Sida Evaluation 05/17

Sida Supported ICT Project at Makerere University in Uganda

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Department for Research Co-operation

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This is a large and multi-faceted project. There is no doubt that the evaluators have at times missed many details and there are unquestionably errors and omissions in this report. For these we take full responsibility.

Executive Summary

Background and Objectives: Sida's Department for Research Cooperation, SAREC, provides assistance for strengthening national research capacity in developing countries. Sida believes that a sound foundation in computers and access to the Internet has become essential to modern higher education and research. Experience has shown that to be successful, this technology infrastructure cannot exist solely for researchers, but must ultimately be integrated into the fabric of the university.

Makerere is a large, multi-disciplinary, research university in Kampala, Uganda. Since beginning to admit fee-paying students (in addition to government-funded students) in 1992, it has experienced phenomenal growth with student numbers increasing from less than 6,000 to 33,000 in a 12 year period. In the late 1990s, a decision was taken to aggressively integrate computer and network-based technologies into all of its functions and operational units. With support from Sida, a Policy and Master Plan was written and complementary support was solicited from several donors.

For its part, Sida decided to fund several major components of the overall project. The objectives of this contribution were to assist Makerere University in incorporating ICT in all its functions; to provide Internet connectivity to research groups supported by Sida long-term research co-operation; to build technical and managerial capacity in information technology at all levels; and to integrate ICT in the main library operations.

Project Details: To meet these objectives, the project included the following goals:

- Help create and support an administrative unit to oversee the implementation and support of the Master Plan – the Directorate for ICT Support (DICTS);
- Makerere-net – Replace the existing campus wireless network with a fast, fibre-based network, extend its coverage to additional buildings, build partial fibre-based networks at the Faculty of Medicine, Business School and Agricultural Research Institute campuses, and interconnect these four campuses;
- Install local area networks (LANs) in research units supported by Sida (note that other LANs were also installed in operational areas associated with other aspects of this project (such as DICTS and the Library);
- Build the e-mail, web and network support vehicles to allow staff and students to use the network;
- Train all users to ensure that they have the basic skills to use this infrastructure;
- Install an integrated library management system to allow creation of an online catalogue and the automation of all manual or non-integrated library tasks (acquisitions, cataloguing, circulation, etc.);
- Arrange for researchers and students to have electronic access to a wide range of research journals augmenting or replacing the previous poor access to print forms;
- Provide doctoral training for staff in DICTS and the Library.

Achievement of Goals: To a large extent the goals have been met, and in cases where they are not yet completed, plans have been adjusted to address the needs in the next project phases.

DICTS: The Directorate for ICT Support has been created and is functioning relatively well. The unit has been quite well accepted on campus, and their leadership role is appreciated. As is typical with this type of operation, they are somewhat short staffed (a combination of requiring specialized skills and lack of sufficient budget).

Makerere-net: The campus network was designed, installed and is functioning as per expectations. The actual connection to the Internet is funded by the university and not Sida. The connection speed has increased in recent years and months, and the per-unit cost of this bandwidth has dropped (in December 2004, the unit cost was reduced by a factor of four from $8000 per million bits per second (mbps) to $2000, while the total bandwidth increased from 3.75 to 22 mbps), but the unit cost is still 10–20 times that paid in developed countries. The current speed is much appreciated compared to the previous situation, but is still not considered adequate by users.

Research Local Area Networks: These networks were all installed and are operational, much to the delight of their users.

E-mail and web infrastructure: The core web services applications (e-mail, web servers, network infrastructure) are in place and operational. Most staff members and many students have access to Makerere e-mail addresses, although there is still heavy use of non-Makerere addresses (such as Yahoo). The Makerere web site is active, but still needs additional coverage, particularly at the faculty and department level.

End User Training: The original plan was to provide basic computer training for all academic staff, administrative staff and students within one year, and that the majority of the training would be computer-based (no instructor). This plan was overly ambitious and the target was not met. The training program was re-aligned to include classroom instruction. To date, about half of the staff have been trained. As of the 2004/5 academic year, all entering students must complete a basic ICT training course. Staff training is continuing, and is expected to take several more years to complete.

Library Automation: A library management system was selected, installed and is now online. The conversion of the card catalogue has taken longer than expected, and that project is ongoing. The other functionality of the system, including all of the internal library functions, is slowly being implemented.

Access to Electronic Journals: Prior to this project, only paper journals were available. Due to the price and delivery problems, their use was limited. The e-journal project has made nearly 8,000 journals in a wide range of disciplines available, and this has virtually revolutionized Makerere's ability to produce world-class research.

Doctoral Training: This aspect of the project was subject to many delays and has only recently gotten underway in a substantive way. The delays were largely due to the inability of Makerere to release staff from their regular duties. The ability to release staff is still an ongoing problem. For a number of reasons, it appears that these doctoral programs will not result in increased research capacity, but rather on sustaining and improving the level of ICT-based services at Makerere, thereby helping to protect the Sida investment there.

Non-Sida Projects: Sida is not the only participant in the overall ICT development of Makerere. Worthy of note is the Norwegian Agency for Development Cooperation (Norad) contribution which includes a new building housing the ICT academic unit and provision of the administrative software systems for Finance, Academic Records and Human Resources. These systems are somewhat behind the original (aggressive) schedule, but are due to be brought online in the very near future.

Summary of Project Results: Overall, all projects that involved the installation of physical infrastructure were carried out professionally and effectively. The effort and time required for projects which were less tangible tended to be underestimated with resultant delays in project completion.

Assessment of Impact of Project: The true measure of success of a project such as this is not whether the immediate goals were achieved, but whether the original objectives were met.

Strengthening Research Capacity: There is absolutely no doubt that research capacity has been enhanced. The network infrastructure coupled with reasonable journal access has allowed many researchers to more actively participate in world-class research. Publication is up, as is participation (both as attendee and speaker) at conferences. The effect has been much larger in those faculties where there was already some computer knowledge and infrastructure, but even the more deprived faculties are starting to change. Given the very short time since the new facilities were made available, the change is remarkable.

Human Resource Development: Over 50% of the university staff have been given basic computer training. In technology-intensive areas and the Library, there has been significant specialized training. With the help of the new ICT infrastructure, the Institute of Computer Science has significantly increased the number of degree and diploma students. The project itself has helped create a small group of people skilled at planning and implementing ICT infrastructures.

Effects on Higher Education and University Operations: Although access to computers is still quite limited, students report that they are regularly and effectively using the new technologies in their education. To a large extent, this is currently web-based material, but Makerere is quickly starting to use courseware and other teaching aids (such as e-laboratories) – much of this software and courseware originating at universities in the west. Although the new administrative systems are not yet in full production, various interim technologies have been implemented, and are beginning to affect how the university operates. As the new systems become available, the changes will increase rapidly.

Sustainability: Sustainability is a multi-faceted issue involving money, skills and moderation. The need for money and skills is obvious. Moderation is required, because growth that is too fast, or too ambitious may be impossible to sustain with sufficiently high quality. Although attention has already been focused on sustainability, it is one area which will require significant senior management attention.

Impact on Other Universities in Uganda, the Country, and East Africa: To date, there has been little impact on other universities. It is hoped that the experiences at Makerere will urge other universities to imitate some of the successes. The effect outside of the university sector and on the Government of Uganda has been far larger. Several ministries and the overall government itself have taken Makerere's experiment to heart and they are actively replicating it (in several cases with significant help from key players at Makerere). The long-term effect of this will likely be one of the larger benefits of the Sida-funded project. Impact outside of Uganda is minimal, but there is no question that the wealth of knowledge and experience being created at Makerere will ultimately create benefits scattered throughout the region.

The Challenges: Despite (and partially because of) the success so far, there are a number of challenges that Makerere will face in the next phase of its ICT development. These include:

- *Leadership:* It is clear that one of the reasons that Makerere has been so successful in its recent transitions is that there has been strong, passionate, cooperative leadership. It is essential that such strong leadership continue, but it is also important that the cooperative relationships are continued.
- *E-learning:* Integrating technology into the academic programs is the next major project. DICTS, the Faculties and the Library each have a role to play in this major change in how the university operates.
- *End User Training:* Progress has been made in ensuring that all potential users of the universities ICT facilities had adequate introductory training. The next challenge is to widen the scope of this training to support the wide range of skills and needs in the user community.
- *Computers, Space and Physical Security:* Makerere's target is to have 1 computer for every 5 undergraduates, and 1 computer for each graduate student. This is a good target, but the practicalities of how to pay for them, where to install them, how to pay for ongoing costs and how to employ sufficient

skilled staff to support them are all problematic. Alternative creative solutions are required which will provide students with adequate access to computers while not requiring the target numbers. Physical computer security is also a problem that requires imaginative solutions.

- *Viruses and Worms:* Viruses and worms are already a large problem at Makerere, and it is clear that without action, the problem will grow to crippling dimensions. Immediate action must be taken on several fronts to reduce the incidence and impact of viruses and worms.
- *Information Dissemination:* Makerere's ICT environment is relatively new, but already quite complex. To general users and to technologists within faculties and departments, it can be very confusing. Additional efforts must be made to communicate with users and support staff.

Summary: Makerere University has set its target at integrating ICT into all of its functions on a comparable level to similar institutions in the west. This is an admirable and reasonable long-term goal. The only danger is that in trying to do this too fast, it may sacrifice quality and sustainability. Keeping this potential pitfall in focus, they can achieve their long-term goal and be the example of how a developing country university can succeed in integrating ICT into its entire fabric.

1 Sida/SAREC Makerere University ICT Project

1.1 Background

One of the fundamental tasks of Sida's Department for Research Cooperation, SAREC[1], is to provide assistance for strengthening national research capacity in developing countries. Support to bilateral research cooperation between Uganda and Sweden dates back to the year 2000, and has been focused on Makerere University in Kampala. Current research cooperation includes faculty-based research programmes mainly in the Faculties of Medicine, Social Science, Technology and Agriculture. Sida believes that a sound foundation in computers and access to the Internet has become essential for modern higher education and research. Uganda is one of the first countries where Sida started supporting Information and Communications Technology (ICT) projects in a substantial way.

Makerere University, in Kampala, Uganda is a large, multi-disciplinary research university. Although a publicly-funded university, Makerere began admitting fee-paying students as well in 1992. By 2003, the student population had increased five-fold to 33,000. By the late 1990s, despite the phenomenal growth, most aspects of the university (including teaching, research, administration and libraries) were still paper oriented and manual-operation oriented. Makerere University decided to begin to use ICT in all its functions including administration, teaching and research.

A first step for Makerere University in 2000 was to develop an ICT Policy and Master Plan providing a coordinated framework for the development of ICT skills, infrastructure and systems. In order to implement the original Master Plan the University established a Directorate for ICT support (DICTS) to coordinate the ICT efforts. A number of donors elected to fund various parts of the plan (e.g. Sida, Norad, Nuffic, USAID, Carnegie, etc.). For its part, Sida provided ICT infrastructure, Library infrastructure and content, and PhD training for the agreement period 2001–2002, later extended to 2002–2004. Total support for the 2001–2004 period amounted to 35 MSEK (approximately US$4,500,000). Sida is now considering a further program covering 2005–2009.

1.2 Project Objectives

In 1999/2000, Makerere University began exploring ways to use ICT to support its various operations. Several donors expressed interest in supporting the university in this endeavour, but decided that a coordinated and planned effort was required. To this end, with support from Sida, a workshop involving all stakeholders was held in early 2000. Following this, also funded by Sida, a comprehensive Policy was established outlining how Makerere wanted to make use of ICT and integrate them into its operations. Along with the Policy, a Master Plan was developed detailing exactly what needed to be done. Moreover, the items in the plan were prioritized.

