3 ANALYSIS OF GAPS AND CONSTRAINTS

This section attempts to determine the major challenges, capacity constraints and gaps in ICT infrastructure, usage and management in SARUA member institutions.

3.0 Major ICT challenges

The SARUA ICT survey questionnaire required member institutions to indicate which challenges they currently face in trying to integrate ICTs into their operations. The results are telling with the major challenges identified relating to lack of funding, attracting and retaining IT staff, capacity of IT staff, inadequate infrastructure, expensive and scarce bandwidth, IT security, ICT leadership and management, alignment of IT to the institutions’ needs and cultural and attitude issues among the staff and students.

<table>
<thead>
<tr>
<th>Top 10 issues/ challenges from SARUA survey 2007 (in order of frequency of response)</th>
<th>Top 10 IT issues for higher education 2007 (EDUCAUSE)10</th>
<th>Top 10 Issues for IT industry 2007 (Society for Information Management SIM)11</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Lack of funding</td>
<td>1. Funding IT</td>
<td>1. Attracting, developing and retaining IT professionals</td>
</tr>
<tr>
<td>2. Attracting and retaining staff</td>
<td>2. Security</td>
<td>2. IT and business alignment</td>
</tr>
<tr>
<td>5. Expensive Bandwidth</td>
<td>5. Disaster Recovery/Business Continuity</td>
<td>5. Improve IT quality</td>
</tr>
<tr>
<td>8. ICT leadership and management</td>
<td>8. Strategic Planning</td>
<td>8. IT strategic planning</td>
</tr>
</tbody>
</table>

Table 17: Top 10 issues from SARUA survey, EDUCAUSE survey and SIM survey

The most frequently reported challenges relate to lack of funding and attracting and retaining skilled staff. Interestingly, lack of funding is cited by universities around the world as a top challenge as reported by a recent EDUCAUSE survey of higher education institutions12 while attracting and retaining skilled staff is a top challenge faced by the ICT industry as a whole according to a report in Computer World on a recent Society for Information Management (SIM) survey.13 See Table 17 above which shows a comparison of top challenges from the SARUA, EDUCAUSE and SIM surveys.

3.1 Specific constraints and gaps

The areas where gaps exist or where there are capacity constraints in campus infrastructure are detailed below.

10 http://www.educause.edu/er/erm07/erm0730.asp
12 http://www.educause.edu/er/erm07/erm0730.asp
3.1.1 Student access to computers

Teaching and administrative staff enjoy much higher access to computers than do students. This is probably not by accident. The use of computers to improve productivity and increase administrative and management efficiency and effectiveness is well known. Research has shown that teaching staff need to have reasonable access to and be familiar and comfortable with technology before they can integrate it effectively into teaching and learning. However, in the long run, it is important that students have more access to personal computing resources if they are benefit from the potential of ICTs to improve learning and to facilitate research, communication and collaboration.

At the moment, the universities with an average of about 70 full-time on-campus students per computer (or about 20 if we exclude University of Goma) are far short of achieving the desired goal of having five students per computer.

Further, a majority of the universities responding to the questionnaire do not have any strategies in place to equip individual staff and students with personal computers.

- Only two (2) universities reported a scheme in place: One university operates a loan scheme and another university has developed a standard policy to issue all teaching and research staff with a computer. Another university reported that it was reviewing a policy to guide such a scheme.
- No university reported a scheme to make computers available to individual students
- Six (6) universities however require graduate level students to own a personal computer

Institutions need to devise strategies and policies to promote individual ownership of computers for students and staff.

3.1.2 Access to a robust, high-capacity campus network

Only 42% of the respondents report having Gigabit capacities in their campus backbones and 67% of the respondents report having all the buildings used for teaching and research fully networked. Gigabit capacity campus networks should be the norm and not the exception. In addition, member universities need to ensure that they have all their offices and teaching and research buildings fully networked with fast Ethernet and even Gigabit Ethernet. At the very least, every university needs to have a fibre-based backbone.

A recent presentation to African Vice Chancellors recommended that this should be achieved for all universities in Africa by 2008 and that university heads have a big role to play in advocating and making the necessary resources available for this to happen.

