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Kenya Education Network

The E-Readiness Survey of Kenyan Universities 2013

E-READINESS 2013 SURVEY OF KENYAN UNIVERSITIES

A STUDY FUNDED BY THE KENYA EDUCATION NETWORK

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ACRONYMS AND ABBREVIATIONS

BYOD	Bring Your Own Device
CFO	Chief Finance Officer
CUEA	Catholic University of East Africa
DVC AA	Deputy Vice Chancellor for academic affairs
EA	East Africa
ERP	Enterprise resource planning systems
Gb/s	Gigabits per second
GER	Gross enrolment ratios
ICT	Information and Communication Technology
IDI	ICT Development Index
IEEE	Institution of Electrical and Electronics Engineering
IP	Internet Protocol
IRU	Indefeasible rights of usage
ISP	Internet service providers
ITU	International Telecommunications Union
JKUAT	Jomo Kenyatta University of Agriculture & Technology
Kb/s	Kilobits per second transmission speeds
KCA	Kenya College of Accountancy
KENET	Kenya Education Network
KTCIP	Kenya Transparency and Communications Infrastructure Project
LMS	Learning management system
M&E	Monitoring and evaluation
Mb/s	Megabits per second
MIS	Management information systems
NOFBI	National Optical Fiber Backbone Infrastructure
NREN	National Research and Education Network
NRI	Networked Readiness Index
ODL	Open and Distance Learning
OPAC	Online Public Access Catalogue
OSS	Open Source Software
PBX	Private Branch Exchange
PC	Personal computer (desktop, laptop or notebook)
PDAs	Personal Digital Assistants
SPSS	Statistical Package for Social Science
UoN	University of Nairobi
UPS	Uninterruptible Power Supply
USD	US Dollars
USIU	United States International University
VCs	Vice Chancellors
VSAT	Very Small Aperture Terminal

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This is the third comprehensive E-readiness 2013 survey of Kenyan Universities and unlike in the past was funded by a Kenya Education Network (KENET) research grant. We therefore thank KENET Board of Trustees for the research grant.

The 2013 E-readiness survey required detailed and confidential data from the 30 participating universities and it could not have been completed without the support of the Vice Chancellors and the senior leadership of the universities. We therefore thank the Vice Chancellor who approved the data collection exercise. We also thank the senior leadership of the universities who include the Deputy Vice Chancellors in charge of Academic Affairs, university registrars, directors of e-learning, university librarians, chief finance officers, deans of ICT and engineering, and ICT directors who completed the hard facts questionnaires and facilitated data collection from the faculty, students, and staff in their respective universities. We also thank the over 14,000 students and over 1,400 faculty and staff who participated in the survey and others who attended stakeholder workshops to discuss the findings.

The researchers were supported by a research team consisting of 42 research assistants from each of the participating campuses coordinated by Dr. Margaret Nyambura Ndungú, the research coordinator. It would have not been possible to collect the data without the support of the research team and we sincerely thank them for their commitments and for the hard work of training and supervising the data collection exercise. Since all the research assistants were employees of the universities, most junior faculty members, we thank the universities for allowing them to provide the research services.

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EXECUTIVE SUMMARY

The e-readiness 2013 survey of Kenyan universities is the third in a series of studies that were started in 2006 (Kashorda et. al., 2006). It is also the first comprehensive survey conducted after the universities were connected to the undersea Internet bandwidth in 2010 that was nearly 10 times cheaper than the satellite bandwidth available during the 2008 survey. The 2013 survey has therefore provided an opportunity to explore the impact of broadband connectivity on the overall e-readiness of universities.

E-readiness is a measure of the preparedness of a university or institution to use ICT to enhance the quality of learning, teaching, and research. A high degree of e-readiness also contributes significantly towards the realizations of a university's academic and administrative goals. As with previous studies, the key objective of the 2013 e-readiness survey was to conduct a *diagnostic* assessment of a representative group of Kenyan universities to provide the research data required to develop, review or monitor institutional and ICT strategic plans. The purpose therefore was not to rank universities but to provide them with information that would assist them to use ICT to realize their mission and goals.

The 2013 survey, supported by an internal KENET research grant for Kenyan universities, covered 30 universities with a student enrolment of 423,664. It included the 17 universities surveyed in 2006 and 2008, making it possible to conduct a trend analysis of e-readiness for these selected universities. The second survey in 2008 was supported by a Rockefeller Foundation grant through KENET, the National Research and Education Network (NREN) of Kenya (see http://www.kenet.or.ke) and covered 50 East African universities in Burundi, Kenya, Rwanda, Tanzania and Uganda.

The e-readiness assessment framework developed by the KENET research team contained 17 e-readiness indicators grouped into five categories: network access; networked campus; networked learning; networked society; and institutional ICT strategies (UC, 2011). Each indicators was staged on a scale of 1 to 4, where 1 represented unprepared and 4 represented the highest level of preparedness.

The KENET e-readiness research team included Professor Meoli Kashorda (USIU, Kenya), the lead researcher, and Professor Timothy Waema (University of Nairobi, Kenya). They were assisted by Dr. Margaret Nyambura Ndung'u, the 2013 research coordinator and a team of data analysts led by Mr. Caleb Ouma Ongong'a, the research statistician since 2006.

Methodology

The e-readiness survey collected data from 30 universities consisting of 20 public universities and 10 private universities. All the 17 universities that participated in the 2006 and 2008 surveys were included. The total student enrolment for the 30 universities was 423,664 and was estimated to be about 80% of total enrolment in Kenyan universities.

The main factors considered in selecting the 30 universities were:

1. The 17 universities that participated in the 2006 and 2008 surveys in order to provide data for longitudinal studies
2. University campuses with a student enrolment of 2,000 and above

3. Universities that participated in the preliminary hard facts demographic data collection exercise in 2012 and 2013
4. Universities that were fully chartered by the Commission for University Education. University colleges or private universities in initial stages of formation were therefore not included.

The e-readiness survey assessment was campus-based and covered 42 campuses of the 30 universities. Data was collected over a one-month, from mid-October to mid-November 2013, using hard facts and perception questionnaires originally developed for the 2006 survey but modified in 2008 and 2013 to collect additional data (e.g., laptop ownership by students). The modified hard facts questionnaire that had six sections was completed by chief academic officers; chief finance officers; registrars; deans of ICT; university librarians; and directors of ICT.

The perception questionnaires were completed by students, faculty and non-teaching staff in all 42 campuses. Unlike in the past, the 2013 modified perception questionnaire included questions on laptop and smartphone ownership as well as the learning and university environment. Similar questions were used in the annual EDUCAUSE survey of undergraduate students and information technology (IT) in the United States of America (USA). The 2013 survey questionnaires were posted on the e-readiness survey 2013 website http://ereadiness.kenet.or.ke.

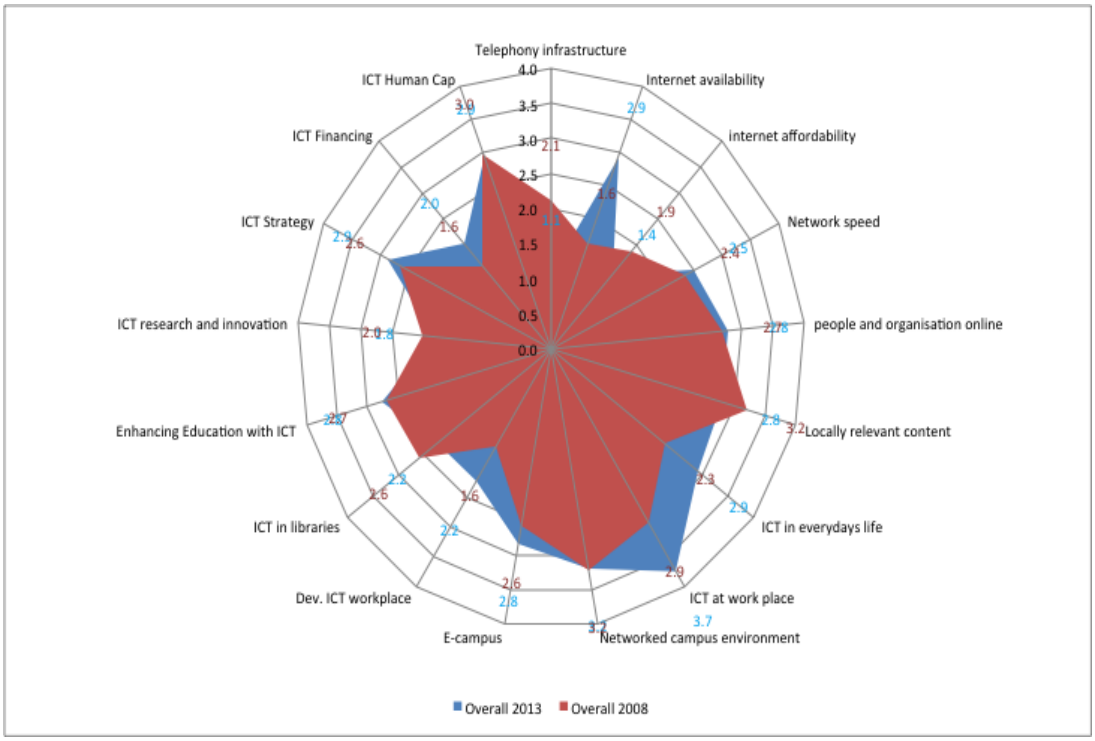
The perception questionnaires were administered to a statistically significant sample for each of the 42 campuses. The total sample comprised 1,497 teaching and non-teaching staff, and 14,974 students. The sample size for the perceptions questionnaires took into account the student population, different categories of students (undergraduates, post-graduates), faculty and staff. The sample sizes were statistically significant for each university. The resulting confidence interval was about 1% with 95% confidence level.

Staging analysis and key findings

The study analyzed the aggregate staging for each of the five categories of e-readiness indicators as well as data for each university. Detailed results for each of the 30 universities that participated in the survey were posted in the e-readiness survey results database and are available to authorized users of in universities (see http://ereadiness.kenet.or.ke). The universities could use the results as part of monitoring and evaluation of their ICT or corporate strategic plans, or for regular review of their strategic plans. The results could also be used for benchmarking among participating universities (i.e., University of Nairobi could compare their results with Kenyatta University with permission).

Figure 8-1 summarizes the overall results of the 2008 and 2013 surveys. It is evident that in the five years between the surveys, there has been limited accession to higher stages for most of the 17 indicators. In fact, only two indicators, namely, ICT in the workplace and network environment had moved to stage 3.0 and above by 2013 while the other 15 indicators remained below stage 3.0. However, the Internet availability indicator moved from stage 1.6 to stage 2.9 in 2013 mainly due to the increase by a factor of 10 in the Internet bandwidth per 1,000 students sub-indicator.

Figure 8-1: Average staging for 17 indicators for 2008 and 2013



Source: KENET e-readiness data 2008 and 2013

In general, the results suggest that accession to higher stages has been slow since the universities were not able to achieve stage 3 for 15 out of the 17 indicators. A similar conclusion was reached by the 2008 survey which demonstrated that accession required the commitment of the academic, administrative and ICT strategic leadership.

Network access

The Internet availability indicator moved from stage 1.6 in 2008 to stage 2.9 in 2013. This was mainly because the average Internet Bandwidth per 1,000 students increased from 0.43 Mb/s to 4.1 Mb/s. This was a tenfold increase, attributed to the drop in the average unit cost of Internet bandwidth from $2,300 per Mb/s in 2008 to about $160 per Mb/s per month in 2013 for the 30 universities. Despite the over 90% price reduction, $160 per Mb/s was still a high price in comparison to developed countries. However, anecdotal evidence suggests that this was one of the lowest unit prices in Kenya for no-contention international Internet bandwidth.

The networked PCs available per 100 students ratio, another sub-indicator of Internet availability, dropped from stage 5.8 in 2008 to stage 3.8 in 2013. This drop was somewhat compensated by the large number of students who owned laptop computers at 53%, as students owned over 200,000 laptop computers compared to 16,174 student lab computers available at the 30 universities. Universities therefore need to invest in enhanced campus backbone and wireless network infrastructures in order to support this large number of student-owned laptop computers.

However, lack of adequate student computer lab facilities for about 50% of the students who did not own laptops was driving students to cyber cafés for computer and Internet access as described in Chapter 3. The results showed that about 25% of the students

accessed computers and Internet from cyber cafés while only 17% accessed computers from their campuses. Universities therefore need to invest in student computer labs to serve the students who are unable to purchase laptop computers or those who may not wish to carry their laptop computers to university campuses.