With Sida playing a leading role, various donors have supported most of the high-priority aspects of the Plan. The overall objective of Sida/SAREC's part of the Makerere ICT project was:

- To assist Makerere University in its endeavour to incorporate ICT in all its functions;
- To provide Internet connectivity to all those institutions where Sida supports long-term research cooperation;
- To build technical and managerial capacity in information technology at all levels;
- To strengthen IT-institutions at the university by promoting research in the field of IT if the required prerequisites exist;
- To integrate ICT in the main library operations.

[1] Throughout this report, the term "Sida" will be synonymous with "Sida/SAREC".

1.3 Project Description

Sida's components included the campus backbone network, building Local Area Networks (LANs), E-mail/intranet infrastructure, staff infrastructure (both administrative and technical), end-user training, electronic access to library resources and current research literature and strengthening of Library and ICT staff resources. All technical aspects of this project included specialized staff training which is implied but not explicitly mentioned in the following sections.

1.3.1 Information Resource Management Department

An essential component of the plan was to create an organizational unit to be responsible for overseeing the increasingly large and complex Makerere ICT infrastructure. This unit, the Directorate for Information and Communications Technology Support (DICTS), would provide professional-calibre services ensuring the appropriate design, procurement, ongoing management and maintenance of the central ICT infrastructure; a second-level help desk (serving technical support staff within other units); as well as providing coordination of the various decentralized aspects of ICT infrastructure.
The medium term goal was to develop on-site expertise to minimize the requirement for using external contractors for ongoing tasks.

1.3.2 Campus Backbone Network – Makerere-net

Prior to the start of the project, there was some limited inter-building connectivity on the main Makerere campus provided by the USAID Leland Initiative. The Sida project[2] entailed connecting most buildings on the main campus via fibre optic networks and building partial, fibre-based networks for the campuses used by the Makerere School of Medicine, Business School and the Agricultural Research Institute. Connectivity between the campuses was to be provided by wireless communications (later replaced by leased fibre-based facilities). The project included core resources necessary to monitor and manage a network of this scope.

External Internet connectivity was initially covered under the USAID/Leland Initiative (64 kilo bits-per-second (kbps) and then 128 kbps). Since 2001, external connectivity has been funded internally by Makerere[3].

1.3.3 Research Local Area Networks

To enable ready access to the backbone network, LANs were to be established for research groups with long-standing Sida/SAREC relationships (within the Faculties of Technology, Medicine, Agriculture and Social Sciences).

1.3.4 Electronic-Mail and Internet/Intranet Services (EMI)

This part of the project provided core networking services. These include e-mail, infrastructure allowing access to the Internet, a full Makerere University web site, a LAN interconnecting these core services and several student computer rooms. It also included provision of documentation for both end-users and technical support staff within faculties and departments.

[2] The term "the Sida project" and similar terms were used by many respondents at Makerere University and is used throughout this report. In all cases, this is a shorthand version for "the Sida-funded project" and should not in any way detract from Makerere's leadership in and ownership of the project.

[3] Sida funding did provide for the acquisition of a VSAT (VSAT=Very Small Aperture Terminal) satellite link for external Internet connectivity. When that proved not to be cost-effective due to falling wired bandwidth prices, Sida agreed that the funds could be used to pay for additional Internet capacity on a one-time basis. Current connectivity is now 15 million bits per second (mbps) into the campus, and 7 mbps out of campus. The total cost is nearly US$50,000 per month, still much above prices in Western Europe or North America.

1.3.5 End User Training (EUT)

It was understood that all of the planned infrastructure would have very little value if the academic and administrative staff as well as students did not have at least minimal skills to use the various services. The project included a very ambitious plan to train all academic staff (~1,000), all administrative staff (~1,250) and all students (~23,000) within the first year. With the exception of personal training of the senior executives, it was the intent to use Computer Based Training (CBT) for the bulk of all staff and students. As part of this project a dedicated training facility (60 workstations and LAN) was to be established.

1.3.6 Library ICT Integration

This aspect of the project included the selection and installation of an integrated Library Information System (LIBIS) including the conversion of the card catalogue to electronic format as well as the provision of workstations and associated LAN for staff and clients.

1.3.7 Access to Electronic Journals

Research journals are a problematic issue for all universities, and more so for those in developing countries. For a multi-disciplined university such as Makerere, there is a very large number of potentially relevant journals and they are expensive. Universities in developing countries have the added problem that paper mail systems are often slow and unreliable. The intent of this project component was to provide access to electronic versions of a wide range of research journals, providing researchers and students with current, relevant information.

1.3.8 Doctoral Training in DICTS and Library

This component of the project was to start "sandwich"[4] PhD programs for two members of the Library staff and several DICTS staff members

1.3.9 Non-Sida Components

From the beginning, the integration of ICT into the fabric of Makerere University has been viewed by the donors as a cooperative venture, and the contributions of the various donors have meshed well. Although many donors contributed to the overall success of the ICT upgrade at Makerere, the contributions of two donors must be highlighted:

- Carnegie Corporation – Support of the Library and computing infrastructure.
- The Norwegian Agency for Development Cooperation (Norad) has funded the three major administrative Information Systems for Finance, Academic Records and Human Resources as well as other administrative technologies. These projects both relied on and complemented the Sida projects.

2 Project Evaluation – Key Issues

2.1 Objectives

The evaluation will mainly address the following issues:

2.1.1 Effectiveness and Efficiency

Assess how effective the project has been in achieving its original goals. Assess the efficiency (that is, whether the cost was commensurate with the output). Where goals have not been met, or have not been achieved cost-effectively, identify the problems.

[4] A *sandwich* PhD program is one in which, typically, the student spends part of each year at the foreign university, and the rest of the year at their home university (still working on their studies).

2.1.2 Contribution to SAREC Programmes

Assess the contributions of this project to the basic objectives of the SAREC programme in Uganda, i.e., human resource development and strengthening of research capacity. The effects of Internet connectivity in particular should be assessed.

2.1.3 Contribution to Higher Education

Assess the contributions of this project to higher education at Makerere and in Uganda (over and above the research aspects discussed in 2.1.2.

2.1.4 Effects on Computer Literacy, Administrative Functioning & Library Services

Examine the overall effect of computerisation on computer literacy, administrative functioning and Library services at Makerere.

2.1.5 Sustainability

Analyze the issues surrounding the medium to long term sustainability of the investments made under the Sida and related programs. Address issues related to Internet connectivity, maintenance and equipment/software renewal and upgrading as well as the prospects for funding and income generation.

2.1.6 Impact on other Universities in Uganda

Assess the impact of the project on other universities in Uganda.

2.1.7 Impact on Uganda and on East Africa

Assess the impact of Sida's support of ICT at Makerere University on the country and the region.

2.1.8 Future Projects

Comment on future ICT future projects at Makerere including funding options.

2.2 Evaluation Process

2.2.1 Project Team

The review team consisted of two experts from Canada and The Netherlands. Between them they had 65 years experience with computing and communications technologies, 40 years experience with university research and technology environments, 45 years experience in administrative computing and 25 years experience working with developing countries. Moreover, the lead evaluator had prior experience evaluating Sida/SAREC projects, and the co-evaluator was involved in the very early stages of Makerere University's ICT policy development. Both of these experiences helped bring focus to the present study.

2.2.2 Document Review

The project team was provided with a large number of documents related to the project. These included original and revised proposals as well as annual reports and plans. They were also given access to documents related to prior related projects and those related to forthcoming project phases (2005–2009).

2.2.3 Interviews

The Evaluation Terms of Reference (Appendix 4) included a list of people to consider for interviews. This list formed the basis for the final interview subject list. In-person interviews were conducted with the majority of these people in Sweden and Uganda. In several cases, these were augmented with e-mail and telephone calls. In a number of cases, in-person interviews were not possible, and in such cases e-mail and telephone calls had to suffice.

A full list of all interviews can be found in Appendix 1.

3 Achievement of Desired Goals

This section addresses how well the original project targets (as described in section 1.3) were met.

There is no evidence that funds were used in ways that were not efficient and cost-effective. As such, the remainder of this section will address how well the various objectives were met.

3.1 Information Resource Management Department – DICTS

The creation of the Directorate for Information and Communications Technology Support was a crucial part of upgrading Makerere University's technology infrastructure. In general, it has been very successful. The programs that it oversees have been well received, and the group generally seems to have the respect of the university. Discussions with staff members indicated that they are up to date on technologies and issues in their particular domains. Comments from Faculties were generally positive, but there were a number of comments that warrant attention. In this regard, it is important to understand that DICTS is responsible for central systems (e.g. network, web and e-mail services, physically running library and administrative systems), but that faculties are currently on their own regarding the establishment and maintenance of their own facilities and working with their own users.

- Units with a long history of using technology (Faculty of Technology and ICS in particular) are reasonably self-sufficient. They need relatively little central support and had few complaints.
- Units with moderate experience (such as Medicine) felt that although the service was acceptable, there was a clear need for faster response and at times, more services available centrally.
- Units with relatively little history using technology not only wanted better and faster services from DICTS, but also wanted advanced training for their technical staff.

There is a plan, as yet not implemented, to transfer staff from the less self-sufficient units to DICTS (that is, the budget and official reporting would be moved to DICTS, the person would still reside in the unit, and would work based on the unit's priorities). This plan has several significant benefits.

- It makes it easier to cover vacations, absences and resignations.
- A centralized pool of (relatively scarce) experts is cost-effective. This means that each faculty support person need not be an expert in everything, but can call of specialized staff when the need arises.
- Centrally managed staff may better understand the broader context of the infrastructure and services than the one concentrating only on the LAN of a particular department. They also may better know and apply university rules, guidelines and policies.
- Regular and on-going professional training/upgrading can be better ensured.
- Better career opportunities – technical staff in a faculty typically have no other jobs within the unit to aspire to.

However, there are several potential problems that need to be considered:

- It is essential that the technical staff still *feel* and act as if they are employees of the faculty/unit.
- When additional staff is needed, who will need to find and justify the additional budget – will it be the faculty/unit, or DICTS (competing with other DICTS priorities)?
- For units that are reasonably self-sufficient and who will retain their own staff, it is essential that their technical staff also be offered training to ensure that they are able to support the changing university infrastructure.

Up to now DICTS' main focus has been on the implementation of systems and creation of the ongoing processes necessary to manage them. In the near future its focus will partially shift to permanent management/maintenance of ICT resources plus end-user support. It is DICTS' responsibility to assure sustainability, availability, reliability and security of all (common) ICT assets and services.

It would appear that in the minds of some users, there is confusion over the roles of DICTS and the Library. It is likely that there will be similar confusion over roles as the various administrative Information Systems are turned on. DICTS should ensure that it is made clear how the various players divide up the overall ICT tasks and responsibilities. Where applicable, each of the units should consider either detailed or general service level agreements.

There is a danger that with the success of their first phase projects, staff will be somewhat overconfident, leading to overambitious future plans with the resultant overextending of resources or missed deadlines and targets. This phenomenon is very common in the ICT sector and management needs to be pro-active to reduce the impact.

Lastly, there are clearly some tensions between the various units providing ICT-based services. Without going into detail or trying to assign causes or blame, it is important to emphasize that in an environment where resources are tight and where there is so much work to be accomplished, such tensions are at best counter-productive, and at worst, can lead to project failure.

3.2 Campus Backbone Network – Makerere-net

The planned campus network interconnecting buildings and campuses is installed and in production. By all reports, it is functioning as per expectations. The bandwidth of the inter-building links is sufficiently high as to not be a concern for years to come.