Without a robust, high-capacity and scalable campus network extending to the entire campus, many of the teaching, research and administration services and applications will not be accessible or fully utilized. The campus network can support advanced research even in the absence of good external connectivity. For example, large databases and datasets can be obtained offline (e.g. on high capacity disks or CDROMs) and stored on the network to provide access to researchers and students, high-speed test beds can be developed, large scale simulations and even grid computing applications can be developed and deployed, blended learning and online learning systems can also be developed and deployed and information management systems and other Enterprise Resource Planning (ERP) systems can be widely accessible and beneficially used.

It is important to note that the campus network can become a significant bottleneck to providing quality internet connectivity and to support research networking. As a study on networking in Europe noted, “a major source of limited network performance is at the campus, and this fact must be drawn to the attention of senior management in the university and similar sectors” and that while great advances have been made in building national, regional and international Research and Education Networks (RENs), the campus network is now “often the weakest link in the network.” There is need for support to develop Gigabit campus backbones for all SARUA members’ campuses and LANs for all buildings used for administration, teaching and research.

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15 Adam, L. 2007, Campus, National and Regional Research and Education Networks Policy, Regulatory, Infrastructure Process Issues, presentation made at AAU Vice Chancellors Conference, 24 October 2007 in Tripoli, Libya
16 Adam, L. 2007, Campus, National and Regional Research and Education Networks: Policy, Regulatory, Infrastructure Process Issues, presentation made at AAU Vice Chancellors Conference, 24 October 2007 in Tripoli, Libya
3.1.3 Inadequate and expensive internet bandwidth

SARUA member universities still have dismal internet bandwidth capacities. No university has anywhere close to a Gigabit connection to the Internet and almost a quarter of the respondents have internet bandwidth of less than 1 Mbps. In fact, the combined capacity for all the respondents is currently only about 114 Mbps while their peers in Europe and North America increasingly enjoy Gigabit connections as shown in Table 18.

<table>
<thead>
<tr>
<th>%age of institutions with bandwidth &gt; 1 Gbps</th>
<th>SADC universities</th>
<th>Nordic Countries</th>
<th>UK</th>
<th>France</th>
<th>Portugal</th>
</tr>
</thead>
<tbody>
<tr>
<td>%age of institutions with bandwidth &lt; 1 Mbps</td>
<td>25%</td>
<td>0%</td>
<td>0%</td>
<td>About 21%</td>
<td>0%</td>
</tr>
</tbody>
</table>

Table 18: Comparison of bandwidth capacities for universities in SADC and in selected countries in Europe

When compared to say the Nordic region of Europe (Denmark, Sweden, Norway and Netherlands) where ALL the universities have bandwidth in excess of 1 Gbps, it becomes apparent that the bandwidth available to universities in the SADC region is dismal. It is no wonder that two thirds of the respondents reported “expensive bandwidth” and “low bandwidth” as one of the biggest challenges they face (see Section 3.0 above).

If SADC universities are to participate in high-end quality research, they must invest in substantially more bandwidth. The current level of planned bandwidth increase reported for the next five years is not enough. Universities must aim to have Gigabit access at the earliest. As the TERENA 2007 report notes “Gigabit connections can be seen as a necessary, though not necessarily sufficient, condition for a university to engage in high-end research and learning programmes.”

At the very least, every university should strive to attain a minimum bandwidth of 10 Mbps by next year (2008) as recommended to all African Vice Chancellors recently.

The cost of bandwidth, while reducing for all institutions across the board, is still over 20 times that of their peers in the more developed world. Inadequate and expensive bandwidth is also one of the major challenges cited by the respondents. SARUA could play an important role in assisting member institutions to access more bandwidth at lower cost.

3.1.4 Bandwidth management

The solutions to tackling the challenge of inadequate bandwidth must involve increasing available capacity as well as managing existing capacities. As the INASP briefing note on optimizing internet bandwidth in developing country higher education argues, institutions must “recognize that ‘bandwidth’ is a valuable institutional resource or asset that needs to be managed, conserved, and shared as effectively as possible” and that the institutions’ management must “make bandwidth management a priority.”

