashby Institute was also connected to the University Computer Centre, about half a mile away. Without realising it, I was actually witnessing the genesis of the Internet. It was that limited exposure that really stimulated my enduring love for computing and anything related to computers.

The invention of the silicon chip and the microprocessors that revolutionised the way we use the computers today was the beginning of the age of the personal computer and the laptop computer that has become part of our everyday working tool even when we are flying. The chip also paved the way for the information super highway, known today as the World Wide Web. Suddenly, the bulky and much less user-friendly mainframe computer, which required huge rooms and

good cooling systems, was giving way to the personal computer, which was a fraction in size. Microsoft's Disk Operating System (or DOS) eliminated the need for programming, except for the more sophisticated users. With DOS, all you had to do was to master the commands. Computers ceased to be the exclusive preserve of the experts and whiz kids. The introduction of the mouse simplified matters further. As they now say, the world had become a click away. Word processing was the last missing piece of the puzzle that made a personal computer everyone's tool. When the University Computer Centre, which in 1986 became the Institute of Computer Science, acquired the first two Apple microcomputers – Apple II C and Apple II E – in the early 1980s, through the UNDP/UNESCO Project, I happened to be one of the early users of the two computers. I even started teaching myself how to programme in the then new and much simpler BASIC language and to word process in WordStar, which was the popular word processing software at the time.

When the university sold its aging ICL mainframe in the 1980s the question was what was the best machine that would replace it? As expected a debate ensued. Some were for another ICL mainframe; others preferred the IBM mainframe, arguing that it was superior to the ICL. Later, as the technology advanced, the discussions shifted from a mainframe to two or more minicomputers, which had just appeared on the market. There was even talk of a super computer, but that was really a wishful thinking. Super computers, like the Cary, were not only very expensive, but also not freely available. In the end, the idea of another mainframe or mini computers was dropped altogether in preference for the much cheaper and convenient personal computers. The acquisition of the IBM XT and AT microcomputers through the UNDP/UNESCO Project in the late 1980s, and later the first much smaller Compaq computer, was the big turning point. We all realised that we did not need the bulky mainframes any more. With that small collection of personal computers, the Institute of Computer Science was able to start offering a Postgraduate Diploma in Computer Science course. Coincidentally at the time, Professor Kirya – the then Vice Chancellor – was also exploring ways of automating the Main Library and the University Administration. The Government of Uganda had successfully negotiated a loan from the African Development Bank (ADB) for Makerere University. Part of the loan was for computerising the university. Government even set aside some money as counterpart fund for the automation project. However, the sudden change of the Vice Chancellors, bureaucratic red tape and poor communication between Kampala and the ADB in Abidjan, stalled the project. The project was forgotten for a while until the early the early 1990s when the university received a grant from the IDRC of Canada and installed its first ever e-mail service under the domain name of Mukla. The server was located in the Institute of Computer Science and managed by a computer expert, Charles Musisi. The e-mail service was a novelty at Makerere. However, the absence of working telephone lines at

the time meant that the dial-up e-mail service was available to only a few offices in the university. Nevertheless, Mukla was a giant step in the evolution of ICT at Makerere. Unfortunately, the university never considered the sustainability of the service beyond the IDRC grant; so, when the grant came to an end, Mukla slowly wound up. The Medical School was next to have an e-mail service under the domain name Healthnet. It was another dial-up service, slow and intermittent, mainly because the available telephone lines were constantly clogged due to heavy traffic. What the university needed was a more reliable e-mail and Internet service.

When I took over as Vice Chancellor in 1993, I remembered Professor Kirya's shelved automation project, which I had strongly supported when I was still at the Faculty of Science. Professor Paul Mugambi of the Department of Mathematics was another of the strongest advocates for a university-wide computerisation initiative. But between 1987 and 1993, a lot had changed; so we had to re-design the project, taking cognizance of the new developments in ICT, the new needs and the lessons learnt from the past. Although I was fully committed to the automation project, there was one big problem we had not yet solved. As if to dampen our enthusiasm, it soon dawned on us that we did not have the money to implement this ambitious and expensive project. We were not talking of small money but billions of shillings that translated into millions of dollars. Although intimidated by the colossal sums of money I had to raise, I was not about to give up. I remember holding several meetings with Michael Kityo Galiwango of the Institute of Computer Science and Patrick Manghen of Mathematics Department, two of the computer experts the university had, to explore the best options for implementing the project as cheaply as possible. I roped in Kityo Galiwango because he had developed customised software for the Academic Registrar, which simplified the hitherto complex and tedious manual selection process that used to take the Admissions Board several weeks to complete. The software reduced the undergraduate admissions from weeks to just a couple of days.

These two colleagues provided me with invaluable technical advice. With their technical advice, we had found a way of building what we believed would be a relatively cheap but good university-wide computer network. One option was to use copper cables; the other was to piggyback the network on the existing telephone system, with all its attendant problems. We also discussed the best minicomputer makes on the market at the time, including brands like DEC. At the time, we thought the minicomputers were the best suited for such a large network. However, all this effort came to naught because of the delays in finalising some formalities before the African Development Bank could release the money. Once again, the project lay shelved. Moreover, in an unexpected way, President Bill Clinton and his wife Hilary visited Uganda in March 1998. They had a very tight programme in Uganda that included, as we have seen, Mrs Clinton's

public lecture at Makerere on March 25, 1998. During a short private session in my office, I presented Mrs Clinton with a list of the university's urgent needs in the hope that she would find a way of convincing her husband to do something for Makerere University, which had hosted her to a public lecture in Uganda. She told me that her husband was working on an initiative, named after the late African-American Texas Congressman – Leland – which was intended to assist Africa bridge the widening digital divide. Congressman Leland had died in an air crash in Ethiopia a few years earlier. She assured me that Uganda and Makerere University would be some of the beneficiaries of the new initiative.