The network does not reach all buildings on the main campus or on the connected satellite campuses, and that is definitely a cause for dissatisfaction. To some extent, this is a measure of the overall benefits of the network. If it were not perceived as being valuable, there would be no need to have it available everywhere. It must be noted that even the proposed 2005–2009 network extensions will still leave some non-academic buildings unconnected, particularly on the remote campuses. The School of Medicine in particular made a point of highlighting the need to connect further buildings[5].

Although external Internet connectivity is not part of the Sida project, it is clearly a major aspect contributing to how well Makerere-net meets users' expectations and needs. All users agree that the recent bandwidth increase to 15/7 mbps (15 mbps into campus, and 7 mbps out) was a *major* improvement. But there are still reports that the link is congested at times, and some users still rely on private dial connections at such times[6].

The new Faculty of Computing and Information Technology (formally the Institute for Computer Science – ICS[7]) sees heavy congestion at busy times. Moreover, they have reported access problems during off-hours (they run 24 hours per day, but the central network services are not staffed on that basis). The evaluators were told that ICS is considering paying for a private Internet connection for the

[5] There are two problems which make the School of Medicine particularly problematic. First, like all such medical schools, it shares space with its teaching hospital, and many "academic" facilities are actually small enclaves within hospital buildings. Second, in a problem relatively unique to Makerere, many buildings on the Medical School site are scheduled for demolition in the near future, and therefore no one wants to "waste" money hooking them onto the campus network.

[6] Although there is indeed congestion on the Makerere Internet links, it is important to distinguish between a user's perception and the actual measurable congestion. It has been observed that using a relatively slow dial line is *perceived* as being faster than a shared higher-speed facility because the user *knows* what is affecting their private line, but feels a lack-of-control about what is affecting the shared line.

[7] To avoid confusion with prior documents on this project, the Faculty of Computing & Information Technology will be referred to as ICS for the remainder of this document.

Faculty (perhaps 2 mbps down) just to ensure that they have bandwidth available for the faculty during busy times, and to ensure availability during off hours. The evaluators do not recommend such a course of action, but it does reinforce how critical external bandwidth is[8].

3.3 Research Local Area Networks

The units that have benefited from the research LANs were extremely happy with the delivered product. The lack of widespread availability was the only issue raised, and this was quite expected given the relatively small number of LANs installed to date.

3.4 Electronic-Mail and Internet/Intranet Services (EMI)

E-mail is now being heavily used on the Makerere campus. During the course of the interviews, business cards were collected from many university staff members, and all of them included a *mak.ac.ug* e-mail address. Unfortunately, many also included a Yahoo address, which implies that either the users feel that the Makerere address may not be reliable (no such problems actually reported) or there is still some confusion on the part of staff regarding e-mail[9]. Regardless of the details, it indicates a need for more education (or service changes if there is indeed a problem). Student access to Makerere e-mail is more problematic, with many students not having access, and others choosing (for various reasons) to stay with other providers such as Yahoo. As with staff e-mail, this indicates a need to review education, communications and service levels.

Prior to the evaluation, it was discovered that one of the Makerere outgoing gateways was *blacklisted* because it had been identified as a potential source of spam in June 2004. As a result, mail from Makerere was being refused by some sites around the world. Once the problem was pointed out to DICTS staff, it was efficiently fixed (note that the potential spam problem had been fixed long ago, all that was needed was to take steps to eliminate the outdated blacklist).

The Makerere web site is functional, but there are many parts that are not complete, broken links[10], and niceties such as a staff search capability are missing (the latter will no doubt be easier to implement once the planned Human Resources system is online[11]). As the web site was reviewed, there were many faculties and departments with either no web presence, or a minimal presence. To balance this, there were some units with very complete web sites. Note that such problems are common everywhere on the web, but it is particularly serious at Makerere. As people start using the Internet, they will naturally start looking for answers to specific questions on the web. If they regularly do not find the information that they seek, they will simply stop looking. This is particularly true with respect to departments that are *viewed* as being ICT leaders such as DICTS, the Library and ICS.

[8] Although Makerere uses two independent connections to the Internet, if one of them fails, it currently requires manual action to switch the entire campus load onto the working link. Work is ongoing to make this process fully automatic. If ICS has funding to augment its Internet connectivity, such funding should be spent in conjunction with DICTS, addressing the ICS-specific needs in such a way that services are not needlessly replicated and so that the rest of Makerere can benefit as well.

[9] There are several reasons that people might publish multiple addresses: a) they feel that if one is good, two is better. Even if this is true, it would lead to correspondents either picking one of the addresses at random, or sending duplicate copies of each e-mail; b) They feel that the systems are less than 100% reliable, and so need a back-up – leading to the same problems as a); or c) they feel that the non-Makerere address is somehow more usable or acceptable off-campus.

[10] Although broken links can be time-consuming to fix, they can be easily identified with readily available software tools.

[11] Actually, there is a staff search capability accessible from the "Intranet" home page, but it includes only a small number of people – even in DICTS only two staff members are listed.

The last aspect of the EMI project was to set up a number of student computer access rooms – *kiosks*[12]. This has been accomplished. Despite the relatively tight quarters provided, these kiosks are heavily used and much appreciated by the students. The only major complaint was that there is so much demand that access time is often rationed.

3.5 End User Training (EUT)

The original plan was to train all academic and administrative staff as well as students in one year, using primarily Computer Based Training (CBT – no instructors). This plan was quite un-realistic, and the goals were of course not met. The plan was problematic for a number of reasons:

- CBT requires tailored material and students who are truly motivated to learn. Neither of these conditions were fully met;
- There was totally inadequate access to computers to allow such a massive amount of training;
- Even without the above problems, the time-frame was not realistic.

Early in the process, it was a realized that a pure CBT approach would not work, and that some classroom instruction would be needed. Although the CBT–self-study approach was not completely abandoned, this was not clear to many of the students who expressed the desire to augment in-class training with additional work while back at their own desks. ICS, the unit giving the training, said that this was possible but many students were seemingly not aware of it.

All of these problems notwithstanding, a majority of the staff has undergone training and feel comfortable with their basic computer skills. This training has been more successful with administrative staff than with academic staff. As well, one must note that the acceptance of the new technologies and training varies across Faculties. In some Faculties, such as Technology, the acceptance rate is nearly 100%. In others, it is well below 50%[13].

The plans for the 2005–2009 have been adjusted to make them far more realistic – indeed one hopes that the implementation will be somewhat more aggressive than the plan. For students, Makerere now requires that all first year students take a basic computer literacy course. This will ensure that in coming years, all students can use these tools for all aspects of their education.

Among those who have begun to use computers regularly, there is some demand for more advanced courses. Most often cited are more advanced courses in WORD, Excel and Access.

3.6 Library ICT Integration

With support from Uppsala University, the Library Information System (MakLIBIS) was selected and installed and is now operational. There were some delays in the process, but nothing particularly troublesome. Although the core monograph collection is badly in need of renewal, the Library also serves as the National Reference Library. In this capacity, it is a legal depository of all works published in Uganda, including government publications. It is also the depository of United Nations' publications and those of related bodies. The Library also houses a number of Ugandan and African collections. As such, having an online and up-to-date catalogue is quite important.

[12] To differentiate *Kiosks* from *Labs*, labs are managed by academic units and are often used at least partially for instruction. Kiosks are managed by DICTS and are not associated with specific academic applications. Kiosks do not tend to have printers, whereas Labs often do.

[13] Among those faculties interviewed, the perceived order of acceptance level from highest to lowest was ICS, Technology, Medicine, Agriculture and Social Sciences.

That being said, the retrospective conversion, which will ensure that all of the Library's holdings are included in the online catalogue, is behind schedule. The effort was under-budgeted, and most likely the effort required was also under-estimated. Both are commonly experienced phenomena.

Although the library now offers access to a large number of electronic journals (see next section), these journals are not directly linked into the online catalogue. This has been a common problem in other libraries (both in the developed and developing world), but nevertheless should be addressed.

The WWW could be considered a super-library with the various search engines being its online catalogue. Although some aspects of web use may be considered intuitive, how to use it efficiently and effectively (given local bandwidth constraints and the lack of content validation associated with most sites), is not obvious. The library currently offers short courses on how to use the electronic resources that they provide (such as e-journals), but users expressed an interest in having the Library offer courses in how to best use those resources available through the Internet (this has also been suggested by INASP – see next section).

3.7 Access to Electronic Journals

Access to current literature is a cornerstone of modern research. Without it, there is virtually no chance of competing in this world-wide endeavour. In conjunction with the International Network for Availability of Scientific Publications (INASP), this project currently provides full-text access to close to 8,000 journals. The improved access to journals has been an almost unqualified success. As will be detailed later in this report, the benefits of this one aspect of the Sida/SAREC project have been enormous.

The implementation of this type of project has potential pitfalls associated with it. Since it is clear that the total number of available journals will always be restricted[14], it is important that researchers be involved in the selection process. Although there were a few problems early in the process, the Library recovered well and it was generally agreed that they were pro-active in involving researchers and getting buy-in on the selection. There were, of course, people who did not participate when asked, but later complained about not having any input.

There are several aspects that warrant ongoing attention:

a) Despite the apparent success and benefits of the e-journal program, the Library reports that there are still would-be users who are not aware of it. Since one needs access to a computer as well as basic computer skills to use the e-journals, hopefully the continued installation of computers and networks, additional EUT and appropriate Library publicity will help address these gaps.

b) The access to journals is not limited to Makerere, but is for all Ugandan Universities, and in fact, for all of Ugandan public institutions. This access has been minimally used. The reasons are obvious: poor Internet access at other universities (the major target audience); minimal publicity (other university libraries may know about it, but not necessarily their clients). Given the medium to long term requirement to share the cost of the e-journals with other universities, it is essential that their usage increases.

c) There is an increased demand for access to many other journals. Unfortunately, this is not an easy request to satisfy, as there are publishers who will not negotiate advantageous rates for developing countries, and there are journals with such limited interest that negotiations or acquisition would have limited pay-back. Part of the problem is that not all researchers understand why their demands cannot be met (additional information explaining the process may be required). The Library has, however, addressed many of the specialized needs through a document delivery system. Although this does not provide the instant gratification that online-access does, it does allow researchers to get timely access to virtually all of the relevant literature in their fields.

d) To offset the ongoing pressure to add new e-journals, it is important to regularly verify that the currently available journals are being used sufficiently to justify their continued presence.

3.8 Doctoral Training in DICTS and Library

3.8.1 Appropriateness

Doctoral training within the Sida ICT project has been a rather controversial issue. The traditional Sida/SAREC motivation for PhD training has been for research capacity building. All but one of the current and planned Makerere Sida-funded PhD candidates are employees of DICTS or the Library, and formal university research and teaching are not planned outcomes of their doctoral studies. There have been several rationales put forward for funding this training regardless of the potential lack of increased research capacity. In abbreviated form, the rationales follow. After each rationale are the thoughts of the project evaluators (*in italics*).

a) (DICTS) Supporting ICT requires thought processes and conceptual skills that are most likely found in people with PhDs.

   Although formal education has many accepted benefits, experience has shown that there is unfortunately little correlation between formal graduate education and leadership in these disciplines.

b) (DICTS) Talented staff will not stay if they are not challenged and given opportunities to grow and experiment.

   The statement is correct, but there is no need to restrict such challenges and opportunities to those with doctorates. Moreover, it is desirable to give all levels of staff such challenges and opportunities.

c) (DICTS) It is expected that ultimately, staff will move back and forth between DICTS and academic units. As DICTS is a new department, some of its staff originally came from the Faculty of Technology or ICS. Current projections call for some of them to return within 3–4 years.