The ATICS 2006 study also found that the “majority of the respondents (59%) reported that they practiced little or no bandwidth management” and concluded that there was a “critical need for skills training in this vital area.”

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22 Adam, L. 2007, Campus, National and Regional Research and Education Networks: Policy, Regulatory, Infrastructure Process Issues, presentation made at AAU Vice Chancellors Conference, 24 October 2007 in Tripoli, Libya
3.1.5 Supporting policies

It is worrying that some universities have no ICT policy of any sort (25% of respondents) while many (83% of respondents) do not have all the most important ICT policies in place. The policy arena is certainly one where there is need for support to ensure that all the relevant policies are enacted by all member institutions. Further, having a policy and actually operationalizing that policy are two different things. An ICT audit should be carried out to determine whether the policies enacted are actually being implemented and followed.

3.1.6 ICT Procurement

42% of respondents lack any ICT standards, only 25% have centralized ICT procurement and only half have any volume licensing or large scale contracts in place for ICT.

Standardization and centralized procurement are key strategies for reduction of cost – both direct acquisition costs through leveraging economies of scale and indirect cost such as support, maintenance, repair and training of technical support staff. As universities have identified funding as a major challenge, any strategies to reduce costs and improve value for money are critical.

3.1.7 Advanced research

Only one respondent reported using their internet connection for collaborative research and there is no evidence of using the internet for any advanced research activities or to connect to advanced distant scientific research facilities. The seeming absence of collaborative research or access to distant scientific research infrastructure could be a result of the relatively poor bandwidth of these institutions as well as other constraints. This is an issue that warrants further investigation to understand the precise status of advanced research at member institutions as well as the constraints and challenges faced by researchers at these institutions. Providing adequate bandwidth and ensuring connections to research networks in Europe, Asia and North America is likely to be only part of the solution. Nevertheless, it is an important part of the solution and should be pursued. This is beginning to happen with the creation of NRENs and the efforts of the UbuntuNet Alliance to connect African NRENs to the global research networks such as GEANT.

3.1.8 E-learning capacity

It is evident that e-learning is increasingly taking root in the member institutions with all the respondents reporting to have an e-learning initiative underway. However, it appears that all the efforts are being directed at deployment with only 42% and 50% of respondents reporting having an eLearning policy and providing training on e-learning to teaching staff respectively. If e-learning efforts are to bear fruit, deployment must be done hand-in-hand with enactment of e-learning policies and training of the teaching staff to enable them use the installed system and develop the necessary content. Students, too, must be equipped with the necessary ICT skills in order to take maximum advantage of e-learning and ICTs. Support in this area is critical as e-learning represents the point at which “the rubber meets the road” when it comes to integration of ICTs into teaching and learning.

3.2 Extent to which ICTs are integrated into university operations

It is difficult to determine the precise extent to which ICTs are integrated into the operations and teaching functions of universities without visiting the institutions and/or interviewing administrators, teaching and research staff and students. However, an attempt can be made to qualitatively gauge the extent to which ICTs are integrated by considering a number of possible indicators. The indicators are based on the assumption that proper integration is largely a result of three key factors:

a) Availability of or adequate access to ICT infrastructure including applications and services: The more users (students, teaching and research staff and administrative staff) have access to computing resources, a robust campus network, adequate bandwidth and ICT applications such as Information Management Systems, the more likely they are to use ICTs in their day-to-day operations and activities. After all it is difficult to integrate anything if one does not have access in the first place.

b) Capacity and know-how of the principal users to integrate and use ICTs: Having access is not enough; users must be equipped with the necessary skills to actually use ICTs in their day-to-day activities and operations.
c) The existence of supporting organizational structures, policies and plans: these must be in place to ensure that ICTs are systematically institutionalized and integrated.