The Internet affordability indicator dropped from stage 1.9 to stage 1.4 which seemed counter-intuitive with the drastic drop in prices of undersea bandwidth. The key reason was the over 100% increase in student enrolment that reduced the ratio of Internet bandwidth expenditure per 1,000 students ratio that was used to stage the affordability indicator. Table 3-1 summarizes the changes in student enrolment and Internet availability sub-indicators.

Table 3-1: Demographic data and Internet availability sub-indicators for 17 universities–2008 and 2013

Year of survey	Total students	Total PCs owned by students	Total bandwidth (Mb/s)	Internet bandwidth per 1,000 students	PCs per 100 students	% of students with PC access at home
2008	162,319	8,907	70.8	0.436	5.5	27
2013	339,418	13,815	1,431.5	4.22	4.07	30.4

Source: KENET e-readiness data 2008 and 2013

Universities therefore need to increase their Internet bandwidth budgets due to the increased student enrolment as well the large number of student-owned laptops in university campuses. On average, the universities were spending only 0.5% of their total recurrent expenditures on Internet bandwidth. The researchers propose that this should be increased to at least 1% of the total recurrent expenditure in order to achieve stage 3 and above.

Apart from the low PC ratio, the students considered the campus networks slow and unstable as described in Chapter 3. For example, about 56% of the students considered the campus networks unstable while 52.2% considered their Internet speed to be slower than cyber cafés or 3G mobile internet. This suggests that campus networks were poorly designed and managed and hence the high degree of dissatisfaction. This clearly points to inadequate investments in campus infrastructure as well as ICT human capacity. This is a critical issue that is analyzed in Chapter 8.

ICT financing

The universities moved from stage 1.7 in ICT financing to stage 2.0 and were spending only 0.5% of their total expenditure. This should be increased about 1% to achieve stage 3 and 2% to achieve stage 4.

The data showed that most of the 30 universities were charging *student lab fees* that could be used to finance all recurrent ICT expenditures, including ICT staff salaries and Internet bandwidth. However, it was not clear from the data if the lab fees were being used exclusively for ICT recurrent expenditures. This is a potential subject for future research. In addition, ICT departments need to start charging for ICT services provided to other universities departments (e.g., finance and academic affairs departments) in order to increase the revenue available for ICT infrastructure investments.

Networked learning indicators

The networked learning indicators include enhancing education with ICT; ICT in libraries; ICT research and innovation; and developing the ICT workforce that were all below stage 3. The networked learning indicators measure the preparedness of institutions to support new and innovative ways of teaching, learning and research in universities. Low stages means that universities were not ready to transform teaching, learning and research using ICT. For example, 77% of the students stated that they preferred blended learning that combined face to face and online learning, rather than the traditional face to face teaching. To better serve students, the faculty should adjust their teaching approaches and develop the necessary e-learning content.

The ICT research and innovation indicator was low at stage 1.8 having dropped slightly from stage 2.2 in the 2008 survey. This was measured only using availability of PhD and master's ICT degree programs as well ICT innovations incubators and not the throughput. Additional data that was not used for staging included throughput of master's and PhD programs and the percentage of faculty with doctoral degrees. The supplementary results showed that only 13.5% of the 535 ICT faculty members in the 30 universities had a PhD while the rest had a master's degree. This could be addressed in the next five years by increasing the throughput of doctoral programs in ICT. The low staging indicates that availability of broadband Internet does not necessarily lead to an increase in research and innovation output without the leadership of academic heads of department.

The enhancing education with ICT indicator at stage 2.8 had not changed significantly since 2008. Universities were still not tracking the percentage of online or e-learning courses developed. The survey results indicate that on average about 73% of university students preferred blended courses compared to only 14.9% who preferred online courses only. This preference, along with results of similar studies conducted in USA universities (Dahltrom, 2013), should inform the e-learning strategies of the universities. However, only 11% of the students reported that nearly all or all courses they took were blended while about 78% reported that only a few or none of the courses were blended in 2013. There was therefore a big disconnect as the majority of students preferred blended courses yet such courses were not widely available. Interestingly, a high percentage of students wanted their instructors to use more learning management systems (LMS) (42%), e-books (51%), and open content available on YouTube or Khan Academy (45%). These findings should also inform university e-learning strategies.

While about 53% of the students reported owning smartphones, only 24.1% of them had very good or excellent experience in using them to access electronic library resources, including the university open public access catalogue (OPAC) system. In addition, only 24.6% of the students had good or excellent experience using their mobile handsets to access the university learning management system that hosted e-learning courses. This suggests that the universities' electronic resources were not yet fully adopted for access using mobile handsets despite the high penetration of mobile handsets among students.

Internal vs. external factors of e-readiness of universities

Only six of the 17 indicators, namely, Internet availability; Internet affordability; network environment (reliability of commercial power supply); ICT in everyday life; locally relevant content, and people and organizations, partly depend on the external national ICT

environment. The staging for all the other 11 indicators were directly influenced by senior leadership of the universities and their Vice Chancellors. They also had significant influence on the level of staging achieved for the six indicators that were partly influenced by external factors.

The Government of Kenya has over the years improved the regulatory environment to promote growth of the ICT sector and increase availability of broadband Internet in the country. Most of the universities surveyed were located in areas where commercial power was available but required backup generators and uninterrupted power supply (UPS). The government also supported the universities through the bandwidth expansion project funded by the World Bank through the Kenya Transparency and Communications Infrastructure Project (KTCIP) that led to the drop in the cost of Internet bandwidth to $160 per Mb/s in 2013. Thus, it was the institutional strategies that would influence accession to higher stages as described in Chapter 8.

Summary results and conclusions

The main conclusion from the 2013 survey is that the university community in Kenya is ready to use ICT for learning, teaching, research and management. Table 7-2 shows that senior leadership of the universities appreciated the full value of ICT in achieving their institutions' mission, however, it unclear why this has not translated into higher levels of e-readiness with only two out of 17 indicators achieving stage 3 and above.

The results also show that universities are not investing sufficiently in campus backbone and wireless network infrastructure that will make it easier for students to use their own laptops and smartphones on campus to access learning materials and other student services. They are also not preparing or encouraging faculty to develop e-learning materials or adopt blended teaching techniques.

Table 7-2: Summary results of perceptions that stakeholders agreed or strongly agreed on impacts of ICT

	DVC AA	Dean ICT	FO	Registrar	Librarian	Director ICT
Enhanced quality of teaching	✓	✓				✓
Enhanced quality of learning	✓	✓				✓
Improved research productivity		✓				
Expanded research opportunities	✓	✓				
Enhanced competitiveness	✓				✓	
Reduced op. costs	✓		✓	✓	✓	
Enhanced revenue						
Enhanced opportunities for revenue generation	✓					
Increased efficiency	✓		✓	✓	✓	✓
Improved quality of service delivery	✓	✓	✓	✓	✓	✓
Increased transparency & accountability	✓		✓	✓	✓	

Source: KENET e-readiness data , 2013

Over the past five years, Internet availability has improved significantly because of the focus on only one sub-indicator–Internet bandwidth per 1,000 students. The target set by KENET researchers had been revised to 10 Mb/s per 1,000 students which is a modest 200 kb/s per online student assuming only 5% were concurrently, which is rather low. The universities in 2013 achieved 4.0 Mb/s per 1,000 students compared to only 0.431 Mb/s per 1,000 students in 2008.

The researchers recommend that universities should start tracking the sub-indicators shown in Table 9-1 in their institutional strategic plans. Though the sub-indicator targets depend on a particular university they have been found to be achievable by some of the 30 universities that participated in the study.

Table 9-1: Recommended critical sub-indicators and targets

Sub-indicator	**Sub-indicator value (2013)**	**Target for 2015 survey**
a. Annual Internet bandwidth expenditure per 1,000 students	$7,330	$15,000
b. Internet bandwidth per 1,000 students	4.0 Mb/s	10 Mb/s
c. PCs per 100 students	3.8	10
d. Estimated % number of students who own laptops	53%	75%
e. Percentage of students who took all or nearly all blended courses	11%	50%

All the data collected and analyzed shall be available in the e-readiness survey research database to authorized users. It could be used for benchmarking among the participating universities.

In conclusion, it is the senior leadership who will have to measure and monitor the strategic e-readiness indicators in order to achieve significant accession in all 17 indicators in the next two years before the 2015 e-readiness survey is conducted.

PART 1: E-READINESS SURVEY RESEARCH CONTEXT AND METHODOLOGY

1. INTRODUCTION

1.1 Background

The e-readiness 2013 survey was the third e-readiness survey of Kenyan universities. The first e-readiness survey of higher education institutions and universities, which included 17 of the well-established public and private universities, was conducted in August 2006 and introduced a staging framework for 17 e-readiness indicators. The second survey in 2008 covered 50 East African universities but again included the 17 universities surveyed in 2006 (Kashorda and Waema, 2009). The 2013 survey included 30 Kenyan universities with a combined student enrolment of 423,664, representing about 80% of total university enrolment as of November 2013. Again, the 17 universities were all included making it possible to track accession in the stages of e-readiness for each of the 17 indicators.

The key motivation for conducting e-readiness surveys is to provide the senior leadership of universities and higher education policy with concrete ways to measure progress in the use of ICT to enhance teaching, learning, research and efficiency. Since the e-readiness assessment tool is diagnostic, it has been possible to incorporate some of e-readiness indicator targets as key performance indicators of institutional strategic plans. For example, the indicator networked PCs per 100 students and Internet bandwidth per 1,000 students that measure Internet availability has been adopted as an institutional Internet access performance indicator.

E-readiness has been measured using a staging framework for 17 indicators grouped in five categories: network access; networked campus; networked learning; network society; and institutional ICT strategy. The network access and networked campus categories have six foundational indicators that together measure ICT infrastructure readiness. Each indicator is mapped to one of 4 stages, with stage 1 being unprepared and stage 4 the full-readiness to exploit the full benefits of ICT. However, accession from lower stages to higher stages for each of the 17 indicators requires an accession strategy that is incorporated into institutional corporate and ICT strategic plans and monitored on an annual basis.

The Ford Foundation and the Rockefeller Foundation research grants supported the e-readiness surveys conducted in 2006 and 2008, while KENET supported the 2013 survey. Only 30 of the 56 member universities participated in the 2013 survey after applying the selection criteria described in Chapter 2 of this report. However, since the e-readiness tool is available to all universities, each university could conduct its own self-assessment and use the results to develop and implement appropriate accession strategies.

This chapter highlight the phenomenal expansion of university education in Kenya from 2008 to 2013 as well as the trends in relevant national ICT indicators and networked readiness ranking over the same period. It also contains the key results and critical issues

of the 2013 survey, the first survey since Internet bandwidth prices dropped tenfold compared to prices in 2008.

1.2 Growth of University Education from 2008 to 2013

Table 1-1 summarizes the key changes in university education in Kenya. This includes the growth in total enrolment in the 17 universities surveyed in 2008 and 2013, the gross enrolment ratio (GER), and the total number of universities in Kenya. The total enrolment for the 30 universities was 423,664, representing 80% of total university enrolment in Kenya. Although student enrolment had more than doubled (109%) for the 17 universities, the number of full-time teaching staff increased by a 30.9%. *The only way for faculty to cope with the increased teaching workload was to adopt greater use of ICT in teaching and learning.*

Table 1-1: Growth of university education in Kenya

Indicator of growth	2008	2013	% growth/change
GER for Kenya (UNESCO)	3%	4%	1%
GER for South Africa	15%	16%	1%
GER for sub-Saharan Africa	6%	8%	2%
Total enrollment of the 17 universities	162,319	339,418	109%
Growth in full-time teaching staff in 17 universities	5,528	7,234	30.9%
Total number of fully chartered private and public universities	18	39	116.6%

Source: UNESCO GED, 2008 and 2013, CHE data 2008 and 2013, KENET e-readiness data 2008 and 2013

The growth in Kenya has been more rapid than in South Africa though the GER remains relatively low in comparison. This means university enrolment will continue to grow rapidly in order to achieve the 10% GER target in the Sessional Paper No. 14 (GoK, 2012).

The University Education Act 2012 (GoK, 2012b) became operational in 2013 introducing major reforms in student admissions to include equity and freedom to select universities, university funding mechanisms, and a common regulatory and accreditation framework for both private and public universities. Moreover, the 10th Cycle of Performance Contracting for public universities includes a section on adoption of ICT in university operations and even requires public universities to spend at least 10% of their recurrent budgets on ICT (GoK, 2013). Sessional Paper No. 14 of 2012 (GoK, 2012) also articulates the Kenya's education policy, including university education. In 2013, the Ministry of Education, Science and Education put university education under the same portfolio as early education, primary, secondary and tertiary education. This was in contrast to the period from 2009 to 2013 when university education was in a separate Ministry of Higher Education Science and Technology.