   This is a good goal. Experience at other institutions indicates that it is typically harder to achieve than expected.

d) (Library) It has been reported that local Library & Information science curriculums are still largely paper-oriented. As such, off-shore education is required to ensure that the Makerere Library continues to make the transition to electronic-based resources.

   This is reasonable, at least at the Master's level.

e) (DICTS & Library) Universities often only respect people with academic qualifications. In such a *collegial* environment, lack of respect often equates to being ignored or side-lined. ICT and Library staff are much more likely to be effective if they have the "proper" credentials.

   This statement is, perhaps unfortunately, very often true.

f) (DICTS & Library) The current culture in Uganda demands that people who aspire to senior government or educational positions have a doctorate. This becomes a circular argument, because people with talent feel that they must have a doctorate in order to succeed.

   This statement also appears to be quite accurate.

[14] To underscore the magnitude of the problem, Cornell University subscribes to 65,000 journals and periodicals.

Given the general acceptance of the last four items, one can make the following case:

- Sida has and will continue to make substantial investments in Makerere's ICT infrastructure;
- To protect these investments, Sida and the university should ensure that high-quality people are supporting this infrastructure on an ongoing basis.

Therefore, even though these doctorates (or MSc-level degrees) may not meet the traditional objective of research capacity building, it is reasonable that Sida support them[15]. However, it must also be noted that in the case of DICTS, due to the heavy project load, it has been exceptionally difficult to give its staff the time off work to pursue these higher degrees.

3.8.2 Implementation

Assuming that (as suggested in the previous section) it is appropriate for Sida to provide doctoral training for DICTS and Library staff, there are some concerns that particularly in DICTS, such training will be difficult to accomplish. Several things point to this conclusion – all are caused by the shortage of staff, the heavy DICTS workload, and the difficulty in releasing people from their work duties.

- There have been delays in beginning the PhD programs;
- The scheduling for a sandwich PhD is flexible, but normally the student is expected to spend from 4 to 6 months per year at the hosting university (Sweden or The Netherlands in this case). For the one student already enrolled, even 4 months has been difficult to achieve, with an estimated 6 weeks spent in The Netherlands in 2004.
- In a typical sandwich PhD situation, when the student is back in their home country, they are supposed to spend the bulk of their time focusing on their academic program, even though it is well known that many of them spend some time working with their old department. In the present case, when back in Uganda, the DICTS people are expected to perform their regular work duties while finding "private" time to work on studies. This is quite worrisome and it is strongly suggested that when a staff member is enrolled in a doctoral program, that they be given full leave from their regular jobs.

Note that these issues are well understood by both management and students at Makerere. But they feel that there is little option but to proceed as described above.

3.8.3 Current Progress

Currently there are two students registered in Computer Science doctoral programs in Sweden and The Netherlands, and two Library Science students enrolled in doctoral programs in Sweden. One of the Computer Science students just began the program.

Computer Science: The candidate is reported to be progressing reasonably, despite the scheduling problems (the fact that her thesis topic is closely associated with her duties at Makerere has helped significantly). She is expected to complete her program either on target (4 years) in 2007 or in 2008. Her advisor strongly recommends that she spend the last six months of her PhD studies in The Netherlands.

Library Science: Both candidates are reported to be progressing well and are expected to complete their programs on target (4 years) in 2008. Some continuity issues have been raised related to previously agreed-to procedures for the collaboration with the Swedish counterpart university.

[15] The evaluation team differed on this point. The co-evaluator felt that given the heavy project load, the shortage of staff and the minimal short-term value to DICTS, that doctoral training was not warranted at this time.

3.9 Swedish University Involvement

As with other Sida-funded university projects, there was a component of the project involving Swedish universities, in this cased focused on Uppsala University. This partnership was most evident early in the project and included two major components; library automation and technical staff training.
The collaboration between Uppsala and the Library was particularly strong and beneficial. Collaboration in the latter phases of the project was at a lower level, focussing mainly on periodic project reviews. This ability of Makerere to function independently has been acknowledged in the next phase proposals, with only minimal budget allocated to Swedish involvement.

3.10 Non-Sida Components

The Carnegie Corporations support played a significant role in transforming the Library from one based purely on paper and manual procedures to their far-more-advanced current situation. Moreover, the areas that they funded, such as the periodical document delivery system (see section 3.7-c) have meshed very well with the Sida-funded areas.

Norad has funded the three major administrative Information Systems: Finance (FINIS), Academic Records (ARIS), and Human Resources (HURIS). The systems are not yet in full production, but several comments can nonetheless be made.

- The systems depend heavily on the Sida-funded ICT infrastructure (network, support structure, End User Training). It would appear that all of these pre-requisites have been put in place or accomplished in a timely manner to allow for the implementation of the Norad systems.
- The student registration component of ARIS is already in full production. The rest of ARIS as well as FINIS and HURIS are scheduled for *formal commissioning* and presumably full production use on May 12, 2005.
- The original timelines for implementing the systems were far too ambitious and did not factor in the problems and delays that regularly occur in such implementations. The systems are all behind the planned schedule, but are not particularly late based on a more reasonable time-line. This conclusion was reached independently by both Norad and the present evaluation team.
- Similarly, the original plans for retrospective data conversion (that is, converting the old paper files to electronic format) were also far too ambitious and have since been radically curtailed. Data conversion is one of the areas where far more time has been taken than was originally predicted.
- The need to customize the systems was perhaps not fully understood or analyzed, and this has caused some additional delay.
- Based on the evidence presented, the systems will all be in production in the foreseeable future, and should meet expectations.
- Ultimately, these systems will have a major impact on all of the universities operations. As a small but important example, it will be possible to know how many students there are in each program, and whether they have paid their fees – things that are not accurately known at the moment.

Norad also funded the construction of the ICS building (also used for some DICTS infrastructure).

The Netherlands organization for international cooperation in higher education (Nuffic) has recently provided scholarships for six Computer Science PhD students.

4 Findings Regarding Other Evaluation Criteria

4.1 Contribution to SAREC Programmes

There is absolutely no doubt that the Sida ICT project has met two of its prime goals – strengthening research capacity and human resource development. Little quantitative data was available, but the anecdotal information is overwhelming and remarkably consistent.

4.1.1 Strengthening Research Capacity

The following comments were typical of those made to the evaluators:

- Before e-journals, it was difficult to just identify the *existence* of applicable literature. If one subscribed to a journal, each issue could take from 6 months to a year to arrive.
- Before the web and e-mail, it was difficult to know what conferences were scheduled. The announcements could come after the conference happened. Now we read about both regional and international conferences on the web, and it is common to submit papers and have them accepted.
- To arrange a collaborative project with Ugandan or East African researchers related to Lake Victoria, it now takes 1 week instead of 3 months.
- External examiners around the world can now use e-mail to receive papers and submit comments. Before it was nearly impossible, with a single evaluation often taking many months or a year (a major impediment to successful post-graduate work).
- People are now writing research grant proposals (examples: EU, Rockefeller). And they are winning!
- Collaborative research is starting in some disciplines where it was previously very rare. One Dean said that he was considering restricting collaborative work, because the extra administrative burden that it causes is becoming time-consuming (not likely to happen, but a measure of how much collaborative work there is). Collaborative work is a direct measure of the world-class calibre of the research. In some cases, the joint research projects with Swedish universities (associated with discipline-specific Sida/SAREC projects) were the first instances of collaboration, but now they are widespread and diverse.

However, it must be noted that the benefits are not uniform across the university. They are much larger in areas where the bulk of the staff are now computer literate and have ready access to networked-computers. If one looks at five key units: ICS; Faculty of Technology; Faculty of Medicine; Faculty of Agriculture and Faculty of Social Sciences, there is a progression from heavy integration of ICT to "just starting". In the latter units, it is not just ICT that must be accepted, but an acceptance of research itself. Comments such as the following were heard:

- The journals are now there, but *the reading culture had died and now needs to be revived*
- Publishing has not picked up as much as expected.
- The Dean is considering mandatory lunchtime seminars where staff would present their current research – as a method of ensuring that they *do* some research.

4.1.2 Human Resource Development

Human resource development can be considered from four different perspectives.

End Users: Makerere has made significant advances in End User Training. The majority of administrative staff have taken the courses and are beginning to use the new technologies. In most academic units from 50% to almost 100% of the academic staff are now trained, and the base number should increase to 75% in the coming year. Many students are now using computers and the Internet, and as of this current academic year, training is mandatory for all incoming students.

Technical Staff: In order to put all of the current projects in place, Makerere has needed skilled professional technicians within DICTS, the Library and all faculties. To a large extent, this requirement has been met, although there will always be a shortage of the best qualified people (as is the case everywhere in the world). There is no doubt that over the coming years, this pool of skills will be replicated and will spread throughout the community.

Formally Trained People: This is the group of people trained by ICS in its formal programs (not EUT). Currently there are over 4200[16] ICS students in its various programs, up from just 1000 students several years ago. By 2007, ICS predicts that this will rise to 6000 students, with 15%–20% of them being graduate students. Although clearly ICS has existed prior to the Sida project, it is difficult to imagine that this past and future growth could occur in the absence of the Sida investments.

ICS has noted that these goals are contingent on donor or internal university support in a number of areas:

- Adequate Internet bandwidth – the needs of ICS (as well as several other technology-intensive units on campus) exceed those of the typical user, and these requirements must be factored in when considering overall Internet bandwidth and the design of the campus network.
- Although the number of desktop and laptop computers currently meets ICS needs, these needs will grow as the number of students increase.
- There is a need for some specialized hardware, such as in the area of high-performance computing (the target is not supercomputing-class systems, but more than a typical desktop system can deliver).
- If ICS is to grow at the hoped-for rate, there will be a considerable need for more accredited academic staff[17].

Management and Planning Capacity: In order to successfully plan and implement a project of this magnitude, certain skills are required. Moreover, the process generates a number of documents and other work products. As will be documented in section 4.6, these skills and work products are already being used directly and indirectly in other sectors, and their impact seems to be quite large. Hopefully, the same effect will ultimately be felt in other higher education institutions as well.

4.2 Contribution to Higher Education

Technology is not a magic bullet to fix all problems in higher education, but it can augment and improve otherwise good education. Following are a few examples of how the new facilities at Makerere have augmented traditional teaching materials and methodologies.

- The net is a major teaching aid – supplementing texts which are costly, in short supply and often out of date.
- There are a large number of web-based courses available from reputable universities. As an example, over 900 courses from the Massachusetts Institute of Technology (MIT) are available for web-based learning (http://ocw.mit.edu/). The set of courses includes a wide range of disciplines from

[16] 2400 undergraduate, 430 postgraduate, 1400 diploma

[17] As per section 3.9, Nuffic has recently funded six PhD scholarships for ICS students.

Aeronautics to Writing (almost A–Z). This OpenCourseWare is freely available, and Makerere has mounted a local mirror copy[18] of the entire set of courses.

- Student body growth can partially be accommodated with larger classrooms (albeit a poor solution), but this cannot work at all with laboratories. Facilities such as MIT's I-Labs (online laboratories) can help relieve the pressure and deliver world-class instructional materials (I-Labs are now in trial and will be widely deployed with the help of MIT and Carnegie grants).
- Architecture students no longer use drawing tables – They do all of their work using CAD/CAM facilities. It should be noted that the CAM/CAD software, like some other specialized software packages, was donated by the suppliers. These donations were greatly facilitated by the existence of the Sida-funded infrastructure. Such donations help to leverage the Sida funds, increasing the effective value to Makerere.
- In specialized fields, Internet resources can be particularly useful. Medicine is perhaps the best example. Resources on the web are often used by today's medical practitioners, and it is essential that students have comparable access.