Mrs Clinton delivered a powerful and moving speech at the Freedom Square. The lecture was attended by the former Vice-President of Uganda, Dr Specioza Wandia Kazibwe and her daughter Caroline, Mrs Janet Museveni and the former speaker of Uganda Parliament, the late James Wapakhabulo, among others. She acknowledged and applauded the efforts Uganda had made in such areas as economic development, human rights, gender equality, and the big strides women were making in Uganda, while condemning the atrocities and excesses of the likes of Idi Amin and Joseph Kony, the Lord's Resistance Army (LRA) leader. I enjoyed her lecture but, deep down, I was disappointed. Naively, I had expected to hear her say something in her speech about the university's needs which I had earlier presented to her; after all, without specifics I had no idea how Makerere University would benefit from the Leland initiative. Had I drawn a blank? Not so.

A few months after President and Mrs Clinton had left Uganda, I was pleasantly surprised to receive the Director of the USAID Mission in Uganda, Dr Dowson Libelli. Although she started by saying that her visit was a courtesy call to congratulate the Vice Chancellor and the university on successfully hosting Mrs Clinton, she had actually come to deliver some good news from President Clinton. The US Government had given Makerere University a grant of one million dollars, channelled through the USAID Mission to Uganda, to support ICT development, adding that the USAID had been mandated to implement the Makerere project under the Leland Initiative. I must admit that the announcement took me by surprise. Mrs Clinton had come and gone and her visit to Makerere was already becoming a distant memory. However, the grant provided the badly needed funds to kick-start the floundering ICT project. Finally, we were edging closer to becoming our own e-mail and Internet providers and automating the university. Although we were eagerly expecting the money, I soon learnt that the USAID policy was to keep all the project money in their account. Payments for the goods and services procured for the project were made directly to the suppliers. The USAID, through the Leland Initiative, would also recruit and pay the salaries of the key project staff.

As we began to roll out the project, I recall the many productive meetings I had with Barbara Keating of Computer Frontiers International (CFI). The

USAID had contracted her company to manage and implement the ICT project at Makerere. In 1998, CFI conducted a survey of the university's ICT needs. The first time she came to see me, she was in the company of Dr Frank Tusubira (or Tusu as he preferred to refer to himself). Dr Tusubira was one of the brilliant engineers and an Associate Professor in the Department of Electrical Engineering in the Faculty of Technology, who the Leland Initiative and CFI had identified to participate in the implementation of the ICT project. Indeed, Tusu had the right credentials for the job. He graduated from Makerere University in 1975 with a first class honours degree in Electrical Engineering. He also possessed an MSc and PhD in Telecommunications Engineering, both obtained from the University of Southampton in the UK. So he was not lost to Barbara Keating and her Leland Initiative colleagues, who were looking for the best Ugandan electrical engineer at Makerere to work with them on the project, right from the inception, and train local staff. Soon they assembled a team of brilliant young men and women, engineers and computer specialists, and it was this team that was behind the successful implementation of the first ever wireless ICT network at Makerere in collaboration with CFI, which became operational in April 2001, with Frank Tusubira as team leader.

As we began to plan for the implementation of the ICT project, one thing became abundantly clear. Since the project was first conceived during professor Kirya's time, the technology had dramatically changed and this necessitated changing the project design altogether. There would be no minicomputers and the university-wide area network would be a mix of wireless connection and dial-up as back up. We had also planned to connect directly to the satellite through a VSAT dish but, on the advice of the experts, the VSAT option was dropped in favour of going through a local Internet Service Provider (ISP). At the time, the South Africa-based Mobile Telephone Network (popularly known as MTN in Uganda) was one of the very few telecommunication companies in the country which had the capacity to provide that kind of link through its repeater mast located on Luby Hill, about five kilometres west of Makerere. Originally, the Institute of Computer Science had been designated as the Network Operating Centre (NOC). However, the NOC required a lot more space than the institute could provide. The Department of Physics happened to have the space and was ideally located for a direct aerial link to the MTN mast at Luby. But there was some urgent homework we had to do first. We had to negotiate with the Head of Department to allow us turn the late Professor Ilukor's microwave research laboratory into the NOC. The negotiations were concluded without difficulty. We now had adequate space for the servers and their racks, as well as work stations for the technical staff. In no time, all the wiring had been done and the equipment fully installed. We were ready to test. During the testing, everything worked flawlessly. Finally, the university could boast of non dial-up Internet connectivity. The bandwidth of about 190kb per second for the up and

down link, which Sida/SAREC paid for in the first few years, was more than adequate. A year later, it was no longer sufficient. Incidentally, shortly before Professor Senteza Kajubi stepped down in 1993, the university had set up an Internet web site, but managing and updating it was problematic as no specific person seemed to have been assigned the responsibility to do it, not to mention the fact that at the time, very few people at Makerere had access to computers with a connection to the Internet. In fact, those who were visiting our web site had started to complain about the stale and boring material posted on it.