When the e-readiness survey was conducted in November 2013 most of the new structures introduced in both the Sessional Paper No. 14 and the new Universities Act 2012 had not yet been implemented. It was therefore likely that future surveys will be impacted by the implementations of the new act and policies.

ICT degree programs on information systems and computer science remained very popular with almost all the 30 universities offering these degree programs and general IT

literacy and foundational courses. Most of the universities had an e-learning strategy and had all started offering a few courses using e-learning in a blended or fully online format.

Thus, all universities seemed to consider ICT strategic in teaching, learning, research, and university management. However, this did not always translate to higher levels of readiness as the 2013 survey results presented in this report indicate. This may be attributed to failure in strategy execution.

1.3 Trends in ICT Readiness Indicators for Kenya

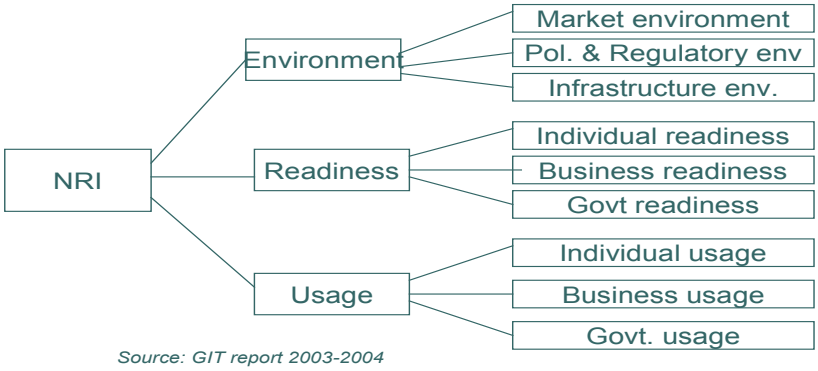
1.3.1 Trends in networked readiness index and ICT development index for Kenya from 2008 to 2013

The World Economic Forum ranks countries using the networked readiness index (NRI), which was originally derived from an assessment tool developed by the Center for International Development, Information Technology Group, at Harvard University [Dutta, 2008]. This assessment tool, also called the CID assessment tool, motivated the staging framework used in this report. The NRI measures the readiness of a country in the three dimensions of ICT, namely, the environment (regulatory and ICT infrastructure); readiness of government, businesses, and individuals; and usage of ICT by individual, businesses, and the government as shown in Figure 1-1.

The NRI is derived from a combination of hard facts data and perception survey data of senior executives of business and government from each of the countries. The hard facts data are obtained from credible databases maintained by institutions such as the World Bank, UNESCO and ITU.

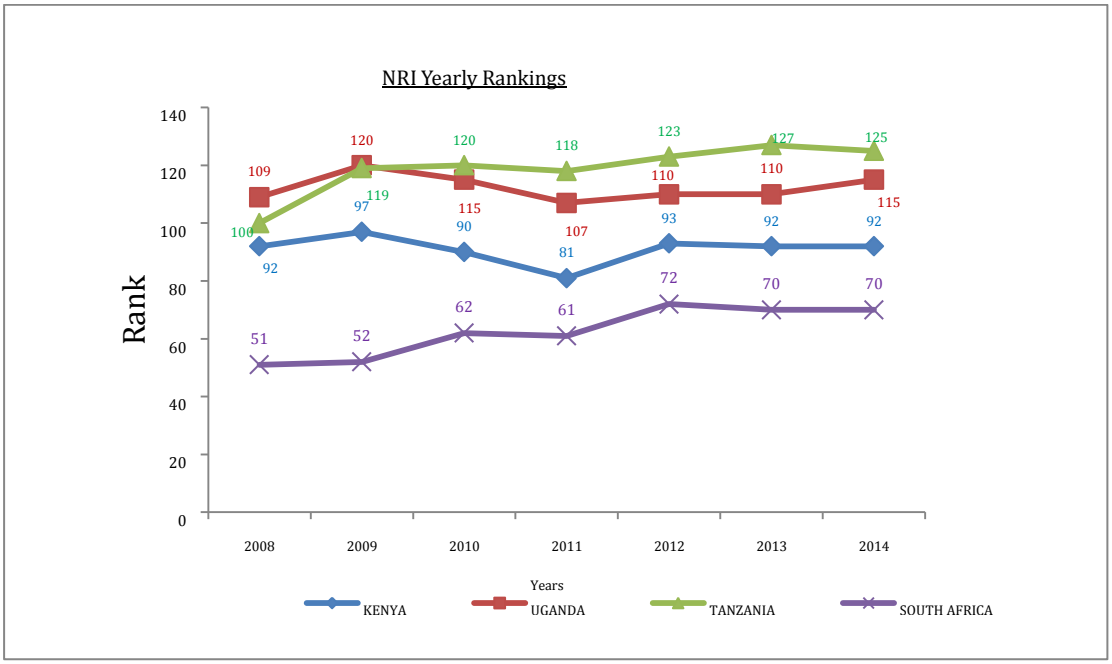
Figure 1-2 shows the NRI trends for the period 2008 to 2013 for Kenya, Tanzania, Uganda and South Africa all derived from Global IT reports published by the World Economic Forum (http://www.weform.org). In 2008, Kenya was ranked position 92 out of 127 countries while in 2013, it was ranked at position 92 out of 144. A low ranking suggests low level of readiness and usage by businesses, government and individuals. Although Kenya on average performed better than the other ranked East African countries, its NRI ranking did not improve even with the high penetration of mobile phones and mobile Internet of 77% and 52% respectively (CCK, 2014). *This shows that national telecommunications and Internet penetration indicators do not necessarily lead to a high uptake of ICT in organizations such higher education institutions, government departments or businesses*. Uptake in organizations, including government, depends on the institutional ICT strategies adopted and strong leadership and is best measured using e-readiness indicators similar to the one developed for the e-readiness survey of universities described in this report or the NRI.

Figure 1-1: Networked readiness index sub-indexes



Source: GIT report 2003-2004

Figure 1-2: NRI ranking for Kenya, Tanzania, South Africa and Uganda



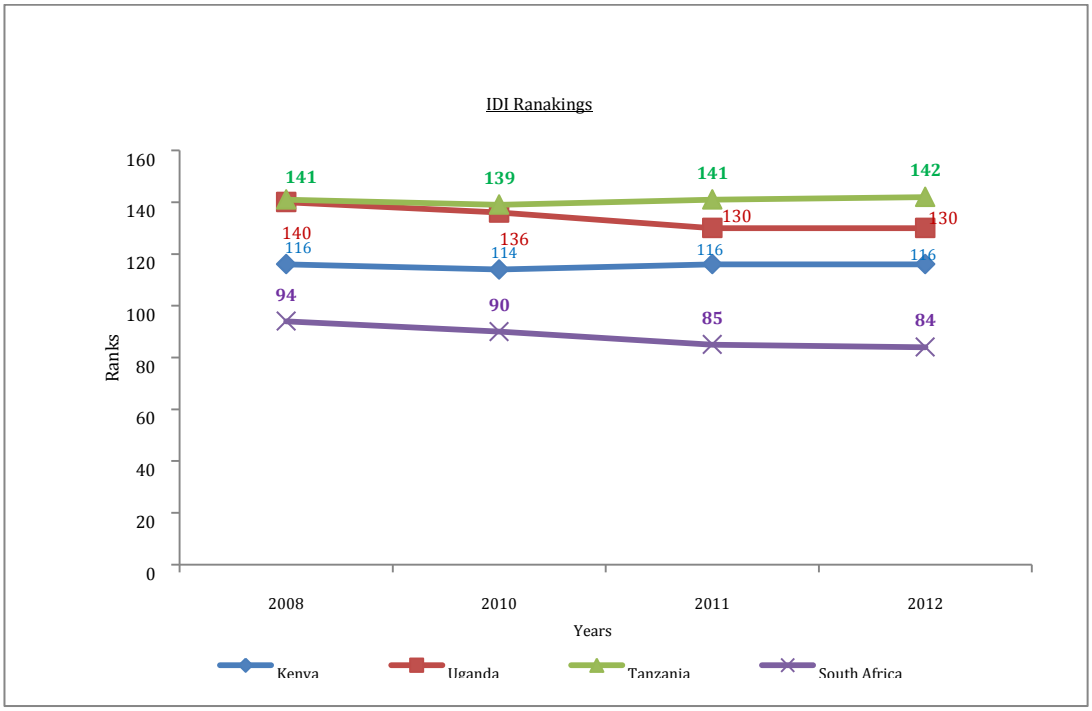
Source: Global IT reports 2008-2014

The International Telecommunications Union (ITU) developed the ICT Development Index (IDI) (ITU, 2007) that measures the following:

a) The development of ICT in countries
b) The level of advancement of ICT
c) The digital divide, i.e. differences among countries with different levels of ICT development
d) The development potential of ICT (i.e., the extent to which countries can use ICT to enhance growth and development, based on available capabilities and skills).

Most of the data used for the ranking is obtained from the national ICT regulators in the different countries. That is, it only uses hard facts data collected by national ICT regulators and submitted to ITU or World Bank. Figure 1-3 shows the IDI trends in the period from 2008 to 2013 for Kenya, Tanzania, Uganda and South Africa. It is evident that Kenya performed poorly in IDI compared to South Africa at position 116 in 2013.

Figure 1-3: IDI trends in the period 2008-2012



Source: ITU 2010-2013 Reports

Although universities operated within the national ICT readiness and uptake as measured by the above indices, it is possible to achieve Stage 4 in all 17 e-readiness indicators adopted in this report by implementing appropriate accession roadmaps.

1.3.2 Growth of the National Research and Education Network for Kenya from 2008 to 2013

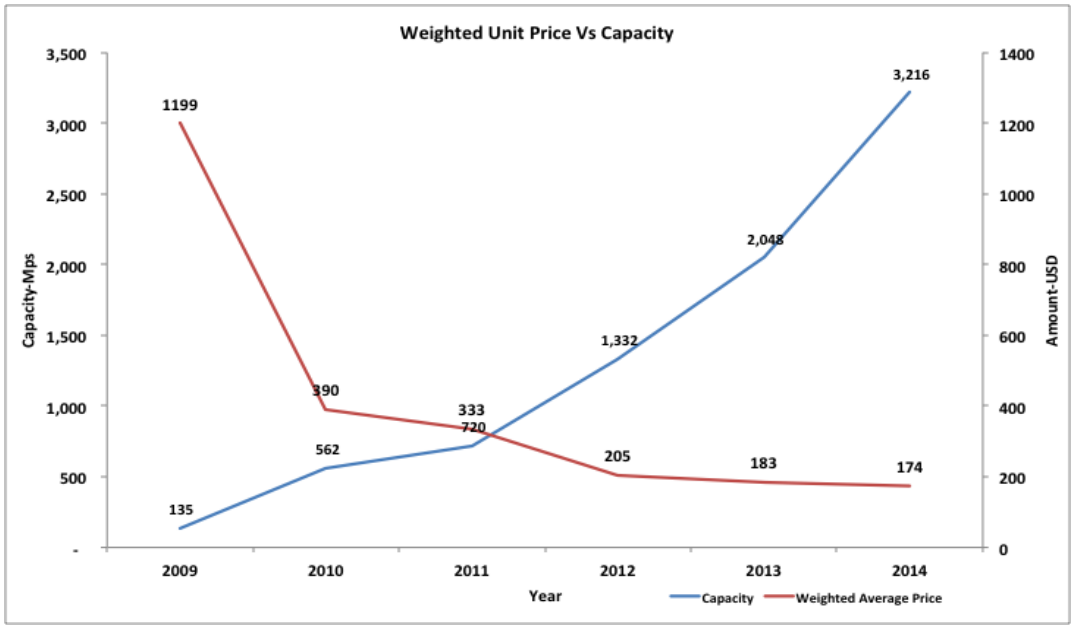
The National Research and Education for Kenya (NREN), also called the Kenya Education Network, was formed in 1999 and started its operations in 2000 in partnership with the incumbent Internet backbone operator (http://www.kenet.or.ke). In 2002, the national ICT regulator licensed it as a private network operator and it began operating its own satellite gateway to the global Internet and providing Internet services to member institutions in 2005.