4.3 Effects on Computer Literacy, Administrative Functioning & Library Services

Although once can teach computer topics even if the student will never use them again, the real proof of computer literacy is when technology plays a regular part in a person's life. The examples in the previous sections have illustrated the extent to which technology has begun to infiltrate all aspects of academic life. The impact on administrative processes is not yet quite as large, but it will grow very quickly. As the evaluators conducted interviews throughout the university, it was clear that computers have arrived in many (or perhaps most) administrative offices. Once the new Information Systems are put in production, the impact will be felt throughout the university. However, even without them, there has been significant use of technology, even if in a non-integrated manner. Examples include:

- There is now often information flow around the university, offsetting the previously pervasive secrecy and control[19].
- Several years ago, it could easily take one year to obtain a transcript from Makerere. This clearly was a major problem. Simple computer-based solutions were use to address the problem. In a practical way, it did not address *all* transcript issues, but did allow the vast majority of requests to be satisfied in a timely manner.
- Time can often be saved by using e-mail – before, given the poor telephone system, the only way to contact someone was via paper or to walk over to their office, hoping they were there.
- The money previously put into books or paper journals can now often be re-focused on other areas.

As with research, the benefits are not uniform over the university:

- In some Faculties, virtually 100% of staff have access to and use e-mail and electronic resources. In others it is closer to 50%. In those areas with lower coverage, it should be noted that administrative staff have more readily accepted the new technology, which is important for the success of the coming administrative systems.

[18] A *mirror* copy is a full image of the MIT courses which resides on a computer on the Makerere network, so students can view all of the material without consuming valuable international bandwidth.

[19] This was not an evaluation perception, but rather a direct quote from a former university officer.

- In one faculty, the Dean is considering refusing to use non-email communications, but there is strong resistance[20].
- There is still a shortage of computers for all uses including administrative applications. Until all potential users have ready access, it will be a reason for uneven usage.

Library services primarily serve the research and learning activities of the university. As such, they have been addressed in the two previous sections. To summarize, the online catalogue is being used by library patrons, and will be increasingly used as more materials are catalogued. Clearly the availability of e-journals has been a radical change, widely used by many staff and students. The integrated library information system has and will increasingly change the mode of operation within the Library itself, since operations such as cataloguing, purchasing and borrowing are an integral part of MakLIBIS.

4.4 Sustainability

There are a number of different aspects of sustainability related to this project. Although not all sustainability issues relate purely to money, many of them do. Makerere has identified a number of funding sources which according to their tally, should suffice:

- For 2005/6, 2% of all student fees are explicitly devoted to ICT expenses. Beginning in 2007, the 2% will be replaced by a new Student Technology Fee (planned at US$30 per student per year).
- For 2005/6, the Government of Uganda is providing US$240k per year as part of the recent new tariff negotiations. This disappears in 2007, but will functionally be covered by the new Student Technology Fee.
- On an ongoing basis, the government is providing a subsidy to help support DICTS staff salaries.

These sources of revenue cover the predicted costs. It is the opinion of the evaluators that this is perhaps "too close for comfort", but the university and government have shown an understanding of the problem, and a willingness to address it.

4.4.1 Human Capacity

The current staffing situation is tight, but working. As described in section 3.8, DICTS is in the paradoxical situation of needing people with doctorates on staff, but cannot easily provide the staff with time off to obtain these doctorates. ICS and other training institutes are graduating large number of people with knowledge and skills (but little experience) which partially addresses the long-term need. Salaries offered are perhaps below those available in industry in Uganda, but coupled with the innovative environment at Makerere, they are likely sufficient to retain staff.

It is clear that human capacity is going to be an issue which needs constant monitoring. However, as with the money issues described in the previous section, the university seems to be aware of the issues and one can hope that they will take appropriate actions.

4.4.2 Internet Connectivity

Although the most recent set of negotiations resulted in the unit cost of Internet bandwidth dropping by a factor of 4, the current costs are still far above western European or North American prices[21]. The

[20] Note that such resistance is not unique to Makerere. Several years ago, a professor at McGill University in Montreal filed a grievance with the academic staff association, complaining that his department chair was insisting that he receive departmental notices via e-mail instead of paper. Upon further investigation, it was determined that he was a heavy and regular user of e-mail. He was complaining just because his management was trying to impose a new rule (and thus a new term of employment) that he felt was somehow unreasonable.

[21] MU currently uses 22 mbps at a total cost of nearly US$50k per month. In western markets, this would buy 10–20 times the bandwidth.

situation is looking up, however. There are currently two fibre-based networks being installed in East Africa – COMTEL and EASSy. Both are expected to be operational in the 2007 time-frame. Neither project is guaranteed to succeed nor to provide radically lower prices[22], but the prospects are good.

4.4.3 Hardware/Software Maintenance

Most of the software installed under the Sida and Norad projects requires ongoing maintenance contracts. The hardware (including network infrastructure) also requires either maintenance contracts, or a provision for repair costs. The current Makerere sustainability proposal includes an allocation for these costs. It is likely that these estimates are somewhat low in the long term.

The recently revised Policy and Master Plan calls for all new software to be Open Source[23]. This could have the effect of drastically lowering Makerere's capital and ongoing software costs. However, it could also impact reliability or increase demand for highly skilled staff. Each decision should be made on a business-case basis and not purely by dogma.

4.4.4 Hardware Renewal

The Makerere sustainability proposal has an allowance for replacing 300 computers per year. Assuming a seven-year lifetime for computers (Makerere's estimate), that allows for the ongoing renewal of just 2100 computers – well under the target number of student computers. However, there is also a commitment to ensure that each faculty allocate a percentage of its budget for ICT acquisitions during the *ramp-up* period, and presumably this allocation may be later applied to renewal as well.

The first phase of the Sida and Norad projects made a large investment in infrastructure hardware for the campus network and the servers running the administrative and library systems. These systems typically have a lifetime of about eight years, but often upgrades are required much earlier to address performance or additional functionality issues. No provision has been made for such upgrades or ultimate replacement. A substantial upgrade for redundancy is, however, included in the current Norad requests[24].

4.4.5 E-journals

To be sustainable, the e-journal costs must ultimately be borne by resources within Uganda. As the service is available to the other non-profit institutions within Uganda, it is reasonable that they contribute. However, at the moment, they make very little effective use of the e-journals. The problem is partly education, and partly access. If an inter-university network is established (see section 4.5), this could help increase usage and thus the potential for cost recovery.

4.4.6 Follow-on Projects

Sustainability does not just refer to the present projects, but the ability to continue on the path of using ICT as an effective tool for education and research. There will be more components over and above those in the 2001–2004 or 2004–2009 phases. The current (and hopefully next phase) success makes it far more likely that donors can be convinced to keep funding these new projects. Ultimately, the government of Uganda must also become a larger contributor to these projects, as they are valuable investments for its future.

4.4.7 Computers, Computers and More Computers

All of the aspects of integrating ICT into the fabric of Makerere assume that all staff and students have ready access to network-connected computers. The ongoing success, particularly as e-learning and other projects are implemented, will rely on easy and abundant access.

[22] Among other potential problems, the two projects are competing for almost the same market, and they are regional networks which need external linkups for world-wide connectivity (potentially at the mercy of the inter-connect supplier(s)).

[23] Open Source software is typically distributed at no cost or for a nominal fee. Maintenance is either similarly low cost, or may be a commercial fee-based service.

[24] Redundancy will allow these systems to continue to function after a hardware failure, while waiting for the supplier to repair or replace the failing component.

Given that only a small percentage of staff and students will have their own computers with good network connectivity, such access implies a number of things:

- The network and LANs are present virtually everywhere on the main campus and the remote campuses;
- Many more computers are purchased, supported and periodically replaced;
- Campus building space must be found for these computers.

This issue is a major one that must be addressed as more ICT-based projects are rolled out. It will be further discussed in section 5.5.

4.4.8 Income Generation

A number of income sources (and redirection) were identified in sections 4.4 and 4.4.4. Other than donors and the government of Uganda, there are only a few other options:

- The student technology fee is effectively an implied fee increase. There remains the (perhaps politically unpalatable) option of raising the general fees which have been fixed for quite some time.
- There is a small market selling services to the general community. ICS and DICTS already do this, with some income going back to the staff members who do the work, and some staying with the department. For example, DICTS is planning to use such income to partially fund student and staff central file storage. It is unlikely that this market will grow to become a *major* source of funds.
- Diploma and other service-type courses in ICS could become a reasonable revenue source if there are sufficient resources available to offer them without impacting undergraduate and graduate services.

4.4.9 Summary

Sustainability is a multi-dimensional problem. Current plans allow for the short term needs, but it is likely that a larger percentage of the Makerere budget and other resources will ultimately need to be devoted to this in the long term. The university needs to consciously and openly look at all aspects of the sustainability issue and to develop effective policies to ensure continued success.

4.5 Impact on other Universities in Uganda

The impact on other universities in Uganda has been minimal. The e-journals are available for use by all universities, but to date the usage has not been significant, largely due to the lack of adequate publicity aimed at researchers and to poor internet connectivity at most other universities.

Presumably, there will eventually be a "me too" effect with other universities trying to match Makerere's ICT services, but that day has not yet arrived.

It was reported that in the past, there was a feeling among senior administrators that Makerere should preserve its uniqueness and not take steps to encourage other universities to replicate its ICT successes. This appears to no longer be the case, and that Makerere may be pro-active in encouraging its sister universities to follow Makerere's lead.

In virtually all countries (developing and developed), some universities have taken the lead over others with respect to ICT. In many countries and regions, one of the *levelling factors* has been an inter-university network. An inter-university network serves several purposes:

- It allows all universities to share Internet access, usually lowering costs due to larger volumes, or at the very least, making the lower unit charges paid by the largest user available to all universities.

- Provide a base level of service to the smaller universities that is higher than they are likely to be able to afford if they were on their own.
- Internet access and internal networks are often a problematic issue. They make most sense when you have both – each alone is not particularly cost-effective. Providing the Internet access via an inter-university network, may increase the likelihood that smaller universities invest in (or obtain donor funds for) campus networks, LANs and computers.
- It allows governments and donors to provide specific services at one university (or other centre) and still have them accessible and usable from the rest. This allows for much greater economies of scale[25].
- Whether such a network is practical will depend partly on the cost on the communications links between the universities. Certainly for those schools in or near Kampala, it can be effective.

The idea of an inter-university network for Uganda is not new, but to date, interest has been very weak. Perhaps it is an idea whose time has come. The National Council for Higher Education[26] says they would support the concept of an inter-university network (but they are not a funding body, so such support does not imply funding).

4.6 Impact on Uganda and on East Africa

Outside of the university sector, the project at Makerere has already had a great effect within Uganda. The Policy and Master Plan, the organizational structure and the perceived benefits of the technology have been used as models for how to proceed within several government ministries, and indeed for the overall government ICT policy. This was openly and readily acknowledged by every Ministry and Agency that the evaluators visited. Typical comments included:

- Makerere has been a model for other organizations.
- The Sida Makerere project will have a positive impact in many areas.
- The public sector has learned a lot from Makerere, in particular, policy making, implementation, guidelines, organizational setup…
- The Makerere ICT development is seen as a most important intervention in higher education.
- Senior Makerere ICT staff have been involved in the development of a Policy & Master Plan for the Ministry. This plan can be seen as a model for other public organizations. It is the first sign of a "multiplier effect" generating far more benefit that than the original (Sida) investment.
- We take advantage of the seeds planted in Makerere.
- The success at Makerere has made it far easier to convince other donors to fund ICT.

The benefits throughout the region are less obvious, but with every ICT success in Uganda, the chances of similar effects elsewhere are increased. It is far easier to replicate a successful implementation elsewhere in East Africa than to invent it from scratch.