With the new wide-area network up and running, we could now do something about the stale web site and also do other things that were not possible before. For example, for the first time, the university had its own domain name – @mak.ac.ug – and soon Dr Tusubira was assigning e-mail addresses on that domain. I had two addresses assigned to me, a private one that carried my name and the vc@mak.ac.ug for general use. In addition, the web site was re-designed and upgraded with a new address; www.makerere.ac.ug. At last, Makerere University had joined the cyberspace. Much as I could not hold back my excitement, I was fully aware that there was more hard work ahead. The champagne had to remain on the ice for a little longer. Although we had a Wide Area Network (WAN, for short) which I dubbed Makerere Net or MakNet, the faculties, departments, main building and other units of the university had no Local Area Networks (LAN). Worse still, few units had sufficient networked computers which could be connected to the WAN, so access to such services as e-mail and Internet were unavailable to the majority of users. We had to solve that problem first so that all units of the university could fully benefit from the new technology, with access to the Internet, the university's e-mail service and other ICT services. This meant buying more computers and increasing the number of telephone lines. The latter was an extremely expensive undertaking due to the high telephone bills. But that was the only way we could have access to the wireless backbone. Connecting the Main Library to the WAN also created its own problems. As the number of users of the Library ICT facilities dramatically increased, the effect translated into reduced Internet connectivity speed. People had suddenly discovered the enormous advantages of the Internet. The small bandwidth was getting clogged. Unfortunately, with the kind of money available at the time, we could not afford to buy bigger bandwidth, but the system was choking and threatening to grind to a halt.

After Sida/SAREC contribution came to an end, the Bursar was having a tough time raising the monthly fee of some US\$1,800 owed to MTN for the 190kbps band. I was learning fast that good things do not come cheap. I must confess that before we commissioned the wireless WAN in 2001, I had never heard of such jargon as bandwidth and bits per second before. Now, I was being asked to look for more money to pay for a bigger bandwidth. We had to raise the money and we had to devise ways of finding it. We constituted an ICT fund, with

subscriptions coming from the internally-generated income and, with the source of funding identified, we could afford to buy a bigger bandwidth. Shortly before I retired, we had upgraded it to almost 4Mbps.

Management Information Systems – ARIS, FINIS, HURIS and MakLIBIS

Way back in the 1980s when we began discussing how we could computerise and automate the Library services and University Central Administration, I am sure that apart from people such as Professor Mugambi, very few of us had a good grasp of what it really entailed. I even doubted whether we had answered the basic 3Ws and H questions; what did we want to automate, when, why and how? I guess at the time that we had no reason to be bogged down with such fine details. The project was consequently stalled. It was time to define what we wanted the system to do. Through my interactions with the more advanced institutions and management experts, I had come to learn of the Management Information Systems (MIS) and how they could dramatically improve the performance efficiency of an organisation. It occurred to me that this was what the university needed. However, a few questions were still unanswered. For instance, did we fully understand what the MIS concept was and how it could enhance our work? I only had a hazy idea. Nevertheless, it was an idea worth exploring in some depth. So, during the first meeting with the NORAD team in 1998, I made a presentation detailing what I thought were the university's priority needs. The shopping list was long, almost bordering on a wish list and I was worried that NORAD would reject most of it. However, that fear did not stop me from sneaking in the MIS project. It was a long shot, because at the time I had no idea whether NORAD would be willing to provide funds for such a project. The MIS project looked the odd ball among the many pressing and deserving university needs.

Fortunately, for us, NORAD recognised the importance of MIS in modern management and agreed to fund the MIS project as part of the Institutional Development Programme (IDP). Even after trimming down the budget, the consultant, Age Ronningen, had advised that the MIS project be retained, and it was among the final projects we submitted to the NORAD Board. In 2000, the NORAD Board approved a four-year NOK110 million grant to support the university's IDP, inclusive of the MIS project, which was funded under the component aimed at strengthening administrative computing in the IDP.

As we began to implement the IDP, it became clear that we were dealing with a multitude of ill-defined management information systems; so it had become necessary to define and differentiate between them. Acting on the advice of our experts, we zeroed in on four. One was inclusively devoted to academic affairs; we called it Academic Information System (or ARIS, for short). Another dealt with human resources; we decided to call that one Human Resource Information System (codenamed HURIS). The third had to do with finance management,

and it went by the name Finance Information System (or FINIS). The fourth was a library system we codenamed Makerere Library Information System (or MakLIBS). The Academic Registrar was responsible for the ARIS. HURIS was under the University Secretary. The University Bursar was in charge of FINIS and the University Librarian was responsible for the MakLIBS. While Kibirige Mayanja as Director of Planning and Development was responsible for implementing the entire IDP, the Vice Chancellor remained the overall head. Both of us had to make sure that the responsible officers implemented the four MIS as planned. At the time, we had underestimated the magnitude of the hard work that lay ahead before we could think of commissioning the four systems. Such complex systems require high-level expertise to design and implement. Each system had to be scoped and a detailed systems analysis done. Most of the university's manual operations had also to be re-engineered. Fortunately, in the IDP grant, NORAD had made a provision for the MIS. That meant we could hire a consultant for this purpose. The Technical University of Delft in the Netherlands, which had assisted us develop the ICT policy and the ICT master plan, was contracted to assist with the design of the four systems.