In 2008 it provided connectivity to 10 of its member universities directly or through licensed operators, and distributed only 12 Mb/s of satellite bandwidth. In 2009, the KENET network was upgraded with the bulk purchase of about 200 Mb/s of satellite bandwidth that was distributed to 34 member institutions, including all the 17 universities included in this survey. The satellite bandwidth was distributed to the 34 university campuses using mainly fiber-based leased lines provided by Kenya Data Networks (KDN). A few of the campuses were on last mile microwave radio links. The funding for purchasing the satellite bandwidth and building the national distribution network was provided by a Government of Kenya grant to universities under the World

Bank's Kenya Transparency and Communications Infrastructure Project (KTCIP). In total, KTCIP provided $22.5 million to the connected member institutions that included most universities. This funding was matched by contributions of the connected higher education institutions and universities through KENET.

In 2010, KENET started distributing undersea fiber Internet bandwidth. Figure 1-4 shows the trends in Internet bandwidth distributed to the campuses of member universities. By November 2013, KENET was distributing Internet bandwidth to 140 campuses, up from the 34 in 2009. The weighted average unit price of Internet bandwidth to the connected institutions had dropped sevenfold from the unit price of about $1,200 per Mb/s per month in 2009 to about $174 per Mb/s per month for the undersea bandwidth in 2013 as shown in Figure 1-4.

Figure 1-4: Growth in Internet bandwidth distributed by KENET and weighted unit price trend



Source: KENET

The results of the e-readiness 2013 survey show that this dramatic increase in Internet bandwidth has not translated into accession to stage 3 and above for most of the 17 indicators (only two out of 17 indicators achieved stage 3 and above). The results also show that accession has occurred mainly in Internet availability indicator as well as in the networked society category of indicators that measure ICT usage by individuals such as students, faculty and staff. *Most of the other e-readiness indicators have not changed in any significant way because they depend on the behaviour of faculty and the leadership of academic heads of departments in the universities.*

1.4 Research Objectives

The e-readiness 2013 survey had the following specific objectives:

1. Conduct a *diagnostic* assessment of overall e-readiness of 30 Kenyan universities using the e-readiness assessment framework developed in 2006 (Kashorda et. al., 2007).
2. Measure the Internet access device ownership of students, faculty and staff.

3. Assess perceptions of students, faculty, and staff on the impact of learning technologies on university learning and teaching environments.
4. Identify critical issues that need to be addressed in order to achieve accession to higher stages of readiness.
5. Disseminate research findings to senior leadership of universities, senior policy makers in government and to students and faculty and develop an ICT in higher education strategy brief in 2014.

1.5 Assessment Framework and Key Research Findings of E-Readiness 2013 Survey

The assessment framework used in the 2008 survey was derived from an e-readiness assessment tool originally developed by the Center for International Development at Harvard University (http://www.readinessguide.org). This is the same assessment framework used in the 2006 e-readiness survey of Kenyan Higher Education Institutions (Kashorda, 2007) but with minor modifications. The framework contained 17 indicators grouped into the following five categories:

(i) Network access (4 indicators–information infrastructure, Internet availability, Internet affordability, network speed and quality)

(ii) Networked campus (2 indicators–network environment, e-campus)

(iii) Networked learning (4 indicators–enhancing education with ICTs, developing the ICT workforce, ICT research and innovation, ICTs in libraries)

(iv) Networked society (4 indicators–people and organizations online, locally relevant content, ICTs in everyday life, ICTs in the workplace)

(v) Institutional ICT strategy (3 indicators–ICT strategy, ICT financing, ICT human capacity)

The framework is diagnostic and stages each of the 17 indicators on a scale of 1 to 4, where 1 represents unpreparedness and 4 the highest degree of readiness. The staging for the 17 indicators was derived from the average of up to 88 sub-indicators similarly staged on a scale of 1 to 4 using the hard facts and perceptions data collected from the 42 campuses surveyed. Using a diagnostic e-readiness framework makes it easier for the results to be used to develop an accession strategy to higher stages for each indicator.

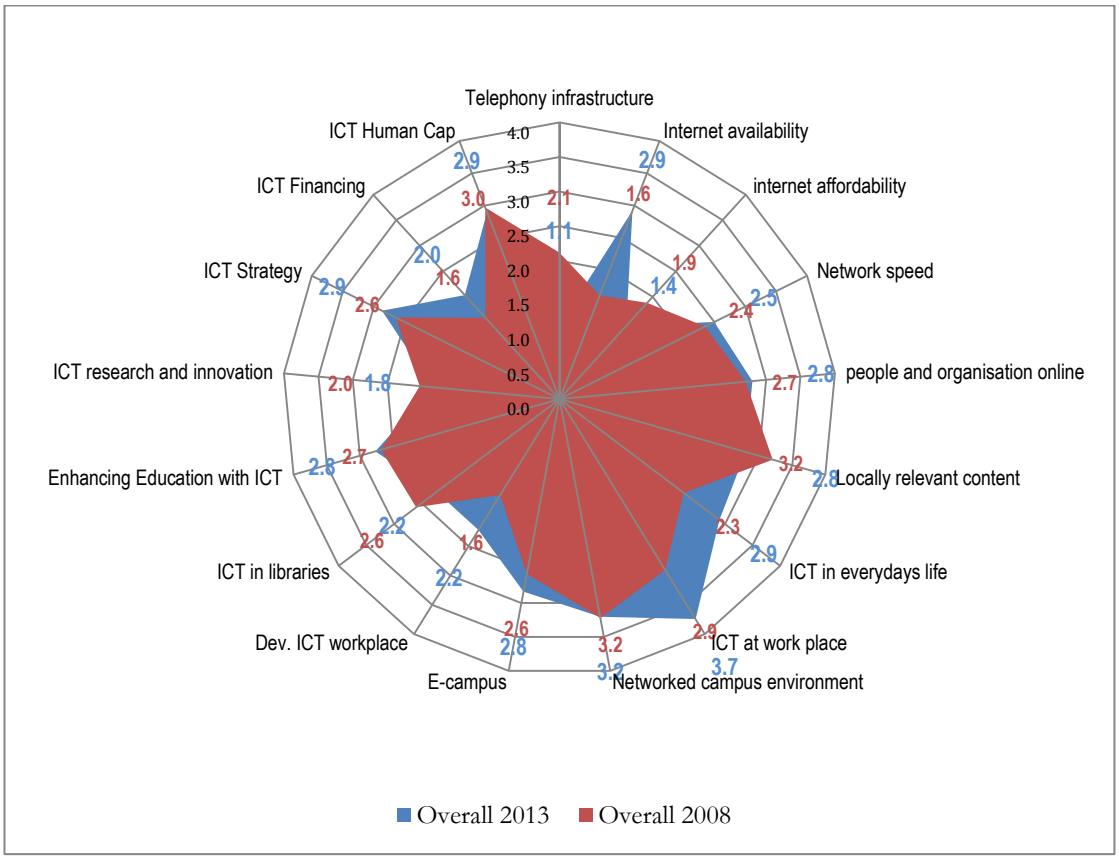
The detailed questionnaires used to collect data were:

- A hard facts questionnaire that was completed by heads of ICT and other senior university administrators such as finance managers and academic registrars.
- A perceptions questionnaire (field data) that was filled by 14,529 students and 1,333 teaching and non-teaching staff from the 30 universities surveyed.

The questionnaires were administered to a statistically significant sample in each of the 30 universities surveyed. The total sample was 1,497 faculty members and non-teaching staff and 14,974 students. All the data (hard facts and survey data) was entered into a web-based database by a selected group of university students (see: http://ereadiness.kenet.or.ke) and is available to each of the universities.

Figure 1-5 summarizes the results of the study by presenting the average staging for each of the 17 indicators in a radar diagram for 2008 and 2013. On average, universities in the survey were at stage 2.0 and above in 10 out of the 17 indicators. However, they only achieved stage 3.0 in one indicator for locally relevant content and stage 2.5 and above in only four of the 17 indicators. This implies that accession would be more dependent on the institutional ICT strategy category than the other categories of indicators. This study also identified the critical issues that needed to be addressed.

Figure 1-5: Overall radar diagram 2008 and 2013



Source: KENET e-readiness data 2008 and 2013

The networked learning category, particularly in the ICT research and innovation indicators, performed poorly as in 2008. It appears that universities are still not allocating adequate budgets to Internet bandwidth as reflected in the low stages in Internet bandwidth financing and Internet affordability indicators.

A surprising result of the survey was that 53% of the students owned laptops and 53% owned smartphones. In some universities, the laptop ownership was as high as 86%. This had happened without any deliberate government or university interventions to support student device ownership, indicating that universities should focus on infrastructure and networked learning category of indicators. Although 73% of the students preferred blended learning and considered learning management systems very important for academic success, online or blended courses were not available. Only 11% of the students reported to have taken all or nearly all blended courses in the academic year 2012/2013.

This survey therefore shows that the senior academic leadership is not providing the necessary environment for developing and teaching blended or online courses in the universities. The dissemination will therefore focus on this group of leaders (e.g., Deputy Vice Chancellor (DVC) for academic affairs, academic deans and heads of academic departments).

1.6 Organization of the Report

This report is organized into three parts: part 1 presents the context and methodology of the e-readiness 2013 survey; part 2 covers the staging results and analysis; and part 3 presents the overall e-readiness findings, critical issues and conclusions.

2 E-READINESS STAGING FRAMEWORK AND RESEARCH METHODOLGY

2.1 E-Readiness Staging Framework and Assessment Tool

In general, e-readiness assessment tools can be classified into two broad categories as follows:

- E-economy readiness tools that focus on a nation's or communities' readiness to exploit ICT for economic development (i.e., to take part in the digital economy).
- E-society readiness tools that measure the ability of the overall society to benefit from ICTs (Bridges, 2002).

E-society readiness assessment tools can also gauge the readiness of a nation or community to participate in the digital economy. The CID e-readiness tool, appropriately titled "Readiness for the Networked World–A Guide for Developing Countries," is an example of an e-society tool (CID, 2000).

Although the authors of this report modified the CID assessment tool in 2006 for use in e-readiness assessment of higher education institutions, the method of staging the indicators on a scale of 1 to 4 was not changed (Kashorda and Waema, 2009). The modified e-readiness assessment tool and staging framework used in the 2006, 2008, and 2013 surveys defined 17 indicators grouped into five categories as follows:

1. *Network access* (4 indicators–information infrastructure, Internet availability, Internet affordability, network speed and quality)

2. *Networked campus* (2 indicators–network environment, e-campus)

3. *Networked learning* (4 indicators–enhancing education with ICTs, developing the ICT workforce, ICT research and innovation, ICTs in libraries)

4. *Networked society* (4 indicators–people and organizations online, locally relevant content, ICTs in everyday life, ICTs in the workplace)

5. *Institutional ICT strategy* (3 indicators–ICT strategy, ICT financing, ICT human capacity)

The staging for each of the 17 indicators is derived as an average of the staging for the associated sub-indicators. In total, 88 sub-indicators were staged and were used to calculate the staging for the indicators.

In order to stage the sub-indicator, the researchers developed a staging framework that maps the values of the sub-indicator to a stage. For example, staging for Internet availability was measured as shown in Table 2-1.

Table 2-1: Internet Availability Indicator Staging

	Sub-indicators 1	Sub-indicator 2
Stage level	**PC per 100 students**	**Internet bandwidth (Mb/s)per 1,000 students**
1	< 5%	< 0.5
2	5 – 19%	0.5 – 2
3	20 – 49.9%	2 – 4
4	≥50	> 4

The data for staging the questionnaires was obtained either from the hard facts questionnaires or the perception questionnaires originally developed in the 2006 survey but modified slightly in 2008 and 2013 for clarity and ease of data collection.

The 2008 survey recommended that five critical e-readiness sub-indicators be incorporated in corporate and ICT strategic plans of universities. This means that the Vice Chancellors or senior management would track the five sub-indicators. In the 2013 survey, the integration of ICT in curricula as reported by DVC for academic affairs was replaced with the sub-indicator of the number of students who had reported to have taken a few blended or fully online courses in the past academic year. The critical sub-indicators also included the percentage of students who owned laptops because this affected the mode of learning adopted and reduced or increased the demand for university student labs.

The five critical sub-indicators for the 2013 survey were:

a. Internet bandwidth cost per 1,000 students
b. Internet bandwidth per 1,000 students
c. PCs per 100 students
d. Estimated percentage of students who owned laptops
e. Percentage of students who took all or nearly all blended courses

This data could be collected regularly from the institutional learning management system, the institutional ERPs that tracks the blended or online courses offered by the universities or the authorization and authentication database for wireless network users. In the 2013 survey, the data on percentage of students who owned laptops or had taken blended courses was obtained from the perception survey of students. Universities at different stages of readiness could also select an even smaller sub-set of the 88 sub-indicators as part of the annual monitoring and evaluation of the implementation of their institutional strategic plans.