[25] As an example, perhaps the new Library Information System at Makerere could be used to catalogue the libraries at other universities. Note that this is not a recommendation, and perhaps this specific example makes little sense, but it is an example of how resources might be shared.

[26] The National Council for Higher Education is a statutory agency which (among other roles) advises the Minister of Education on higher education issues.

5 The Challenges Ahead

The following comments arose out of the many interviews and discussions during the evaluation. Some pertain directly to projects for which Sida funding has been requested. Others are not in the direct purview of Sida, but given their investment in ICT at Makerere, Sida has a vested interest in ensuring that all aspects of the project succeed.

5.1 Leadership

It was clear that that a major factor in Makerere's success in its adoption of ICT was the skill and personalities of key players and the collaborative way in which they worked. Without this leadership, the changes would not have come as easily or as quickly. This calibre of leadership must continue of Makerere is to have similar success in the next project phases. This is a twofold challenge.

- Management positions at universities are often somewhat transient, as people move from purely academic roles to senior management, and then back again. As management changes, it is important that the long term (but evolving) objectives and goals of the institution are supported.
- Strong leadership often implies strong personalities. It is important that all possible efforts are made to ensure that these strong personalities do not clash with one another but rather continue the collaboration between the various groups.

5.2 E-learning

The first phases of the ICT project have already shown that web-based materials (the web in general, and sources such as MIT's OpenCourseWare) will play a significant part in the education process. As Makerere embarks on its new e-learning project, this component will increase substantially.

It is clear that DICTS will have a prime role in building and supporting the infrastructure required for e-learning. It is equally clear that each faculty and indeed each instructor will be responsible for providing appropriate course material. It is not as clear what roles the Library will play in the overall process. Discussions with INASP indicate that they too would like to see the Library integrated into the overall e-learning design.

It is important that the Library be a participant in this process. Otherwise, they will be increasingly marginalized as more and more learning materials are in digital format.

5.3 Makerere-net

The proposal to Sida for 2005–2009 lists as one of the goals to implement Voice-over-IP (VoIP) to replace (or compensate for) the poor voice telephone system on campus.

It is clear that the basic network infrastructure is sufficiently capable[27] of handling this voice traffic, and it is an excellent, virtually free bonus resulting from the existence of the network.

Nevertheless, the plan is troublesome for the following reasons:

- When the original request to Sida was submitted in August 2004, the Makerere-net component included adding 6200 voice and data jacks over the 5 years.

[27] The term *sufficiently capable* is used because the current network design is not on par with what is recommended for business-quality telephone service in developed countries. However, it is likely to be more than acceptable in the Makerere environment – and far more affordable than any viable alternative.

- The latest revision shows 3600 jacks – the reduction at least partly due to constraints on the Sida-provided budget (there was also a small increase in unit-costs for some items).
- Some of the equipment that is included in the building structured cable facility is dedicated to VoIP (based on equipment lists and discussions with DICTS staff).
- There may be switch ports, wiring and network jacks installed for voice purposes. There are plans to try to use the regular desktop computer as a telephone (and thus not needing additional wiring or jacks), but there are potential problems with that alternative.

Given the overall need for computer and networking technology on campus, it does not seem reasonable to devote Sida funds to building a voice telephone network (as important as this may be in its own right).

It should also be noted that once the use of VoIP commences (whether Sida-funded or not), it will be a small and logical step to begin using the technology to place overseas telephone calls, avoiding the extremely high overseas charges levied by the telephone providers. This will place additional demand on the already-stressed external Internet connections. There is also the possibility that both ramping up VoIP service as well as ongoing support could draw staff resources away from core ICT requirements.

5.4 End-User Training

Makerere recognized from the very beginning that End User Training was critical to its success in integrating ICT into all aspects of its environment. Despite the early problems and the difficulty of training *everyone* immediately, the EUT program has been eminently successful.

However, it is now time to widen its scope. Several suggestions may be worth considering.

- Training should be offered at several levels. Examples of possible levels are:
  - Entry-level – no previous knowledge
  - Some computer exposure
  - Good skills, but need Makerere-specific training
- More advanced application training – possible applications include Word, Excel, Access
- Although wholly self-study training was ruled out at the start, it may be worthwhile re-visiting for targeted advanced training.

Although the current training reportedly includes self-study components which could be done either in the teaching lab or on the student's own computer, the latter option is not widely understood. If it is available, it should be publicized better. If it is not currently available, it should be considered. This option seems particularly attractive to academic staff who need more practice time than the formal class/lab allows.

In general, there needs to be more feedback in the EUT program. Perhaps surveys or satisfaction questionnaires should be considered.

Although the time is not right for it at the moment, in the future, consideration should be given to reorganizing End User Training along the lines outlined below. It may make sense as ICS is increasingly focused on higher education and as the campus needs for training become increasingly diverse.

- Create a new group responsible for coordinating EUT focusing on both staff and graduate student non-credit ICT training. The group could report within DICTS or Human Resources. All credit-courses would remain wholly with ICS.

- Actual training could be carried out by staff employed for the purpose, outsourced to ICS, or outsourced to local commercial training groups.

5.5 Computers and Space

Computers and the space to put them in is a **major** problem. Makerere's target is to have 1 computer for every 5 undergraduates and 1 computer for each graduate student. Based on projected use per student, this target is on par with those in developed countries and is certainly an admirably goal. That amounts to 6,000[28] student computers (over and above staff and administrative computers). By any measure, this is a large number. Certainly finding the space to securely house them all will be difficult. Even the cost of electricity is a daunting figure[29]. Moreover, the staff costs to keep them operational are also non-trivial.

In developed countries, most universities have accepted that this level of publicly accessible computers is not achievable. Fortunately, in their environments, many students have their own computers and the need for public machines is greatly reduced.

One must question whether it is really possible to have enough computers, given an environment where individual undergraduate students will rarely have their own machines?

One partial solution is to increase the hours of operation of labs and kiosks. To illustrate, if a kiosk with 30 computers is open from 0700–2200 instead of 0900–1800, it is equivalent to buying an additional 20 computers (and effective increase of 67%). This assumes that students will arrive early or stay late if the facilities are open. Based on discussions with students at Makerere and experience elsewhere, it is highly likely that the evening hours will be fully utilized, and that morning hours will be at least partly utilized. ICS has already instituted a 24 hour working day, so their experience can be used to model the impact of extending hours for faculty labs and DICTS kiosks.

This problem needs some "out-of-the-box thinking"[30].

5.6 Physical Security

Physical security is another growing problem. At the moment, all computers are protected by iron burglar-proof grilles. Typically, the room housing a computer will have such a grille outer door, or the door/hallway leading to a group of rooms will be similarly protected. In a few cases, a whole building is protected in this way. Although this is a relatively expensive and unwieldy solution to the security problem, the more traditional methods of locked doors[31] and computer tie-downs have not proved successful. It is clear that the cost of computers is sufficiently high that the university does not want to loose many computers to theft or malicious damage.

If computer facilities are kept open for longer hours, the problem is exacerbated, as there is an increasing chance that rooms could be left empty (and therefore prone to theft).

Although there may be some unique factors at Makerere, there is much experience elsewhere in protecting computer facilities, and perhaps one can draw on that to address this problem.

[28] Based on 25,000 undergraduates (excluding distance education) and 1,000 graduates.

[29] At a conservative 125 watts/computer, 10 hours/day, 250 days/year and 200 Ugandan shillings/kWh, this comes to about US$200,000 per year. This calculation excludes the non-trivial costs of air conditioning (acquisition, maintenance and electrical power),

[30] "Out-of-the-box thinking" implies creative brainstorming which sometimes leads to novel ideas and solutions.

[31] Most doors at Makerere are wooden panel doors which are easily broken. The locks are lever-style mortise locks that are also easily defeated.

5.7 Viruses and Worms

Viruses and worms are two related types of Malicious Software (sometimes called Malware). Both can have negative and very nasty effects on individual computers and on the Makerere network as a whole.

5.7.1 Viruses

Viruses and related malicious programs are already a significant problem at Makerere. The impact will grow unless explicit action is taken.

All e-mail arriving at the Makerere gateway is checked for viruses. Some people use other ISPs, but most of them also scan for viruses. The same cannot be said for the removable media that students (and others) use. Makerere does not currently provide any network accessible file space for students. As a result, the only way that student can save mail or other work is via floppy disk or other removable media (which could be virus infected). Most lab and kiosk machines do not have anti-virus software on them, so it is easy for these machines to be infected by an already-infected floppy disk. Once infected, it may not be obvious that it is, so the next student can put in their floppy, and it too is infected. One of the real problems in this type of scenario is that many viruses operate silently, so a student can infect a machine, and then walk away not knowing what just happened. It was reported that the most common reason for lab and kiosk machines being out of service was infections.

There are a number of ways to reduce this problem. They include:

- All machines on campus should have anti-virus software installed, with virus signatures updated regularly (at least once a week or oftener when new threats are discovered). The estimated cost should be well under US$10 per machine per year. The university has approved central funding for anti-virus software, but unfortunately, it will not be available until July 2007. It is recommended that interim funding (perhaps from Sida) be found to allow immediate installation of anti-virus software on all computers.
- To ensure that all future computer purchases are similarly protected, the university should consider a levy on each new computer purchased to cover the cost of life-time anti-virus protection.
- Until all machines run anti-virus software, each lab and kiosk should have one dedicated machine running anti-virus software, and it must be mandatory for students to check that all removable media is virus-free before using it in any other machine.

Makerere does have plans to provide limited file space for students, and that will be a significant help. But anti-virus software is still an absolute requirement.

Viruses today can easily destroy files on computers, send large volumes of spam, infect other computers at Makerere (even if their user practices *safe computing*) and can severely hurt network performance. Infected machines take time to repair, and for office machines, can impact user productivity. An infected machine that is not noticed can easily invade other machines on the Makerere network. The threat must be taken seriously.

Moreover, all EUT courses should ensure that users are well aware of the potential problems.

5.7.2 Worms

Unlike simple viruses that need to transported onto a computer (via e-mail or removable media), a worm can invade your machine without your knowledge and without any intervention on your part. They generally enter via programming or design errors in the operating system or applications. The worm is sent by any other infected computer that can "see" the target computer over the network. Makerere, like many developing country institutions is fortunate for an unlikely reason. Because of a

perceived or real shortage of Internet addresses[32], Makerere uses a network feature called *Network Address Translation* (NAT). With NAT the only machines on campus that have real Internet addresses are machines such as e-mail and web servers – those which need to be accessed from off-campus. The vast majority of other machines use a non-public address which can only be accessed from on-campus. Because of the way that NAT works, this does not inhibit what these machines can do – it only prevents computers from off-campus from talking to them without their permission. As a result, these machines cannot be infected with a worm from off-campus, protecting them from many of the ugly problems on the Internet. They can, of course, be infected by other machines on-campus[33].

It is likely that in the next few years, the Internet addresses used by Makerere could change (there are a number of good reasons to do this), and then all computers at Makerere would be visible worldwide. However, even without this change, as noted above, Makerere computers are still vulnerable from attack from other campus computers.

Anti-virus programs will notice some worms and stop them from entering. The only way to guard against others is to ensure that operating systems and application software is updated when the manufacturer issues a fix to a security problem. This typically happens once a month for products such as Microsoft Windows. The normal way to do this (for Windows) is to run *Windows Update* regularly. When it notices an urgent update, it downloads and installs it. Doing this on a regular basis is not hard, but for hundreds or thousands of machines, it can be tedious. It can also consume large amounts of Internet bandwidth. But there are techniques to automate the process and to use locally-resident updates.