Another important issue to determine is what minimum level of integration (targets) is required and in what time frame this should be achieved. A recent presentation to African Vice Chancellors is very instructive. The presentation outlines the following targets and dates by which they should be achieved:

- **Targets for campus infrastructure**
  - All campuses need to have fibre backbone by 2008
  - Campuses need to achieve student and computer ratio of at least to 1:5 by 2010 – US targets
  - Campuses should attain a minimum international bandwidth of 10 Mbits/second Internet connectivity by 2008

- **Targets for content**
  - Meet the content needs of “low level users” by 2008
  - E-learning content for all students by 2009
  - Meet the needs of “higher level users” by 2010
  - Improve bandwidth management, centralized network management and technical capacity
  - Train 500 professionals in e-learning and bandwidth management

- **Targets for NRENs**
  - Establish fully functional NRENs by end of 2008
  - Establish National backbones
  - Connect to any available fiber
  - Lobby for National ICT strategies and broadband strategies to integrate educational needs
  - Reduction of access fees to academic network (differential fees)
  - Put good governance framework in place to benefit from economy of scale
  - Each NREN should strive to obtain at least 1Gbps of bandwidth – only fibre cable can provide this – Take advantage of new fibre cable projects, if fiber exists and lying there try to use it

If these targets are taken as “desirable end states” and collated with the factors outlined above and their corresponding indicators, one can, at a qualitative level, roughly determine the level of integration in SARUA’s member institutions as presented in Table 19 below.

An analysis of the targets and the number of institutions that have achieved these targets shows that roughly half or more of the universities are making progress in creating enabling organizational structures and polices and in building the capacity of users (students and teaching staff). The major challenge for most universities seems to be in the area of providing adequate infrastructure especially enough computing resources and internet bandwidth. This is not a surprise as lack of funding and inadequate infrastructure and facilities were cited among the top 10 challenges faced by these universities.

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<table>
<thead>
<tr>
<th>Factor/ Indicator</th>
<th>Target</th>
<th>%age of institutions meeting target as of Nov 2007</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Availability of adequate access to ICT infrastructure</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Student: PC ratio</td>
<td>1:5</td>
<td>17%</td>
</tr>
<tr>
<td>Teaching staff: PC ratio</td>
<td>1:1</td>
<td>8%</td>
</tr>
<tr>
<td>Fibre campus backbone</td>
<td>Gigabit capacity</td>
<td>42%</td>
</tr>
<tr>
<td>Adequate bandwidth</td>
<td>10 Mbps minimum</td>
<td>33%</td>
</tr>
<tr>
<td>Existence of IMS</td>
<td>At least student management, financial, library, HR systems installed</td>
<td>50%</td>
</tr>
<tr>
<td>Existence of e-learning applications</td>
<td>E-Learning application installed</td>
<td>67%</td>
</tr>
<tr>
<td>Existence of collaborative research infrastructure</td>
<td>University connected to NREN</td>
<td>43%</td>
</tr>
<tr>
<td><strong>Existence of supporting organizational structure and policies</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Existence of centralized ICT unit</td>
<td>Independent unit with Head reporting to VC or Deputy VC level</td>
<td>92%</td>
</tr>
<tr>
<td>Existence of dedicated e-learning unit</td>
<td>Functionally separate from and independent from ICT unit</td>
<td>50%</td>
</tr>
<tr>
<td>Existence of ICT policy</td>
<td>Policy enacted and strategic plan developed</td>
<td>75%</td>
</tr>
<tr>
<td>Existence of E-learning policy</td>
<td>Policy enacted</td>
<td>42%</td>
</tr>
<tr>
<td>Existence of BWM policy and tools</td>
<td>Campus network and Internet connection monitored and bandwidth managed</td>
<td>42%</td>
</tr>
<tr>
<td>Capacity of users</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Provision of eLearning training for teaching staff</td>
<td>All teaching staff</td>
<td>50%</td>
</tr>
<tr>
<td>Provision of ICT training for teaching staff</td>
<td>All teaching staff</td>
<td>75%</td>
</tr>
<tr>
<td>Provision of ICT training for students</td>
<td>All students</td>
<td>50%</td>
</tr>
</tbody>
</table>

Table 19- Factors that determine extent to which ICTs are integrated

It should also be pointed out that institutions are at different levels of ICT development with some having made advances in integrating ICTs and other still far below meeting the targets. This is a clue to any strategies that SARUA will have to adopt: institutions cannot be treated in the same way because they are at different levels of ICT development and integration. Any strategies will have to be customized and individualized. A good solution is to group or classify institutions according to their level of ICT development and integration and then design solutions that respond to specific classes of universities.