2.2 Methodology

2.2.1 Participating universities and selection criteria

The e- readiness 2013 survey collected data from 30 universities consisting of 20 public universities and 10 private universities. This included all the 17 universities that participated in the 2006 and 2008 e-readiness survey studies. The total student enrolment in the 30 universities was 423,664 and was estimated to be about 80% of the total enrolment in Kenyan universities.

The main factors considered in the selection of the 30 universities were:

1. The 17 universities that participated in the 2006 and 2008 surveys in order to provide data for longitudinal studies
2. University campuses with a student enrolment of 2,000 and above
3. Universities that had participated in preliminary hard facts demographic data collection exercise in 2012 and 2013
4. Universities that were fully chartered by the Commission for University Education. University colleges or private universities in initial stages of formation were therefore not included.

The e-readiness survey assessment was campus-based and 42 campuses of the 30 universities were included in the survey. The data was collected over a one-month period from mid-October to mid-November 2013.

2.2.2 The e-readiness survey process and data collection window

The survey started in September 2013 when letters of authorization were sent to the Vice Chancellors (VCs) of the 30 participating universities. This was followed by recruitment of research assistants who were mainly junior ICT faculty staff from each of the participating campuses. This was the first time that the research team had included research assistants from the participating campus.

The researchers trained the research assistants at the start of the survey process in September 2013. The training included introduction to the e-readiness indicators and assessment tool developed by the researchers. The training also included understanding the hard facts and perceptions questionnaire that were to be used for data collection as well as the logistics of data collection and data entry.

Each research assistant was required to recruit 10 student enumerators per campus based on the following criteria: they had to be distributed across all the faculties and departments; across the years of study including those pursuing postgraduate studies; and there had to be gender balance. Ten enumerators were recommended per campus.

All the hard facts and perception questionnaires were sent to the campuses through courier services. Data collection commenced on October 10, 2013 and was to be completed within a maximum of four weeks.

2.2.3 Hard facts and perception questionnaires

Data for the 2013 survey was collected using hard facts and perception questionnaires originally developed in 2006 survey but modified in 2008 and 2013. The modified hard facts questionnaire, divided into six sections, was completed by the following senior officers at the universities:

1. DVC for academic affairs or equivalent with overall responsibility for academic programs, including e-learning and distance education
2. Registrar in charge of student records
3. Chief finance officers (CFOs)
4. Deans of the faculty or ICT schools (mostly deans responsible for computer science or information systems).
5. University librarians

6. Directors of ICT responsible for infrastructure, administrative and academic information systems

The hard facts questionnaire included questions on the perceptions on the impact of ICT on the overall mission and outcomes of the universities. For example, the DVC for academic affairs and the deans were asked questions on the impact of ICT readiness on research productivity. This was the first time the impact questions were included.

The perception questionnaire completed by students, faculty and non-teaching staff in the 42 campuses included the following new categories of questions:

1. Device ownership questions on ownership of smartphones, laptops, desktop computers and tablets by the students, staff and faculty.
2. Learning environment questions on the student's preferences for learning (face to face, blended and online) and the availability of blended or online courses.
3. University environment and ICT questions on how the university ICT environment was supporting faculty and students to achieve academic success.

The 2013 survey questionnaires were posted on the e-readiness survey 2013 website at http://ereadiness.kenet.or.ke.

2.2.4 Sampling method and sample sizes

The questionnaires were administered to a statistically significant sample from each of the 42 campus surveyed. The total sample was 1,497 teaching and non-teaching staff and 14,974 students. A key challenge in obtaining a random sample was the lack of student and staff data in electronic form in most institutions. For example, the survey intended to sample the students and staff at random from an electronic list obtained from the academic registrars. This was not possible. Instead, the randomization was achieved using the guidelines to the enumerators that the samples should include staff and students from different departments and years of study for the students. In future strictly random data generated from the information systems of the universities will be used.

The sample sizes for perceptions questionnaires took into account the student population, different categories of students (undergraduates, post-graduates), faculty and staff. Statistically significant samples with a 95% confidence level were determined for each university.

2.2.5 Data collection and data entry processes

The hard facts and perceptions questionnaires were directed questionnaires. The following procedure was used:

1. The e-readiness survey coordinator recruited and trained research assistants from participating universities.
2. Each research assistant recruited and trained the student enumerators in his/her university using the guidelines provided. These enumerators then administered the perception survey questionnaires to students.
3. The research assistants from each campus were responsible for collecting the hard facts data, which was the most challenging part of the exercise. They also collected the staff perception data.

The hard facts questionnaires took an average of 10 working days to complete, and for some universities it took over a month to obtain the data. *It also took exceptionally long to obtain financial data (i.e., complete the CFO hard facts questionnaires) and for most of the universities, the published annual reports or audited were not provided as supporting data. Researchers were therefore unable to verify the data collected using published data or reports.*

All the hard facts and valid perceptions data was entered into the online database and then exported to SPSS for analysis. A group of 81 university students entered the data at a centralized computer lab at the University of Nairobi using a web-based data entry interface developed for the survey (http://ereadiness.kenet.or.ke). The students were from the participating universities based in Nairobi in addition to those who were involved in data collection. Although the data could have been entered at campuses, the centralized data entry ensured that the project statistician and research assistant responsible for developing the database could supervise the data entry exercise. Quality assurance involved sampling 10% of the questionnaires entered by independent data entry students and checking that the data entered was accurate.

2.2.6 Data analysis

A total of 14,529 student questionnaires and 1,333 staff questionnaires were successfully entered into the e-readiness 2013 survey database for the 42 campuses. The data was then exported to SPSS for data analysis by the team of data analysts. The analysis was done at both campus and university level and all the data has been posted in the results database for each institution. Thus, it will be possible for each of the 30 universities to query the database and check analyzed data for each of the 17 indicators. The aggregated results of the analysis and staging are contained in Chapters 3 to 8 of this report.

Demographic analysis of the universities

The study surveyed 30 universities (20 public and 10 private) with an enrolment of 423,664 students. The sample size comprised 14,974 students and 1,497 staff. For students, 14,529 questionnaires were valid and analyzed with a response rate of 87.8% of which 59.4% of the respondents were male while 39.9% were female. For the staff 1,333 questionnaires, were valid and analyzed with a response rate of 89 % of which 58.7% of the respondents were male and 35.5% female. Table 2-2 shows the categories of staff respondents.

Table 2-2: Staff distribution by academic department

	Number of Staff	Percentage
Admissions, Registrar	87	6.5
Student services (residential, co-curriculum)	61	4.6
Accounting, finance, administration	193	14.5
Academic services	226	17.0
Maintenance, security, transport	28	2.1
IT services	180	13.5
Other	92	6.9
Not stated	466	35.0
Total	1,333	100.0

Source: KENET e-readiness data 2013

The staff respondents had different levels of education as shown in *Table 2-3*.

Table 2-3 : Level of formal education of staff

Academic qualification	Number of staff	Percentage
PhD	141	10.6
Master's	524	39.3
Bachelors	428	32.1
Diploma	175	13.1
Other	15	1.1
Not stated	50	3.8
Total	1,333	100.0

Source: KENET e-readiness data 2013

Those in the other categories had qualifications ranging from Kenya Certificate of Secondary Education (KCSE), higher diploma and professional courses. The non-teaching staff members were also in different academic areas as shown in *Table 2-4*.

Table 2-4: Staff academic areas

Academic areas	Number of staff	Percentage
Human and social sciences	130	9.75
Languages, communication, journalism	45	3.38
Computing (IT, IS, computer science, computer engineering)	283	21.23
Engineering (electrical, mechanical, civil)	89	6.68
Biological sciences, physical sciences	104	7.80
Education	63	4.73
Medical sciences	53	3.98
Business or commerce	182	13.65
System	384	28.81
Total	1,333	100.00

Source: KENET e-readiness data 2013

The students' sample was also representative of students in different levels of study with 92% of the respondents undertaking their undergraduate studies.

2.3 Conclusion

This chapter discussed the e-readiness staging framework and assessment tool. The five critical sub-indicators for the survey were discussed. The chapter further discussed the methodology adopted and the selection criteria for the participating universities. The survey process and the tools used are explained including the data collection and entry process. Overview of the data; mainly demographic and frequency distribution are also provided.

PART 2: FINDINGS AND STAGING ANALYSIS

3 NETWORK ACCESS

3.1. Overall Staging for Network Access Category of Indicators

The network access category of indicators included the following four indicators:

(i) Telephony infrastructure (in the campus)
(ii) Internet availability (by the universities)
(iii) Internet affordability (by the universities)
(iv) Network speed and quality (as perceived by users on campus)

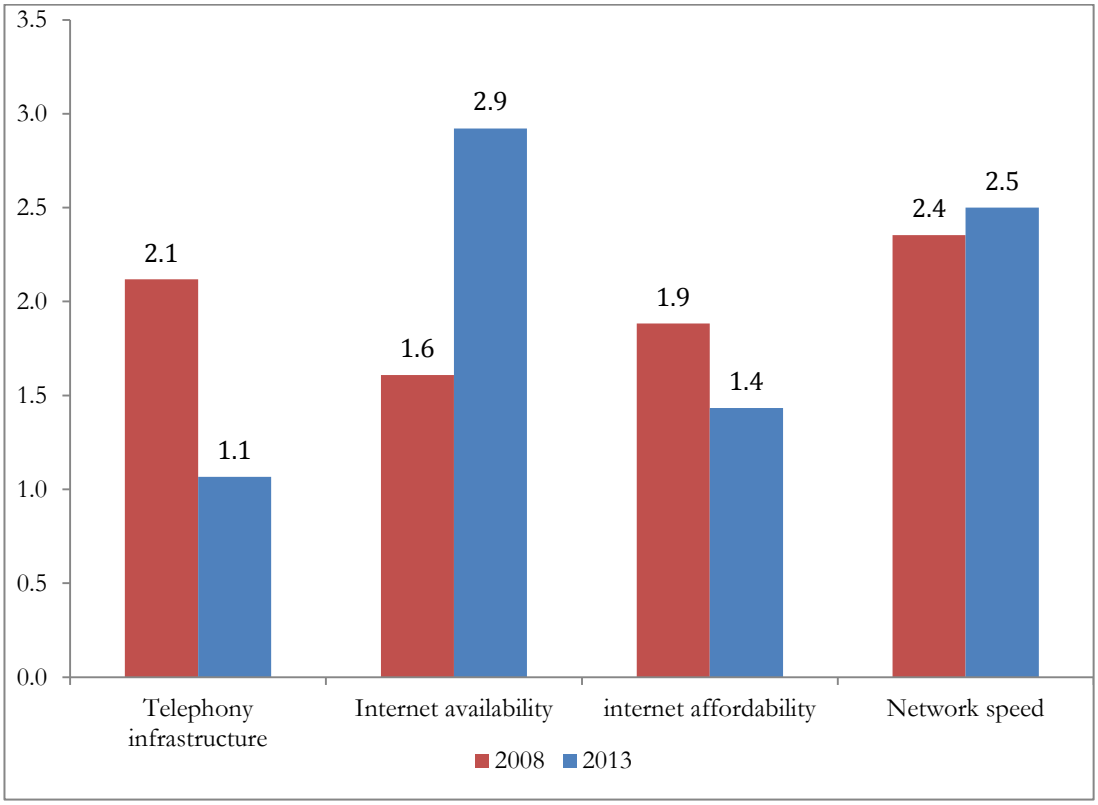
The telephony infrastructure was measured using two sub-indicators – internal and external teledensity, that measured the availability of voice communication telephone extensions to employees of the university (faculty and staff) as well as access to external telephone lines (mobile or fixed) from the universities' private branch exchange (PBX).

The Internet availability indicator depended on availability of networked computers as well as the international bandwidth purchased. The sub-indicators therefore included PCs per 100 students and Internet bandwidth per 1,000 students. For example, stage 2 in the framework was attained by a PC to student ratio range of 1:20 to 1:5 and a downlink bandwidth range of 640 Kb/s to 2.5 Mb/s per 1,000 students (Kashorda and Waema, 2009). Stage 4 downlink bandwidth was 4 Mb/s per 1,000 and above according to the staging framework.