In the meantime, each information system put together an implementation committee, each with a chairperson and a team leader. For example, Sestina Ngobi was the chair of the ARIS Committee, assisted by Godfrey Bazannye Nkangi as team leader. The HURIS was chaired by Sam Byanagwa, with Mrs Stella Rwakooma as team leader. Ben Byambabazi, the University Bursar, was responsible for the FINIS, while James Mugasha, the University Librarian was responsible for the MakLIBS. The teams worked closely with the consultants on all aspects of their MIS projects. Some, such as the ARIS team, organised a study tour to the University of Dar es Salaam. In terms of ICT development, Dar es Salaam was ahead of Makerere. The team also visited some universities and Technikons in South Africa to learn from their best practices. Although all systems were important, I was more preoccupied with ARIS, and for a reason. We badly needed a system that would help us solve the long standing and embarrassing problem of those unnecessarily long delays students experienced in getting their academic transcripts. The problem had become a serious concern for the university as it was already denting its reputation. Every time you opened a newspaper, you were sure to read an article or a letter to the editor, written by a frustrated graduate who had not been able to secure his or her transcript months after completing all formalities. The transcript office had become a dirty word, a stick in the mud. Most students had come to perceive the Academic Transcript Unit as the most inefficient unit in the Academic Registrar's Department, and for good reasons. In the ARIS, I could see the long awaited solution to the transcript problem and I wanted this particular MIS to be developed and operationalised as quickly as possible.

The slow start notwithstanding, by June 2004 MakLIBIS was operational. As we have seen before, the Library was one of the units that quickly embraced the new technology so much such that Makerere was chosen as one of the eleven universities selected by the Association of African Universities to participate in the Database of African Theses and Dissertations (DATAD) project. Besides the NORAD's grant, the Library received additional funding from other sources for its MakLIBIS. One of the advantages the MakLIBIS offered to the users was the convenience with which the information could be retrieved from the Main Library. At a touch of a button you could find out whether the book you wanted to read was available without having to leave your desk. By the time I left the university, the other three systems were at various stages of development. My colleagues were working hard to ensure that their systems succeeded. However, this level of success would not have been possible without the assistance of other donors and the Government of Uganda. The NORAD grant alone could not have covered all the costs, including the MIS software.

Much as the MIS and other ICT related systems were being implemented at good speed, we needed more money and better management of the entire ICT project. I was pleasantly surprised to receive Dr Hannah Akuffo from Sida/SAREC on October 27, 2000. Dr Akuffo is a Swede of Ghanaian descent and a professor at the Karolinska Institute, a medical university on the outskirts of Stockholm. She was also a staff of Sida's research arm, SAREC. Her mission was to explore ways Sida/SAREC and Makerere University could cooperate in research and postgraduate training. Sida/SAREC had developed a strong interest in Lake Victoria and its basin and had begun supporting research programmes and studies related to the lake's environment. I was also aware that Makerere University staff was participating in some of the Sida-funded research projects on Lake Victoria. I therefore wanted the new support to be channelled to the university's other needy research areas which were either poorly funded or had no funding at all. At the time, I held the view that research on Lake Victoria was well funded. At the end of an interesting discussion over a cup of tea in the Guest House, we had figured out how we could do it within the overall framework of Lake Victoria's research, which was Sida/SAREC interest in East Africa.

Although at the time infrastructure was my top priority, Dr Akuffo made it clear to me that Sida/SAREC did not fund buildings. It was primarily a research funding agency. Although disappointed, I remembered that research was also limping, because it was chronically starved of funding. Therefore, Sida/SAREC support was more than welcome. We could now conduct some serious and meaningful research and train more postgraduate students. To get things going, I asked Professor John Opuda-Asibo, who was then Director of the School of Postgraduate Studies, to coordinate the Sida/SAREC programme and act as Dr Akuffo's counterpart and contact.

It was now becoming increasingly apparent to us that ICT was poised to play a big role in research. Besides the material available on the Internet, many journals were also available online as e-journals. The question was how Makerere University researchers and graduate students could access this vast resource without an appropriate ICT infrastructure. Sida/SAREC had the answer for us. First, the University Library received funding for the online journal subscriptions. Soon, the Library was subscribing to over 7,000 online journals. What this meant was that researchers could have access to the latest abstracts and full papers almost instantly. Secondly, Sida/SAREC agreed to provide additional funding towards the development of the ICT infrastructure. In fact, the Sida/SAREC support came in just when the USAID funding was about to run out and with it we were able to keep Dr Tusubira and his team on the project. Thirdly, we quickly realised that the level of computer literacy amongst staff, both academic and administrative – except a few in the scientific and technical fields – was too low and if we did not do something about it, the huge investment in the ICT infrastructure would have been wasted. The solution was to organise a massive end-user training programme, which Sida/SAREC funded with the Institute of Computer Science conducting the training.