5.8 Information Dissemination

Intranets and the internet are powerful tools for disseminating information. As noted, they can reduce secrecy and spread knowledge. They should be used more effectively by Makerere to ensure that all university ICT users (that is, everyone) know "what is going on". Several examples may help to illustrate:

- A plan should be drawn up listing all university buildings and indicating when they will be connected to the backbone network. If there are no current plans to connect, this should be stated, some mechanism should be given for getting a building attached (perhaps a measure of how much money is required).
- Since a common complaint is that Internet access is insufficient, the information about what the bandwidth is, how much it costs, and what is being done about increasing it should be readily available to all.
- As services are added or changed, a regular (web and/or e-mail list) newsletter should alert all users (or at least those who want to be alerted).
- As new Library services are added, there should be similar notices.
- Notices about Virus infection incidents on campus can help to alert and educate people about the problem.

In essence, the new technology should be used to ensure that all users feel that they are involved or at least informed about what is happening. This can go a long way to address user dissatisfaction and to address real operational problems.

[32] In some cases, the shortage is real, but in many cases, there is a fear that if you run out of addresses, you will not be able to get more, so the available addresses are effectively hoarded and kept unused, just in case you need them later.

[33] Worms are often sent from programs that are installed by a virus! So a virus infected machine in a kiosk or lab can send worms to other computers at Makerere.

6 Summary

Throughout the evaluation process, all participants (and particularly those from government ministries and agencies) were fully aware of the projects, and extremely grateful to Sida for the instrumental part that it has played in supporting the redevelopment of Makerere.

By all standards, the changes at Makerere University related to its use of ICT have been phenomenal. Although far from flawless, the various projects have been implemented in a timely manner, and have been accompanied by the pre-requisite organizational changes. Physical implementations (installation of networks, servers, computers) have been well done, while the efforts requited for personnel intensive tasks (major software integration, data conversion) were initially underestimated. The *social engineering* changes needed to get all staff and students to effectively use this new technology are more difficult. However, significant headway has been made and senior administration seems to appreciate that the job is far from complete.

Makerere University has set its target at integrating ICT into all of its functions on a comparable level to similar institutions in the west. This is an admirable and reasonable long-term goal. However, such a target requires a very robust human and technical infrastructure. There is a danger that in trying to do this too fast, quality and sustainability may be sacrificed. Keeping this potential pitfall in focus, Makerere can achieve its long-term goal and be the example of how a developing country university can succeed in integrating ICT into its entire fabric.

7 Recommendations

Following are all of the major recommendation from within this report along with references to the original source(s). They are ordered by original occurrence of the recommendation and not by priority. In addition, there are a number of other recommendations embedded throughout the report.

- DICTS should increase communications with their various constituencies (end users, faculties and departments, technical staff throughout the university). Communication must be both as an information source and for feedback and interaction. Stakeholder involvement has been a key factor of the success in the overall project, but it must be continued on a regular and ongoing basis. The respective ICT-related responsibilities of DICTS, the Library, and the owners of FINIS, ARIS and HURIS should be well defined and clearly communicated to the user community. (Sections 3.1, 5.8)
- The overall success of the first phases of ICT integration coupled with a constrained pool of skilled staff can easily lead to overextending resources and resultant failures or quality problems. Management must ensure that projects are only undertaken with adequate resource allocations. (Sections 3.1, 6)
- Tensions among ICT leadership can ultimately reduce their effectiveness and impact the university's ability move quickly with increased ICT integration. Senior management should be pro-active in addressing such problems. (Sections 3.1, 5.1)
- E-mail is a core service which should be readily accessible and have the full confidence if all university users. When and where it fails to meet this standard, concrete action must be taken. (Section 3.4)
- The scope of End User Training should be widened to address users at a variety of skill levels and additional tools to increase user effectiveness. (Sections 3.5, 5.4)

- The Library should offer seminars on how to efficiently and effectively use the web for research. (Section 3.6)
- Makerere staff that are given the opportunity to pursue sandwich PhD programs should be given leave from their regular employment duties to ensure that they adequately focus on their academic programs. (Section 3.8.2)
- Makerere should evaluate how access to computers will be addressed given the large need and the significant constraints in meeting this need in traditional ways. The security of these computer installations should be looked at the same time. (Sections 4.4.7, 5.5, 5.6)
- Senior management needs to take a pragmatic look at all aspects of sustainability to ensure continued ICT-related success. (Section 4.4.9)
- Books will always be important, but as knowledge and learning resources become increasingly computer-based (such as with the e-learning initiative), the Library needs to either be an active participant or to risk being obsoleted. (Section 5.2)
- VoIP telephony can be a beneficial and effective technology, but Makerere must ensure that it does not siphon funds or human resources from the core data technology infrastructure. (Section 5.3)
- Anti-virus software must be installed on *all* computers connected to the Makerere-net, and virus signatures must be automatically kept up to date on a regular basis. If internal funding is not available immediately, interim external funding should be sought. Policies and processes should be developed for routine, regular and preferably automatic updating of computer software. (Section 5.7)

Appendix 1: List of Interview Subjects

Makerere University

Directorate for ICT Support – DICTS

Dr. F. F. Tusubira, Director

Mrs. Nora, K. Mulira, Deputy Director & Coordinator – Information Systems; PhD student

Apolo Kyeyune, Planning/Maintenance Manager

Joseph Kimaili, Network Manager

David Kiwana, Systems Manager

Gabriel Komakech, Database Administrator

Office of the Vice Chancellor

Prof. Livingstone S. Luboobi, Vice-Chancellor

Martha Loy Muwanguzi, Senior Administrative Assistant, International Affairs, Office of the Vice Chancellor

Prof. P. J. M. Ssebuwufu, Former Vice Chancelor

Institute of Computer Science (now Faculty of Computing & Information Technology)

Dr. Venansius Baryamureeba, Director

Faculty of Technology

Arch. Dr. Barnabas Nawangwe, Dean

Mackay Okure, Associate Professor

Albert Lumu, Systems Administrator

Faculty of Medicine

Nelson Sewankambo, Dean

Dr. Edison Arwanire Mworozi, Consultant Pediatrician, Mulago Hospital

Dr. Patrick Okello, Project Director, Uganda Health Information Network (UHIN)

Project Director, Uganda Chartered Healthnet

Mr. Fred Kakaire, IT Professional; Acting Chief Executive Officer of Uganda Chartered Healthnet

Faculty of Social Sciences

Dr. Edward K. Kirumira, Dean

Vincent Lubega, Systems Administrator

Faculty of Agriculture

Dr. Margaret Nabasirye, Deputy Dean (Research)

Prof. E. N. Sabiiti, Former Dean

Dr. W. Kyamuhangire, Faculty of Agriculture

Fred Edward Businge, Systems Administrator

University Library

Dr. Maria G. N. Musoke, University Librarian

Mrs. Beatrice Sekabembe, E-resources National Coordinator

Ms. Miriam Kakai, Deputy E-resources National Coordinator

Mr. Elly Gamukama, Head, ICT Section, MakLibis Project Manager

Mrs. L. State, Assistant Project Manager (Cataloguing)

Mrs. Prisca Tibenderana, Deputy University Librarian

James Mugasha, Former University Librarian

Planning and Development Department

Muhammad Kibirige Mayanja, Director

Graduate School

Prof. Opuda-Asibo, Former Director

Prof. Yusto Kaahwa, Ag. Director

Administrative Units

Mr. Godfrey Bazannye – ARIS

Mr. Paul Teefe – Finis

Mr. Tom Mukasa – Huris

Students

Bruce Kakimpa, Student (3rd year), Faculty of Technology

Robert Mugambwa, Student (3rd year), Faculty of Forestry

Brenda Kalebbo, Student (3rd year), Institute of Statistics and Applied Economics

Government of Uganda and Related Agencies

Uganda Communications Commission

Hodge Semakula, Commission Secretary

Patric Mwesigwa, Technical Manager

Simon Bugaba, Assistant Technical Manager, Licensing & Standards

Irene Kaggwa-Sewankanbo, Technical Officer, Licensing & Standards

Uganda National Council for Science and Technology

Dr. Peter Ndemere, Assistant Executive Secretary,

Ismail Nabil Barugahara, Assisant Executive Secretary, Policy, Planning and Evaluation

Ministry of Works, Housing and Communications

Dr. Godfrey Kibuuki, Commissioner for Communications,

Dr. David Turahi, Assistant Commissioner for Communications

Ministry of Education & Sports

Elizabeth K. M. Gabona, Acting Commissioner, Higher Education

Mr. Athmani Bilali, Senior Education Officer for Universities and Polytechnics

Jolly Uzamukunda, Principal Education Officer, Higher Education Department, Admissions & Scholarships Division

Ministry of Foreign Affairs

David Etuket, Ambassador, Director Regional Co-operation

Julius Peter Torach, Senior Information Scientist

Ministry of Finance, Planning and Economic Development

Dr. Ham-Mukasa Mulira, Executive Director, Uganda Computer Services, EFMPII/World bank Project

National Council for Higher Education, Ministry of Education & Sports

Dr. A. B. K. Kasozi, Executive Director

Birungi Phenny, Assistant Executive Director

Embassy of Sweden, Kampala, Uganda

Mrs. Gloria Kempaka Mugambe, Economist

Mrs. Anneli Hildeman, Economist

Royal Norwegian Embassy, Kamlapa, Uganda

Lisbeth Skuland, Second Secretary, Political Affairs

Sida

Hannah Akuffo, SAREC, Deputy Head of Division for University Support (UNI); Country Co-ordinator, Uganda

Tomas Kjellqvist, SAREC, Head of Division for University Support (UNI)

Per-Einar Tröften, ICT for Development Secretariat, ICT Advisor

Afzal Sher, formerly ICT for Development Secretariat, ICT Advisor, currently Director, Swedish Program for ICT in Developing Regions (SPIDER)

INASP

Carol Priestley, Director

University College of Borås, The Swedish School of Library and Information Science (SSLIS)

Lars Seldén, Professor, PhD Advisor

Joacim Hansson, Professor, PhD Advisor

Technical University of Delft

Henk Sol, Professor, PhD Advisor

Appendix 2: PhD Students Progress Report Summary

Name	Makerere Affiliation	Study University	Supervisor	Research Title	Start of program	Projected PhD Completion
Ruth Nalumaga	Library	University College of Borås (PhD degree conferred by Göteborg University)	Lars Seldén	Information Literacy in Legislation: A study of Uganda Women Parliamentarians	2004	2008
Jane Kawalya	Library	University College of Borås (PhD degree conferred by Göteborg University)	Joacim Hansson	The Establishment of a National Library: The Case of the National Library of Uganda	2004	2008
Nora Mulira	DICTS	Technical University of Delft	Henk Sol	A Service Approach to effective IS Implementation in Universities: The socio-technical challenge	2003	2007 or 2008
Moses Niwe	ICS	Stockholm University /KTH	Janis Stirna	ICT Infostructure framework for sustainable development in Uganda	2005	n/a

Appendix 3: Acronyms

ARIS	Academic Records Information System
CBT	Computer Based Training
DICTS	Directorate for ICT Support
EMI	E-mail & Internet/Intranet Services
EUT	End User Training
gbps	giga/billion bits per second
GIS	Geographic Information System
HURIS	Human Resources Information System
ICS	Institute for Computer Science
ICT	Information and Communication Technology/Technologies
INASP	International Network for Availability of Scientific Publications
IP	Internet Protocol
ISP	Internet Service Provider
IT	Information Technology/Technologies
kbps	kilo/thousand bits per second
LAN	Local Area Network
LIBIS	Library Information System
mbps	mega/million bits per second
MSEK	Million Swedish Kronor (Crowns)
NAT	Network Address Translation
Norad	The Norwegian Agency for Development Cooperation
Nuffic	Netherlands organization for international cooperation in higher education
SAREC	Sida, Department for Research Cooperation
USAID	US Agency for International Development
VoIP	Voice over IP

Appendix 4: Terms of Reference

Evaluation of Sida supported ICT project at Makerere University in Uganda

1 Background

One of the fundamental tasks of Sida's Department for Research Cooperation, SAREC, is to provide assistance for strengthening national research capacity in developing countries. Swedish support to bilateral research cooperation between Uganda and Sweden dates back to year 2000, and has been focused on Makerere University with long-term scientific cooperation and partnership between Uganda and Swedish institutions. The current program for research cooperation covers a wide area including research supporting structures as well as focused faculty research programmes administered by Makerere University. The faculty based research programmes have to date been hosted mainly in the Faculties of Medicine, Social Science, Technology and Agriculture. The point of departure for the Sida support is Makerere University's strategy plan which emphasis research and training in the sciences. In addition Makerere University seeks to use ICT in all its functions including administration, training and research.