However, the researchers recommended a target of 10 Mb/s per 1,000 students with undersea bandwidth that was at least tenfold cheaper than the satellite bandwidth available in the 2008 survey. Assuming 5% of students were online (i.e., with a PC ratio of 1:20), that translated to only 200 kb/s per student, lower than the 256 kb/s target of the UN broadband commission (UNB, 2013) or the Kenya National Broadband Strategy 2013 targets (GoK, 2013c). In 2008, the researchers had set a downlink bandwidth target of 1 Mb/s per 1,000 for stage 2 for Kenyan universities because of the high cost of satellite-based Internet bandwidth at that time.

Figure 3-1 shows the staging of the network access category of indicators for the 2008 and 2013 surveys for 17 universities and 30 universities respectively. Overall, the universities were at stage 2.0 in 2008 and this increased marginally to stage 2.1 in 2013. However, the telephony infrastructure indicator decreased to stage 1.1 in 2013 compared to stage 2.1 in 2008. The drop in telephony infrastructure indicator staging suggests that the universities did not have adequate telephones for staff and faculty could have a negative impact on the work environment. Further research was required to determine the impact on efficiency and quality of academic and business services of the universities.

Figure 3-1: Overall staging of network access category of indicators – 2008 and 2013



Source: KENET e-readiness data 2008, 2013

Table 3-1 shows that the student population for the 17 universities that participated in the e-readiness surveys of 2008 and 2013 increased by about 109%. The strategic sub-indicators of Internet bandwidth per 1,000 students had increased to 4.22 Mb/s by 2013, up from only 0.436 Mb/s in 2008. The average cost of Internet bandwidth had dropped from an average of $2,300 per Mb/s per month in November 2008 to $160 per Mb/s per month in November 2013 (i.e., 14 times reduction in unit cost), and the total institutional bandwidth had increased by 21 times. This means that the 17 universities had increased their Internet budgets in order to provide a better broadband Internet experience for their users and to cope with the large increase in the student population.

Table 3-1 also shows that the PC ratio had decreased to 4.1 per 100 students from 5.5 per 100 in 2008. This was probably due to the high increase of 109% in the student population without a corresponding increase in student computer lab PCs. In 2008, an estimated 25% of students had access to a computer off campus, at home, compared to 30.4% in the 2013 survey. *Additional research was required to establish why only 30.4% of the students reported that they had access to a computer at home while average student laptop ownership was 53%.*

Table 3-1: Demographic data and Internet availability sub-indicators for 17 universities – 2008 and 2013

Year of survey	Total students	Total PCs owned by students	Total bandwidth (Mb/s)	Bandwidth per 1,000 students	PCs per 100 students	% of students with PC access at home
2008	162,319	8,907	70.8	0.436	5.5	27
2013	339,418	13,815	1,431.5	4.22	4.07	30.4

Source: KENET e-readiness data 2008, 2013

3.1.1 Telephony infrastructure

Stage 1.1 on this indicator shown in Figure 3.1 means that the internal teledensity was under 50% while the external teledensity was under 10% in the 2013 survey. This was a drop from stage 2.1 in 2008 for the 17 universities, which indicated that the additional 13 universities included in the 2013 survey had not established telephony infrastructure for their staff.

The 30 universities surveyed in 2013 had a total of 8,850 faculty and 16,792 non-teaching staff. This was a large community that required telephone communications for both internal and external communications. A private branch exchange with adequate capacity to serve the large community was used to provide organizational telephony services. However, universities did not seem to have invested in telephony infrastructure which could have reduced the efficiency of faculty and staff members, and compelled them to use personal mobile phones or alternative modes of communications while on campus. This is an area that may warrant further research.

3.1.2 Internet availability

Internet availability was measured using two main sub-indicators – Internet bandwidth per 1,000 students and shared student PCs per 100 students available in the labs and libraries. In 2008 the Internet availability indicator was at stage 1.6, suggesting that most universities were providing limited Internet access to students. In 2013, this indicator was at stage 2.9 mainly because of increased Internet bandwidth ratios of the universities.

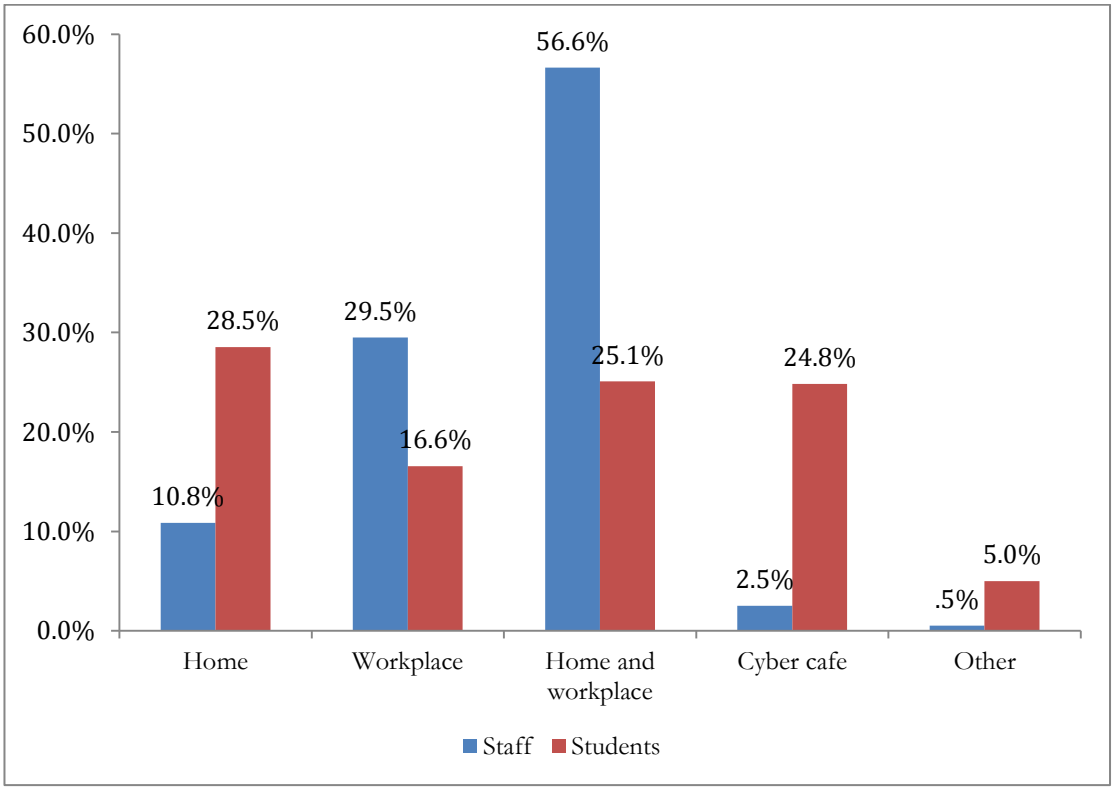
For example, Table 3-1 shows that on average the 17 universities were providing 436 kb/s per 1,000 students while they were providing 4.22 Mb/s per 1,000 students in the 2013. This was considered stage 4 for the Internet bandwidth per 1,000 students sub-indicator. However, it was still below the revised researchers' target of 10 Mb/s per 1,000 students minimum for campus broadband access (*a modest target since it translates to only 200 Kb/s per student if 5% were concurrently online at any time during the day*). In 2008, the researchers' target for institutional bandwidth was 1 Mb/s per 1,000 students but with availability of undersea Internet bandwidth that was about 10 times cheaper than the satellite bandwidth in 2008, this was revised upwards to 10 Mb/s per 1,000 students in 2012.

Internet access on campus also required availability of networked PCs in the labs and offices. This was measured using the sub-indicator of PCs per 100 students. Table 3-1 shows that the average PCs per 100 students was only 4.1 for the 17 universities which was not only below the 10 student PCs per 100 students researchers' target but also lower than the 5.5 PCs per 100 students in the 2008 survey.

This means that the increase in student PCs ratio did not match the increase in student enrolment. *The overall PC ratio for the 30 universities was only 3.8 PCs per 100 students.*

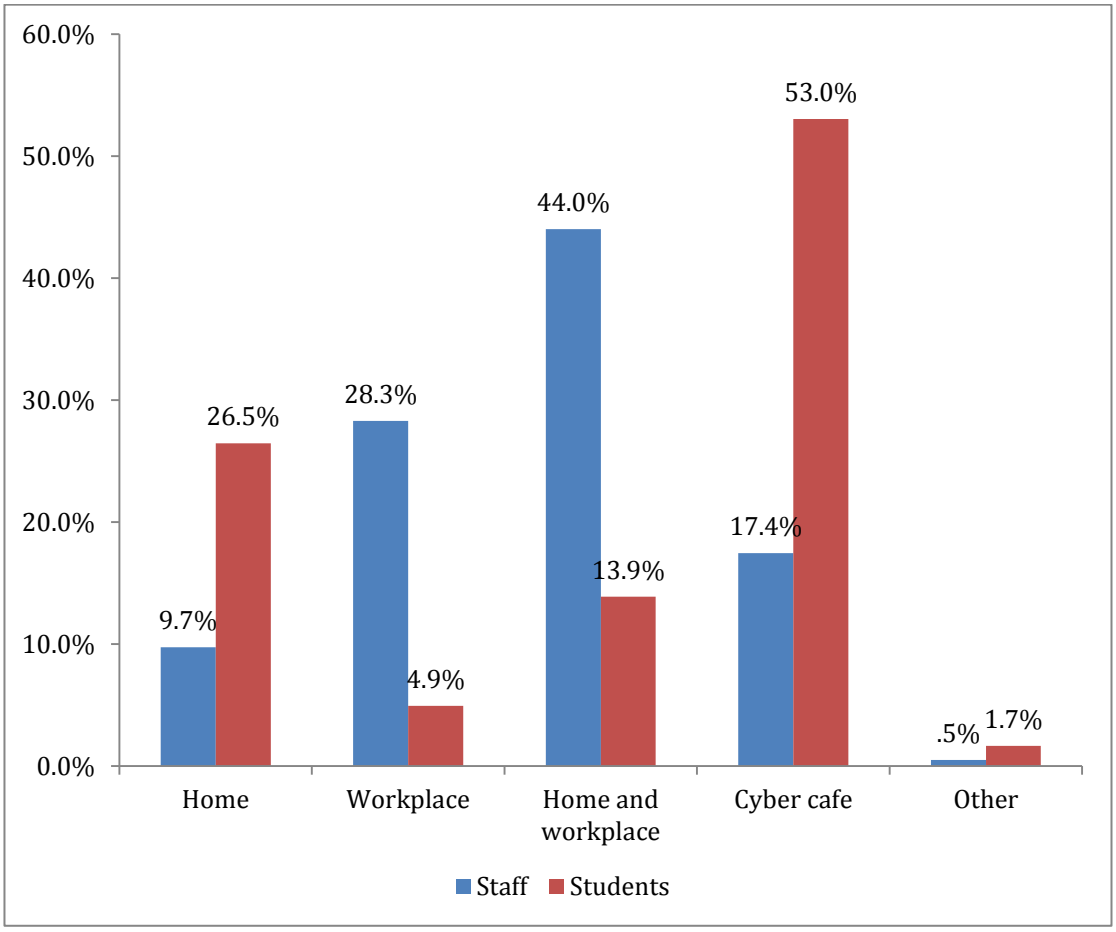
Although some universities had started providing wireless access to Internet to students through Wi-Fi hotspots on campus, about 25% of the 423,664 students enrolled in the 30 universities still used cyber cafés for primary computer and Internet access as shown in *Figure 3-3*. In the 2008 survey, about 53% accessed computers and Internet from commercial cyber cafés as shown in *Figure 3-3*. This was a significant improvement but it still implied inadequate on campus access to computers by students either from student labs or student-owned laptops. Universities therefore still needed to invest in expanded Wi-Fi coverage on campus and in shared student lab facilities in order to further reduce the use of cyber cafés as the primary access to computers. For example, an increase of PC ratio from the 3.8 in 2013 to the target of 10 per 100 students would reduce access to computers from cyber cafés. Similarly, an increase in student ownership of laptops from 53% in 2013 to 75% would further reduce the need for cyber cafés.

Figure 3-2: Location of primary access to computers by users in universities (2013 survey)



Source: KENET 2013

Figure 3-3: Location of primary access to computers by users in universities (17 universities in 2008 survey)



Source: KENET 2013

Table 3-2 shows that small universities had a PC ratio of 5.4 compared to 2.0 for large universities with 10,001 to 30,000 students. The table also shows that small universities achieved an Internet bandwidth ratio of up to 10Mb/s per 1,000 students compared to 3.3 Mb/s in large universities. Interestingly, the very large universities with an enrolment of 30,000 students and above had better PC ratios compared to the medium-sized or large universities. This will be a subject of further research to determine the causes of this anomaly.