The Directorate of ICT Support (DICTS) – Its Genesis and MakNet

Now that MakNet – based on a wireless backbone – was up and running, a policy and a good plan to manage this gigantic and complex enterprise was what was missing. The solution was to develop a proper ICT policy and master plan. Assured that Sida/SAREC was interested in funding such an initiative, we decided to organise a special workshop which was held at the International Conference Centre in April 2000. The objective of the conference was to solicit from the experts good ideas that would assist us formulate a realistic university ICT master plan. A consortium made up of the Technical University of Delft in the Netherlands, the University of Uppsala and the University of Dar es Salaam was assigned the task to craft the first ever Makerere University ICT master plan. Frank Tusubira took care of all the logistics to ensure a successful workshop. In spite of a few problems at his university, Professor Mathew Luhanga, the Vice Chancellor of the University of Dar es Salaam and an accomplished Professor of Telecommunications Engineering, attended the workshop in person and made an invaluable input.

Besides the ICT master plan, another key outcome from the workshop was a proposal to set up a separate unit to manage the network and every aspect of the ICT. The idea was the brainchild of Dr Fabian Nabugomu, who was then Head of Department of Mathematics. His idea received overwhelming support at the workshop and was passed. The University Council accepted most of the workshop's recommendations. Dr Nabugomu preferred to call it a directorate rather than a

department or centre. The Directorate of ICT Support (or DICTS as it is popularly known) was born and became operational in 2001, with Frank Tusubira as Acting Director. His technical NOC team constituted the initial DICTS staff. Besides managing the university's wide area network (WAN) and providing technical back-up, DICTS was mandated to advise the university on all aspects of ICT, including computer purchases, software licenses and general computer maintenance. Combining administration with the technical management of the university network added extra load to Frank Tusubira as Director, and he needed a helping hand. We believed that Mrs Norah Muliira, who had been acting as Director of the Institute of Computer Science was the right kind of person to deputise for Frank Tusubira, so we asked her to move to DICTS as acting Deputy. Later, a few additional technical staff were brought in to beef up the team and before long, DICTS had become a household name throughout the university. With all the extra new equipment that was coming in, including additional servers for the expanding network and all the staff crammed in one small room at the Physics Department, the place was becoming overcrowded and we had to find space quickly for both the NOC and the DICTS staff. We had agreed with NORAD that the basement of the new building for the Institute of Computer Science would house the university's ICT facilities. As soon as the building was completed in late 2002, the massive job of moving the network's operating centre from the Physics Department began and DICTS handled it successfully. At the same time, we thought it was time to separate DICTS as an administrative unit from MakNet's technical operations, now located in the well air-conditioned basement of the new ICS building. Earlier, we had made a decision to turn all the flats in the newly renovated Lincoln House into offices for academic programmes. We decided to allocate one of the flats to DICTS, which served as the offices for the Director, Deputy Director and all non-technical staff. The technical staff moved to the new ICS building. As I had expected, the Director of ICS was not amused having part of DICTS in his building, but that was a matter of university policy.

I had heard people say that ICT was an addictive technology and that once you got hooked on, you would never be able to do without a computer. For the first time, after commissioning the new ICT facility, I became acutely aware of what that statement really meant. Although when we started, a few of us had some rudimentary ideas about computers, several members of staff – including some very prominent senior administrators – had no idea at all. To them, learning to use a computer was like asking them to learn classical Greek. As each senior officer in the University Administration was allocated a computer to work with, I was amazed at the speed with which these colleagues of mine were picking up keyboard skills. After a few weeks of training, some were asking whether I had received the e-mail they had sent a few minutes earlier or telling me that they had spent a good part of the day surfing the Internet but the speed was very slow. This was re-assuring news. It was as if we had unleashed an unstoppable

revolution on the university. My impression was of people asking why someone had not told them the day before that a computer was as easy to use as chewing *matooke*, one of Ugandas most popular staple foods, and why it had taken so long to realise the enormous benefits the ICT offered, such as the e-mail for instant written communication. However, for the majority of staff with limited technical background overcoming the fear for the computer took a lot longer, but taking the first step meant that they were determined never to look back. While they dilly-dallied, I was growing impatient with some senior administrative staff who had continued to show little or no interest at all in the new technology; but Frank Tusbira in his optimistic way kept counselling me not to lose patience too soon, reassuring me that before long everyone would be on board, that it was a matter of time and persistence. He was dead right as the bug soon infected everyone. The pressure was now on me to provide enough computers, have them networked and linked to MakNet. That was the challenge, but a rewarding one.

With few users of the Internet at the beginning, the bandwidth we had was just about sufficient. You could access the Internet almost instantly at any time of the day and the telephone bills for the dial-up connections were still affordable. However, as more people discovered the wonders of the Internet and the convenience of the electronic mail, they started logging on in big numbers and soon the small bandwidth could no longer cope with the volume of users. The Internet became frustratingly slow and the wireless WAN was almost at choking point. The dial-up phone bill was also escalating. However, not to disappoint members of staff we had driven so hard to become digital, mainly through the End-User Training Programme, we needed to quickly find a good solution to the problem of inadequate bandwidth. This meant that we had to invest more in the system, which money we did not have at the time.

Fortunately, by 2000, the Government of Uganda had successfully negotiated a soft loan for Makerere University from the African Development Bank. About US\$100,000 of the loan was earmarked for ICT development. The solution was realised through a combination of the new WAN based on a high quality optical fibre backbone and the old wireless network. When the optical fibre network became fully operational, the wireless backbone became slightly redundant except for connecting to far centres like Mulago, the University Hospital and Kabanyolo.