Sida believes that a sound foundation in computers and access to the Internet has become essential for modern higher education and research. Uganda is one of the first countries where Sida started supporting ICT projects in a substantial way. A first step for Makerere University in 2000 was to develop an ICT Policy and Master Plan providing a coordinated framework for the development of ICT skills, infrastructure and systems. The first phase of the plan was for Makerere University to be transformed into an ICT user. In the second phase the University seeks to become an ICT knowledge and application driver that will form a nucleus of skills and knowledge that can contribute to development in Uganda. In order to implement the original Master Plan the University established a directorate for ICT support (DICTS) to coordinate the ICT efforts. A number of donors decided to fund various parts of the plan (e.g. Sida, NORAD, NUFFIC, USAID, Carnegie, etc.). This was followed by Sida providing ICT, bibliographic support and PhD training for the agreement period 2001–2002 amounting to a total of 20 MSEK (approx 2.5 MUSD, if 1 USD equals 7.5 SEK), and 2002–2004 amounting to a total of 15 MSEK (approx 2 MUSD, if 1 USD equals 7.5 SEK). Encouraged by the progress of ICT integration at Makerere University Sida is now considering a continued ICT and bibliographic support for the next agreement period 2005–2009.

The evaluation will primarily resolve around three key documents:

- the ICT Policy and Master plan (the initial and the revised).
- the former application for 2002–2004 (i.e., for evaluating its progress).
- the new application for 2005–2009 (i.e., for evaluating its potential, providing Makerere University with feed back and providing Sida with comments and recommendations for the coming agreement).

The evaluator(s) will receive a file with relevant documents including the Policy and Master Plan, the applications, Sida's assessment of the project including the budget and the progress and financial reports submitted by the project leaders to Sida which will provide further background information.

2 The Objectives of the ICT Project

The overall objective of Sida/SAREC's ICT project in Uganda is:

- To assist Makerere University in its endeavour to incorporate ICT in all its functions.
- To provide Internet connectivity to all those institutions where Sida supports long-term research co-operation.
- To build technical and managerial capacity in information technology at all levels.
- To strengthen IT-institutions at the universities by promoting research in the field of IT if the required prerequisites exist.
- To integrate ICT in the main library operations.

2.1 Project Activities

In correspondence with the overall objectives, the project consists of three sub-projects: (A) Internet connectivity and (B) postgraduate studies in IT and (C) integration of ICT in the library operations.

Within the scope of the sub-project Internet connectivity, a VSAT hub[1] to provide high bandwidth internet access, a campus-wide high-speed backbone and Local Area Networks (LANs) have been created. Within the scope of this sub-project, technicians and managers have been trained at respective institutions so that the installed infrastructure can be operated and maintained. In addition, high level training has equipped and continues to equip the staff with capacity for policy planning and evolution to ensure that ICT supports transformation leads to real efficiency gains. Makerere University is also a member of a group working towards lower prices for bandwidth.

In the sub-project for postgraduate studies in IT, two staff members from the main library at Makerere University have started their "sandwich type" PhD education in collaboration with the Swedish School of Library and Information Science in Borås. One staff member from DICTS has started a "sandwich type" PhD education in collaboration with TUDelft University in the Netherlands.

Within the scope of the sub-project integration of ICT in the library operations, ICT infrastructure, computer resources, subscription fees for electronic on-line journals and local training of staff have been set up. In cooperation with INASP (International Network for the Availability of Scientific Publications) the University currently subscribes to over 7,000 scientific journals which are accessible to all researchers in Uganda. Also the above mentioned PhD students are from the main library, thus, a part of the overall objective of this sub-project as well.

Details of the project along with an on-line progress report are available at http://www.sida.se/ –> Sectors –> ICT –> ICT in the development cooperation –> ICT and research –> Uganda. Information is also available at www.makerere.ac.ug/makict/

A final report on the progress of the project will be provided to the evaluators by the Uganda project coordinator, Professor F.F. Tusubira.

3 Aims of the Evaluation

The overall aim of the evaluation is to document the project concept, its implementation and analyse lesson learnt for continuation of further support to ICT at Makerere University and support to new ICT projects in the future both in Uganda and elsewhere.

[1] Comment from Prof Tusubira on ToR: "This was the original plan, but competition and increased volumes have todate drive prices to a level at which a VSAT hub is not justified. This change was made with the approval of Sida/SAREC".

The main purpose of this evaluation is to provide Makerere University with additional qualitative feedback that may improve its efforts in the detailed planning and implementation of the coming phase II of Sida support. Another important objective is to provide Sida with an independent external view/opinion on the results of Sida support during the previous agreement period, i.e., phase I. A third objective is to provide Sida with comments and recommendations for the selected Sida supported sub-projects for the coming phase II.

3.1 Evaluation Issues

This evaluation will mainly address the following issues. Since the project has recently been commissioned thus some of the issues may be difficult to evaluate, in which case, the evaluators should give an indication of the direction and trend.

i. To assess and compare the overall efficiency (cost/output) and effectiveness (degree of goal achievement) of the implementation and running of the ICT project at Makerere University as well as to assess the efficiency and effectiveness with which the organisation has attained the objectives of the project. Furthermore, explain the cause(s) behind the differences in efficiency and effectiveness among the various activities, if any. Make an analysis in retrospect if the ICT project's original design and set-up have been appropriate with respect to the goals set-up and stated in their respective application.

ii. To assess the contribution of the ICT project to the overall objectives of SAREC programme in Uganda, i.e., human resource development and strengthening of research capacity and to give some concrete examples, if possible, of the effects of the ICT project might have had on these overall SAREC objectives.

iii. The effects of connectivity to the Internet on improvement in higher education and research at Makerere University. Evaluate specific examples of relationships (cause and effects) between connectivity and improvements in higher education.

iv. The overall effect of computerisation on computer literacy and administrative functioning of Makerere University and evaluate concrete examples of improvement in administrative management and library functions due to computerisation.

v. Discuss and analyse the issue of sustainability of the investments made in the infrastructure at Makerere University in terms of annual reservations of funds for operation (including cost for international connectivity), maintenance and depreciation of equipment acquired in the framework of this project after the external funding has ended. Analysis of the prospects for income generation.

vi. A brief overview and assessment of the results and impact of Sida's support to ICT at Makerere University on the country. An assessment of the role of ICT at Makerere University for the development of ICT in Uganda.

vii. Seen from the Uganda perspective, what could be the next phases of the ICT project at Makerere University with respect to models for funding and the sources of funding.

viii. Discuss and analyse national and regional impact or benefits arising out of the support.

4 Methodology And Time Table

The evaluation will be based on:

- Project documents including the ICT Policy and Master Plan, project proposals/applications and progress reports.

- Interviews with persons and institutions in Uganda and Sweden that are directly or indirectly involved in the project (e.g., the involved faculties/departments, DICTS and the main library at Makerere University in Uganda, the "sandwich" PhD students, counterpart universities in Sweden, selected desk officers at Sida and the Swedish Embassy in Uganda), but also contacts with TUDelft university and INASP in UK.
- Inspection of the infrastructure created at Makerere University.
- Other relevant information.
- An innovative method can be to start the whole exercise with a workshop on the situation of ICT at Makerere University to which all the stake holders are invited.

The evaluation will be conducted by Mr Alan Greenberg, former member of the Internet Society Board of Trustees, and an additional co-evaluator. The co-evaluator must be approved by Sida. Mr Alan Greenberg will act as a team leader.

The mission will take place in January/February 2005 (exact dates still to be determined in consultation with Professor F.F. Tusubira in Uganda). The consultants shall visit the project in Uganda. The team leader will conduct interviews in Sweden as well, and will present the results of the evaluation at Sida following the submission of the final report.

5 Reporting

The final report shall be in English and should not exceed 50 pages excluding annexes. Two copies of the draft report shall be submitted to Sida no later than 2005-04-07. Sida's comments on the draft report may lead to additional work for the evaluator. A final version in 5 paper copies as well as in electronic form in Microsoft Word for Windows shall be submitted to Sida no later than 2005-04-30. Subject to decision by Sida, the report may be published and distributed within the Sida Evaluation series.

Suggested list of institutions/people to meet (or communicate with by other means).

In Uganda

DICTS: Dr. F.F. Tusubira – tusu@dicts.mak.ac.ug; Mrs Nora Mulira – nora@dicts.mak.ac.ug

Former Vice Chancellor, Prof Ssebuwufu and current Vice Chancellor, Prof Luboobi: (the Director DICTS reports to the Vice Chancellor).

Deans of the linkage faculties under Phase 1: Technology, Social Science, Agriculture and Medicine.

The Director, Planning and Development Department.

The President, Makerere Students Guild.

Executive Director, Uganda National Council for Higher Education.

University Library: former librarian Mr. James Mugasha – jmugasha@mulib.mak.ac.ug – and current university librarian.

Institute of Computer Science: Dr. V. Baryamureeba – director@ics.mak.ac.ug

The PhD students in the ICT project studying on a "sandwich" basis in Sweden and Holland.

Project leaders of ongoing SAREC supported research projects (names can be obtained from Hannah Akuffo at SAREC).

Uganda National Council for Science and Technology (UNCST): Dr. Z. Nyiira – uncst@starcom.go.ug

Swedish Embassy in Uganda: Mrs Anneli Hildeman and Mrs Gloria Mugambe – anneli.

hildeman@sida.se and gloria.mugambe@sida.se

Norwegian Embassy in Uganda: Mrs Randi Lotsberg – randi.lotsberg@norad.no or rel@norad.no

Ministry of X: (prof Tusubira will organise).

Executive Director, Uganda Communications Commission, Mr Patrick Masambu – patmas@ucc.co.ug

In Sweden

Sida/SAREC: Dr Berit Olsson, Mr Tomas Kjellquist & Assoc. Prof. Hannah Akuffo – hannah.akuffo@sida.se

Sida/Department for Africa: Mrs Pernilla Tragardh – pernilla.tragardh@sida.se

Sida/ICT4D: Dr Anders Granlund & Dr Per Einar Tröften – per-einar.troften@sida.se

SPIDER/IT-university: Dr Afzal Sher & possibly Professor Love Ekenberg – afzal_sher@hotmail.com or afzal@dsv.su.se or info@spider-center.org

Uppsala University: Professor Richard Wait and through him, the other Swedish supervisor for the Uganda PhD students – richard.wait@isp.uu.se

Borås University: Professor Lars Höglund – lars.hoglund@hb.se

In UK

INASP: Carol Priestly – inasp@inasp.info

In Holland

Groninge University: Dr Robert Janz (Dutch NTP program at MU) – R.F.Janz@rc.rug.nl

Delft University: Mr Bert Geers – e.m.a.geers@ewi.tudelft.nl

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