In the 2008 survey the large universities had a bandwidth ratio of only 0.4 Mb/s per 1,000 compared to 3.3 in 2013 despite the dramatic increase in student enrolment. The 30 universities had a total student enrolment of 423,664, which represented an estimated 80% of the total university enrolment in Kenya as of November 2013.

Table 3-2: Internet availability indicators for universities analyzed by size of universities

Category	Number of institutions	Total Number of students	Total bandwidth (mb/s)	BW per 1000 students	PCs per 100 students
>30,000 students (very large)	4	224,804	770.2	3.5	4.7
10,001–30,000 students (large)	6	88,417	275.7	3.3	2.0
5,000–10,000 students (medium)	13	84,418	422.0	5.0	4.0
<5,000 students (small)	7	26,025	231.8	10.1	5.4
Total	**30**	**423,664**	**1,699.65**	**4.0**	**3.8**

Source: KENET 2013

What drives students to cyber cafés?

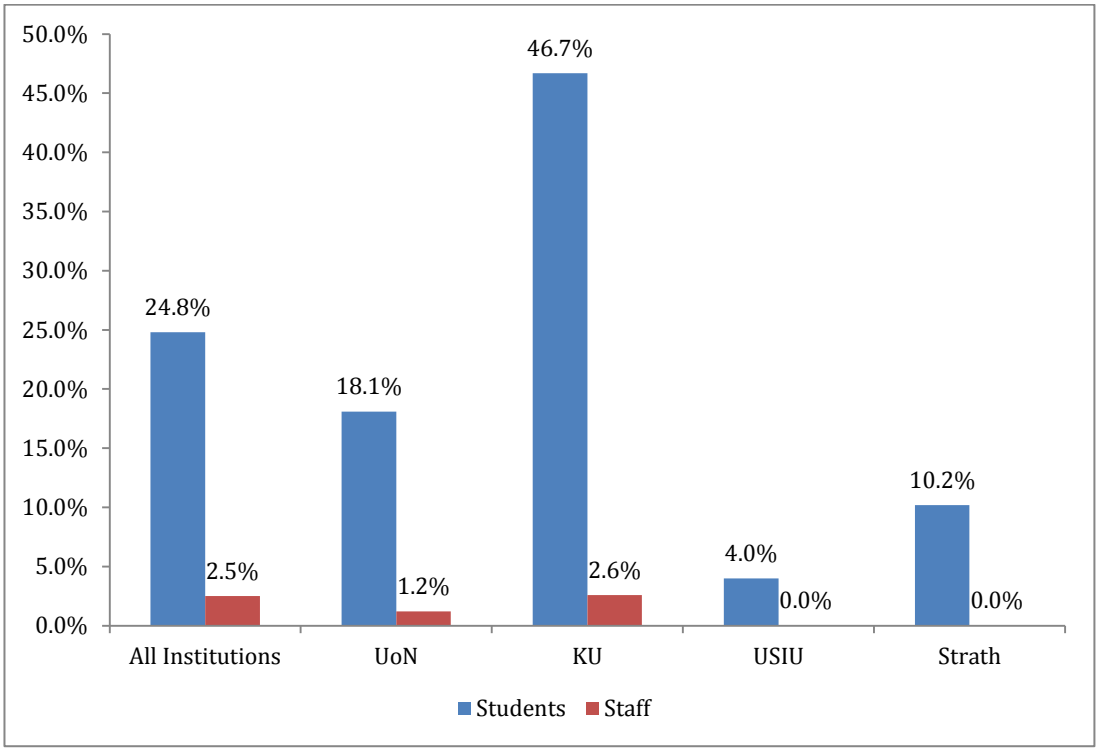
Low PC and bandwidth ratios in the universities drove students to cyber cafés as shown in Figure 3-4. In the 2008 survey 53% of the students accessed PCs and the Internet from cyber cafés and this dropped to 25% in 2013, despite the more than 140% (162,319 to 423,664) increase in total student enrolment over the five year period.

Unlike in the 2006 and 2008 surveys, the 2013 survey collected data on student ownership of laptops, desktop computers and smartphones. Data shows that on average, 52.8% of the students had a laptop and 53.3% had a smartphone. The smaller private universities had a higher proportion of students owning laptops compared to the large public universities. For example, 86% of students in the United States International University (USIU), a private university in Nairobi with an enrolment of about 5,000 students, owned a laptop. At Kenyatta University, a public university that was just about 5 km from USIU but with a much larger student enrolment of 76,000 students, only 34% reported to own laptops.

Figure 3-4 suggests low laptop ownership by students or low student PC ratios might be related to proportion of students who used cyber cafés as primary location for access of computers and Internet. For example, Kenyatta University, where only 34% of the students owned laptops, had a relatively high percentage of students using cyber cafés at 47%. At University of Nairobi, where 57% of students owned laptops, only 18% reported to use cyber cafés while at USIU, only 4% of students used cyber cafés probably because of the high proportion of students who owned laptops at 87% as of the 2013 survey.

This was also observed in 2008 where low campus PC ratios translated to higher percent of students accessing Internet from cyber cafés. To increase laptop ownership by students the universities started signing partnership agreements with laptop suppliers and manufacturers in 2013. However, this was an area for further research to establish the balance between student laptop ownership and university-based student computer labs.

Figure 3-4: Percent of users with cyber café as primary computer and internet access location (Overall, UoN, KU, USIU and Strathmore)



Source: KENET 2013

3.1.3 Internet affordability

The universities achieved stage 1.4 in this indicator (Figure 3-1) indicating that institutions were spending about US$13,000 to US$25,000 per 1,000 students per year on Internet bandwidth according to the researchers' staging framework. In November 2008, US$13,000 annual Internet budget could purchase only 0.47Mb/s at the unit price of $2,300 while in November 2013 this same budget could purchase 6.8 Mb/s at unit price of $160 per Mb/s per month.

The total Internet bandwidth expenditure in the 2012/2013 financial year for the 30 universities surveyed was $3,145,999.20 and the average monthly Internet bandwidth allocated to the 30 universities was 1,699.7 Mb/s. This represented only $7,425.69 per 1,000 students and was about 0.5% of the annual recurrent expenditure of the 30 universities. Thus, universities were still allocating relatively low annual Internet budgets.

In order to achieve stage 3 in Internet affordability indicator, universities would need to spend between $25,000 and $37,000 per 1,000 students per year. This translates to about 1.4% of the total university expenditure on average at the unit price of $160 per Mb/s per month. An expenditure of 1.5% could be considered affordable given that broadband Internet is essential to learning in a 21st century university.

The unit cost of Internet bandwidth depends mainly on the cost of the national distribution network (representing over 60% of the costs). This includes the cost of leased lines, operations and maintenance of broadband networks, licensed radio frequencies and power supply. With the increasing trend towards broadband connectivity at speeds of 100 Mb/s and above for most universities, the Internet traffic economies of scale are expected to drive the unit costs further down. It is therefore expected that by

2016, the weighted unit cost of Internet bandwidth will have dropped to about US$ 100 per Mb/s per month. Stage 4 of Internet affordability would then translate to Internet bandwidth expenditure of about 1% of the total recurrent expenditure for a university.

However, with the adoption of bring your own device (BYOD) policies as well as cloud computing in universities, there will be need for increased Internet bandwidth expenditure to support student services, including cloud-based email and learning management systems services. *Universities therefore should increase Internet expenditures to 1.5% of their recurrent expenditures by the 2016/2017 financial year.*

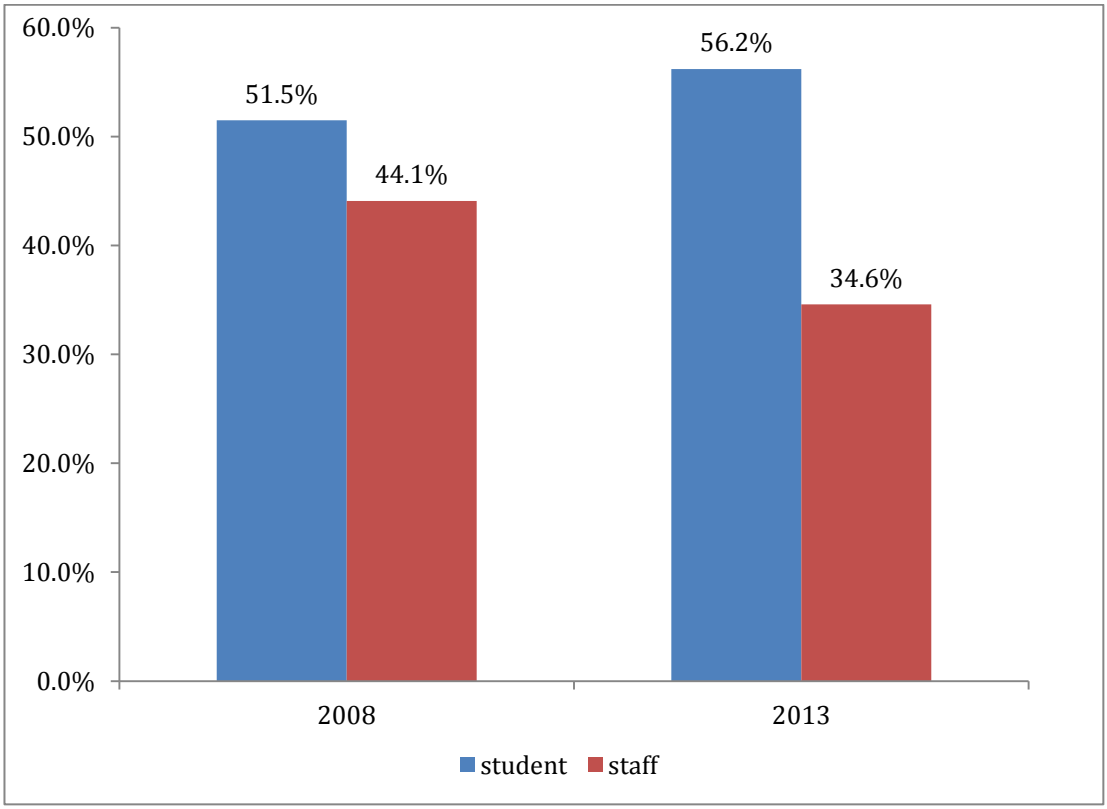
3.1.4 Network speed and quality

The staging for this indicator was obtained from the field survey of students, staff, and faculty using six sub-indicators that measured quality and speed. The staging in 2008 was 2.4 compared to 2.5 in 2013 despite the nearly tenfold increase in Internet bandwidth per 1,000 students (from 0.431 Mb/s to 4Mb/s per 1000 students). *This suggests that the increase in bandwidth was not well distributed within the campus and did not affect the student and faculty Internet access experience. It could also mean that the campus networks were still not stable and the quality was perceived to be quite low.*

Drivers for perceived quality and speed of campus networks

Figure 3-5 shows that in 2008 about 52% of the students considered campus networks unstable increasing to 56% in 2013. This means that campus networks were not working well for most students and staff.