Sam Byanagwa was the Deputy Secretary in charge of the Project Implementation Office. His office was directly responsible for the implementation of the all capital projects throughout the university. Way back in the late 1980s when the African Development Bank gave the Government firm indications that the second loan from the African Development Fund (ADF) would be approved, the Ministry of Finance started disbursing money to the university in small monthly instalments as counter-funds. The then University Secretary, Reverend David

Sentongo, deposited the money on a special university projects account. Even when the loan appeared to have fallen through, the counter funds amounting to some two hundred million or so remained on the university account. When the signal was finally given to build a fibre optics high speed, high data density WAN, we used the money Reverend Sentongo had saved on the counter-fund account to finance the civil works, which involved excavating trenches all over the university's main campus. The money from ADF II loan financed the rest.

By 2001 and after a lot of hard work under Frank Tusubira's watchful eye, a 15-kilometre optical fibre cable had been laid and the new wide-area network was ready for commissioning. Only Mulago, Nakawa, Kabanyolo campuses and the University Hospital were not yet connected. Later the cable was extended to 18 kilometres. Much as there was a lot to celebrate, we were not yet done. There was a lot more to do before we could get things really going. Under the old wireless WAN, most of the university departments were connected to the network's backbone through Post Office telephone lines. The optical fibre network would eliminate the telephone lines. It had several nodes located at different points throughout the university. Using what the experts called intelligent switches, each department or unit could get a connection to the WAN as long it had a local area network (LAN). But LANs did not come cheap. It was clear right from the beginning that we could not afford to finance all the LANs from the centre. The solution was to offload that responsibility to individual departments and units. We had to persuade Deans and Directors and even Heads of Departments to raise money to build the LANs. The process took time largely because not everybody had internalised the potential benefits of ICT fully. Even the Main Building, the seat of power, did not have a LAN. As for the Main Building, we sourced for funding and built a LAN covering most of what President Museveni had called the ancient building. But as the engineers found out, much as the Main Building was seen as an old building, it was as solid as a rock. Drilling through the walls was extremely hard work. The LAN was connected to a powerful server located in what used to be the Academic Registrar's examination strong room. Fortunately, most Faculties responded positively. Later we were able to connect Mulago and Kabanyolo, which had been out of reach in the initial stages. As we shall see later, when the Universities and Other Tertiary Institutions Act of 2001 came into force, the Business School at Nakawa ceased to be an integral part of Makerere University; so we did not extend the link there.

As we implemented the ICT initiative, I was convinced that the technology would not only lead to a more efficient University Administration through the use of the MIS, but also to significant improvements in teaching, learning and research. I saw the ICT initiative as a logical extension of other initiatives such as the Virtual University and e-Learning project, which Godfrey Bazannye of the Academic Registrar's Department was leading. Given the perpetual shortage

of textbooks and other learning material, the Internet offered both staff and students a unique opportunity to access an unprecedented wealth of information moreover much of it was free. It was an attractive prospect, but to get there, we had to overcome a few obstacles. Although the wireless network was accessible from virtually every corner of the university's main campus and anyone with a laptop with an antenna and an authorised password from DICTS could freely access the Internet through MakNet, at the time very few members of staff and students could afford a laptop. Therefore, for a long time this facility remained under-utilised. Secondly, few departments had enough networked computers. In spite of the presence a digital library in the Main Library where staff and students could access the Internet free of charge, the computers were still too few to satisfy the big demand. Thirdly, even with the more efficient optical fibre network, the bandwidth was still a big impediment to the high speed connectivity as it could hardly cope with the heavy traffic. The last major obstacle was our ability to sustain the new technology beyond donor funding.

By now the problem of access had been more or less solved. Through its first grant to the university from 2001 to 2004, Sida/SAREC had provided us with funds to set up a few Internet kiosks for the undergraduate students. The first to open was located in Senate House. However, the aim was to set up one in every faculty. When I visited the Senate House in 2003, I was fascinated to see the enthusiasm with which the students were using the Internet kiosks. Some of them were already on the keyboards, busy surfing the Net; others were in a queue, patiently waiting for their turn. I was happy to see them making full use of the new technology as I had predicted, but it was also a stark reminder that we had a long way to go before we could have enough computers to satisfy the surging demand. We had to provide more kiosks and more computers so students did not have to queue up for too long before they could get to a computer. The problem was no longer sustaining the ICT services only, the number of available computers had become an issue.

Engineer Tsubira's ideal ratio was one computer to every five students, but by 2003, we were still light years away from that magic number and we had to speed up the search for a durable solution. The fact that the clock had started ticking for me towards the exit made the search much more urgent. I did not want to bequeath to my successor anything he could find difficult to sustain. To tackle the problem of sustainability and adequate numbers of computers, we turned to university's private revenue. The quick answer was to set up an ICT fund.

Initially, it was hard to convince some of the Deans and Directors to give up their income for yet another fund. Already a significant proportion of their share of the internally-generated revenue was going to a multitude of initiatives like the Retirement Fund, Staff Development Fund, Maintenance Fund, Library Fund, Salary top-up and a host of others. Here we were, asking them to contribute to

yet another new fund. When would it end? In fact, one could have argued – and correctly so – that the university was overtaxing the Faculties, which made the bulk of the money. The unpalatable reality was that the university had very few sources of income to turn to. It had to bootstrap itself. Because the Government budget was grossly inadequate, the university was relying more and more on the goodwill of its donors. If we were to sustain initiatives like ICT, which served as a public good, we had to make more sacrifices. Fortunately, the majority of the Deans and Directors had realised the importance of ICT and agreed to make another sacrifice for the new ICT fund. But we were not about to let the Government off the hook, so we made it a point to include an ICT vote in the Government budget as well. With those two sources, I was convinced that we could somehow sustain the ICT services. We had done some good thinking. In its first year of launch, we realised close to a billion shillings, equivalent to some US\$ 600,000. That was not a bad start. Whether it was enough to cover all costs was another matter.

The size of the bandwidth remained a nagging problem for quite some time. As we have seen, the cost of even that small 192 kbps bandwidth was running into thousands of US dollars a month. In fact, it came as a rude shock to discover that the Internet users in Africa were paying far higher for the bandwidth than their counterparts in America and Europe. That was the reality we had to live with for as long as we wanted to be part of the digital world. When we began, the USAID and Leland Initiative-Sida/SAREC paid the bandwidth bill for us in full, but I was aware that someday their support would come to an end. I envisaged that day when we would have to foot all the ICT bills from our own resources. We had to square up to that reality.

For a start, we had to take over the salary bill of the DICTS staff as soon as both USAID and Sida/SAREC funding came to an end. Here, the ICT Fund would come in handy. Secondly, we had to do something quickly about the bandwidth which was slowing down everything. We could not justify to the Deans, Directors and other users why they should continue to pay for a poor service. As a temporary solution, we decided to ration the bandwidth and improve the way it was managed. Naturally, some users had started abusing the system, downloading music and pornography, among other things. Music and pictures take up a big chunk of the bandwidth, making it difficult for the bona fide users to access the sites they want to visit. DICTS was instructed to block most of the websites that were likely to lead to unproductive use of the small bandwidth. These measures brought about some improvements for a while, but they were not enough to convince the sceptics that the service was efficient. The solution was to increase the bandwidth, even if that meant paying more for it.

In 2002, the Director of DICTS came up with the idea of introducing some elements of competition amongst the major Internet Service Providers, namely MTN and the new Uganda Telecommunication Limited (UTL). According

to his analysis, UTL was more competitive. It was selling the bandwidth at a lower price than MTN, so we agreed to phase out MTN and switch to UTL. In addition, with UTL the signal would be coming from its recently installed mast on top of the Observatory Hill, which was closer to the university than the MTN mast at Lubyā. Interestingly, MTN had also erected a mast on the same site, but as I could recall the signal was still coming from Lubyā. My young son, Martin Mwanje, always reminded me that competition was good for the consumer. How right he was as I soon discovered. As soon as we indicated that we were about to phase them out, MTN told us that they were willing to consider revising their monthly rates. Makerere University had become one of the biggest bandwidth users in Uganda and no serious Internet Service Provider could afford to ignore it and, for that matter, MTN was not about to lose its piece of the pie to its competitors. As a compromise, we decided to access the bandwidth from both service providers. By 2002/2003, the combined bandwidth was a more comfortable 2.3Mbps. In 2004, it was increased to almost 4Mbps. At that time, the number of networked computers connected to MakNet had reached 1,300. About a year later, it had dramatically increased to over 3,000. At the same time, the university was accessing almost 8,000 e-journals. Although it was the kind of farewell I was looking forward to, I was acutely aware that given the growing demand, it was a matter of time before the bandwidth needed upgrading again.

The i-Labs – Makerere Links up with MIT

In the spring of 2003, the four American Foundations, namely the Carnegie Corporation of New York, the Ford Foundation, the MacArthur Foundation and the Rockefeller Foundation, which had come together to form the Partnership for Higher Education in Africa, organised a study tour to some of the most outstanding research institutions and top research universities on the east coast of USA for nine African Vice Chancellors. I happened to be one of them. The other eight came from Tanzania, Ghana and Nigeria. For the first time I had occasion to visit Columbia University in New York and the Massachusetts Institute of Technology (or MIT as it is famously known all over the world) in Cambridge, Boston. On our second day in New York, the Presidents of the four Foundations met us at the headquarters of the Carnegie Corporation of New York. The meeting was also attended by some of the trustees of the four Foundations. The President of the Carnegie Corporation, Dr Vartan Gregorian, asked Professor Narciso Matos, a former President of the Eduardo Mondlane University in Mozambique and former Secretary General of the Association of African Universities, to facilitate the discussion. I had known Professor Matos from his days at the AAU. When the Carnegie Corporation resumed support to Makerere University in 1997, he had been visiting the university regularly, so he was familiar with all the developments there.

The trustees of the Foundations wanted to know how they could assist our universities. At first, I took it as a rhetorical question; after all, four Foundations were already providing support to our institutions. Did they want to hear another litany of needs from us again? Nevertheless, as the discussion progressed, I realised it was a serious question. We discussed many areas where we thought new support could be channelled and which could make a real difference and a lasting impact. Then Professor Matos turned to me and asked me about Makerere and what I thought were my priority needs. Without hesitation, I singled out ICT as priority number one and in particular the size and cost of the bandwidth available to my university. I explained the high cost of the bandwidth was frustrating our efforts to introduce ICT in our struggling university. Unexpectedly, the idea generated a lot of interest. A trustee of the MacArthur Foundation and a former US Navy Admiral whose name I do not recall, pointed out that there were many satellites in the southern hemisphere which were virtually redundant. He advised that we should consider approaching the companies that owned them, individually or as a consortium, and negotiate with them for a bigger bandwidth to our institutions at a lower cost. After we had left the USA, the Foundations continued discussing the idea. Apparently they had taken a keen interest in the subject. I later learnt that shortly after I had retired, the Rockefeller Foundation provided funds to Makerere University which helped it to upgrade its bandwidth to an unprecedented 5Mbps. I was pleased to know that perhaps through my exuberant enthusiasm for ICT, my modest contribution during that meeting in New York had stimulated a wider and serious debate on the cost of bandwidth, and would eventually culminate in a commitment on the part of the Partnership for Higher Education in Africa to assist African universities access bigger bandwidth at a relatively low cost. This is a contribution which I am sure few people know about or can remember. As a Ugandan, I was pleased to meet and interact with Olara Otunnu. Otunnu was Uganda's Permanent Representative to the United Nations from 1980 to 1985 and served as Minister of Foreign Affairs from 1985 to 1986. Later, he was President of the International Peace Academy from 1990 to 1998, and he was an Under-Secretary-General of the United Nations and Special Representative for Children and Armed Conflict from 1997 to 2005. He was at the meeting as a trustee of the Carnegie Corporation, something I was not aware of before I met him. I was moved to hear him speak so well about Makerere, its problems and how it was struggling to overcome them. I had not seen him since that famous speech he made at Makerere before Idi Amin's Minister of Education, Barnabas Kili, way back in 1973.

The meetings in New York were followed by visits to a number of research institutions, including universities. It was a dream come true for me to visit Massachusetts Institute of Technology for the first time. I had always envied my classmate at Makerere, Peter Kwizera, who took his PhD in Physics there. During the day, we listened to presentation after presentation on the various aspects of this

great Institution from several officials, including one on the MIT Open Courseware and the rationale for putting their courses online. After the presentations, we visited the Department of Electrical Engineering and Computer Science where we met a young electrical professor going by an interesting Spanish name of Jesus del Alamo, who introduced us to a novel idea MIT had been experimenting with since 1998 – the Internet laboratories (or i-labs). He explained that through the information superhighway, MIT had made it possible for institutions outside the USA to conduct sophisticated experiments on its state-of-the art equipment in real time without coming to Boston. As an example, he mentioned a university in Sweden that was already participating in the initiative, adding that he had conceived the idea with Professor Steve Lerman of the Centre for Educational Initiative. To me, it sounded like what we know as remote control. It was so fascinating that we had to ask whether it would be possible for our institutions to participate. The young professor was quick to assure us that, as part of MIT policy of collaborating with institutions outside USA and sub-Saharan Africa, some of our universities would be part of the initiative. He promised to visit Makerere and Dar es Salaam on a technical fact-finding mission in the near future to assess the capacity of the various Science and Engineering Departments to participate in the initiative.

On return to Makerere, I reported to my colleagues the potential this new initiative offered to our university and, in particular, to the Faculties of Technology and Science. I also urged them to make full use of this innovative collaboration with MIT, made possible by the ICT revolution. True to his word, Professor del Alamo made his maiden visit to the Faculty of Technology in the latter part of 2004. With the help of Dr Frank Tusubira, we identified a young brilliant Electrical Engineering graduate, Albert Lumu, to coordinate the programme. I was amused when one morning Frank Tusubira called me on my cellular phone and told me that Jesus had come. At first I was puzzled, thinking that perhaps Frank Tusubira had suddenly become a *mulokole* – a born-again Christian – but later I remembered that Jesus is the first name of Professor del Alamo. In spite of the bandwidth problem that was still bedeviling us, his visit paved the way for Makerere University to participate in the MIT i-lab initiative. Makerere's participation in the initiative was made possible because of the generous Carnegie Corporation funding. Two other African universities, the University of Dar es Salaam, Tanzania and Obafemi Awolowo University, Nigeria also received funding from the same Corporation for the same purpose. As far as I know, this was also the first time Makerere was collaborating with MIT, a world class American Science and Engineering University.

No doubt, the competent team of young engineers and computer specialists in DICTS made a significant contribution to the successful implementation of the ICT project. I was grateful to Engineer Frank Tusubira and his brilliant team

for making it work. Good teamwork at all levels of the university and committed senior management was another critical factor. Without the support of senior management, we could have achieved very little. The willingness of the university community to embrace the technology was equally important but, above all, the financial support from the Government of Uganda and our development partners was the magic bullet which did the trick. For this, I will always be grateful to the Government of Uganda, NORAD, Sida/SAREC, USAID/Leland Initiative, the Rockefeller Foundation, the Carnegie Corporation of New York, NUFFIC of the Netherlands, as well as our consultants and contractors. The Ford Foundation made it possible for the Faculty of Social Sciences at Makerere to link up with Tufts University in Boston and the University of Dar es Salaam in the first ever joint programme of interactive online Political Science course, using the Blackboard Software. I also pay tribute to Professor Pearl Robinson of Tufts University, who had spent a year at Makerere in the late 1990s as a Ford Foundation fellow, for playing a critical role in this nascent initiative. The external technical experts and advisers, in particular the Technical University of the Delft team and Professor Wait of the University of Uppsala in Sweden, deserve a special mention. It is almost impossible to list everyone who contributed to Makerere's ICT initiative. As I started preparing for my exit, I kept telling my colleagues that ICT was all I wanted them to remember me for. The rest they could forget.