Figure 3-5: Campus networks not stable (2008-2013)

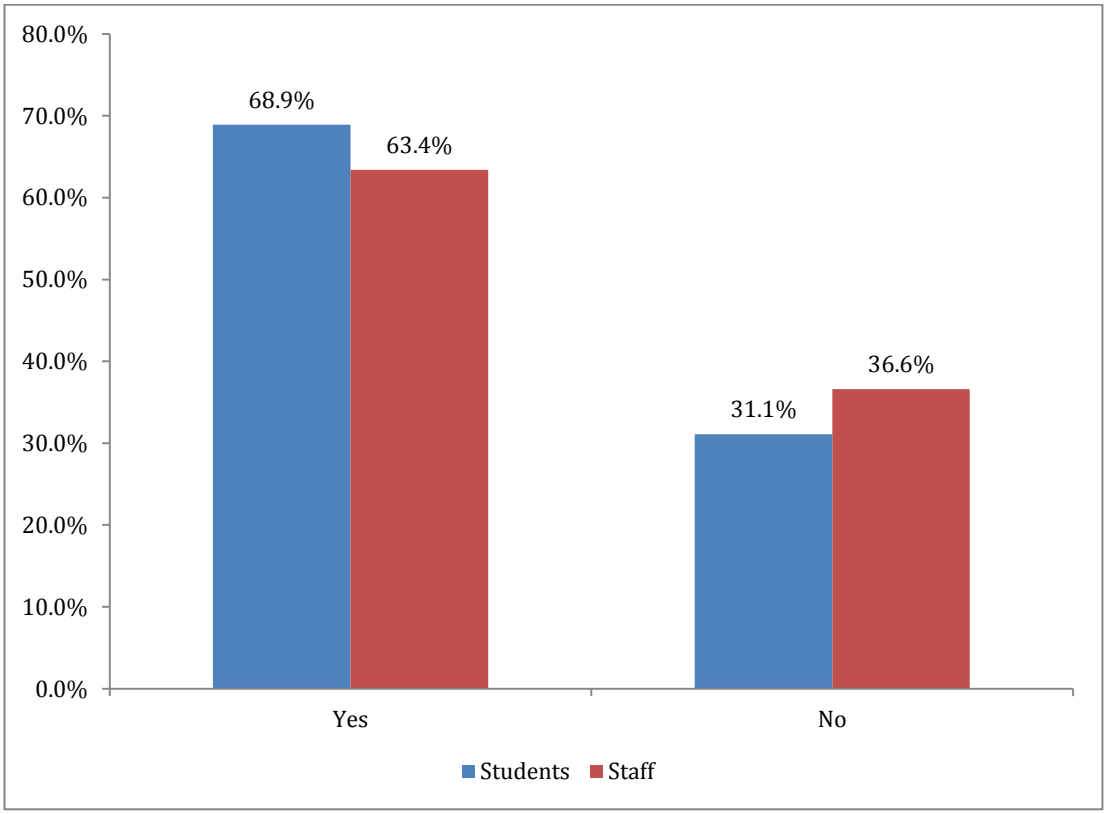


Source: KENET e-readiness data 2008, 2013

Another sub-indicator of network speed and quality indicator was the perceived speed of the campus Internet when compared to cyber cafés. In 2008, 44% of the students were convinced that that cyber cafés provided faster Internet services than campus networks. In the 2013, this figure went up to 48%. The important difference was that in 2013, the comparison was with mobile Internet and/or cyber cafés. That is, over 50% of users considered that institutional campus networks provided lower Internet speeds compared to alternatives such as mobile Internet, indicating that either the bandwidth allocated to the universities was inadequate or that campus networks were not well designed and managed to provide superior services. Network access should therefore include well-designed and managed campus networks and systems.

Figure 3-6 shows that about 63% of faculty and 68.9% of students reported that slow Internet on campus affected their academic work. This was not a significant change from 2008 survey where 76% of students reported that Internet speeds frustrated their academic work. Thus, the increase in Internet bandwidth by close to 10 times from 2008 to 2013 did not significantly affect the perceptions of the campus network users in terms of speed. This suggests that the problem with Internet speeds and perceptions of quality could be due the quality of campus network design and bandwidth management policies.

Figure 3-6: Effect of Internet speeds on academic work (2013)



Source: KENET 2013

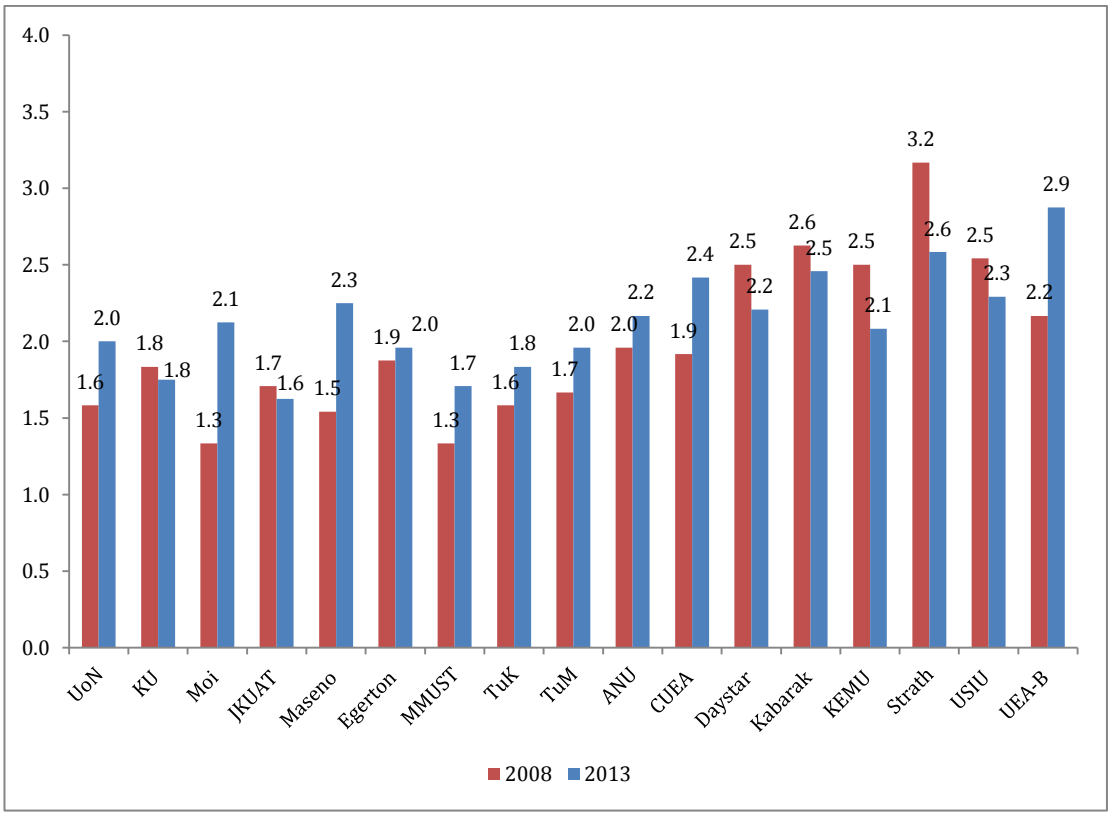
Anecdotal evidence suggests that many campus networks were still not optimized and campus wireless networks were not well managed. Besides most, universities were still not purchasing adequate Internet bandwidth for the increased student population. Consequently, many faculty members and students did not have real broadband Internet experience on campus. *Accession from stage 2.5 to stage 4 in the network speed and quality indicator would require a major upgrade of campus ICT infrastructure and operations.*

3.2 Network Access Average Staging for Individual Universities

Figure 3-7 on the average staging of network access category of indicators shows that only three of the 17 universities surveyed achieved stage 2.5 and above in 2013, and only one achieved stage 2.9. Thus, there was very limited accession to higher stages in network access with eight of the 17 universities recording a drop in staging levels.

This data suggests that the 109% growth in enrollment by the 17 universities had probably made it more difficult to achieve accession to higher stages for indicators in the network access category. Universities will need to develop detailed accession roadmaps for network access category of indicators and this would require increased investments in campus ICT infrastructure and building the ICT human capacity required to manage the complex campus networks.

Figure 3-7: Network access average staging for the 17 universities (2008 and 2013)



Source: KENET E-readiness data 2008, 2013

3.3 Network Access Average Staging by Size

3.3.1 Does size matter?

This study also analyzed the effect of student enrolment on the network access indicator for the 30 universities, categorized as: small, medium, large and very large on network access category of indicators.

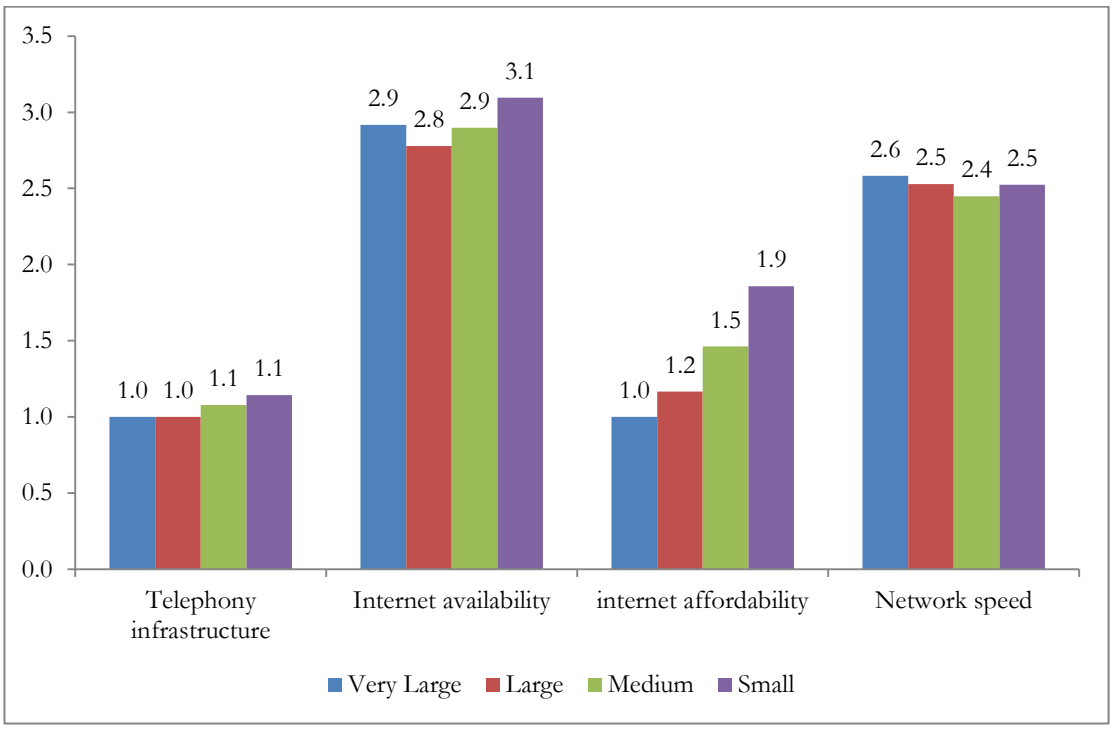
Figure 3-8 showing the results for the different categories suggests that telephony infrastructure was at stage 1 for all the universities regardless of size. It is not clear why the universities did not consider telephony infrastructure important for faculty and staff

and yet it could improve the working environment in universities. This is an area that requires further research.

In the Internet affordability indicator small universities were at stage 1.9, while the very large universities remained at stage 1.0 which means that they were spending less than $13,000 per 1,000 students per year. The average Internet expenditure was only 0.5%. All universities should therefore increase their Internet and ICT budgets in order to accession to higher stages of readiness. As expected, the Internet availability had increased to stage 3.1 for small universities and above stage 2.8 in all universities. This reflected the close to 10 times increase in Internet bandwidth consumption.

The network speed and quality indicator also seems to be independent of size of the university and remained at stage 2.6 and below even for small universities. This shows that none of the universities were managing their campus networks well. Anecdotal evidence suggests that the main reason was low human ICT capacity in the universities as well as inadequate investments in campus networks. This should be an area of focus for all universities.

Figure 3-8: Network access staging by category of universities (Group of 30 Universities)



3.4 Conclusion

This section has demonstrated that universities needed to pay special attention to upgrading their campus infrastructures and to build the capacity of the ICT support staff to ensure that the complex campus networks were well managed. The upgrade of the campus network infrastructure must include an upgrade of the telephony infrastructure that will also share the same infrastructure. This will lead to accession in telephony infrastructure staging from 1 to at least stage 3 required to enhance the work environment for faculty and staff.

The results have shown that there is a relationship between students-owned laptops and the use of cyber cafés. Since a cyber café cannot be a good learning environment, universities need to help students acquire their own laptops. A few universities have signed agreements with suppliers of laptops to reduce the unit cost of laptops and provide financing. These initiatives could be scaled up with joint procurement programs in order to reduce the cost further by aggregating demand. It will also be important to improve Wi-Fi cover on campuses to ensure easy access to students from their laptops.

All of these changes will require big investments in campus ICT infrastructure as well as a corresponding in capacity building and salaries budget for high-end ICT professionals. Universities also need to be collect and analyze user satisfaction data on annual basis in order to prioritize the areas of special focus in upgrading campus networks in order to respond to their students' and staff needs.

Although availability of Internet indicator had increased to up to 3.1 for small universities and was above 2.8 for all universities, this did not take into account the effects of implementing bring your own device (BYOD) policies in the universities. Most of the universities were only providing very limited campus Wi-Fi cover and so most of the student devices were not joining the campus networks. In future, universities will need to increase Internet bandwidth capacity for their campuses to cope with the increased demand from students bringing their own laptops or smartphones to the campus networks.

The increase in Internet bandwidth will therefore need to gradually increase their percentage of Internet bandwidth expenditures to the total expenditure from 0.5% in 2013 to 1.5% by 2016. This will be despite the fact that unit cost of Internet will continue to fall at about 20% per year with increased uptake of broadband connectivity of campuses at 1 Gb/s or 10 Gb/s in the period 2014 to 2017.

The four network access indicators are foundational and affect uptake in networked learning category of indicators and automation. The survey has shown that they still need to be a priority for institutional leaders.

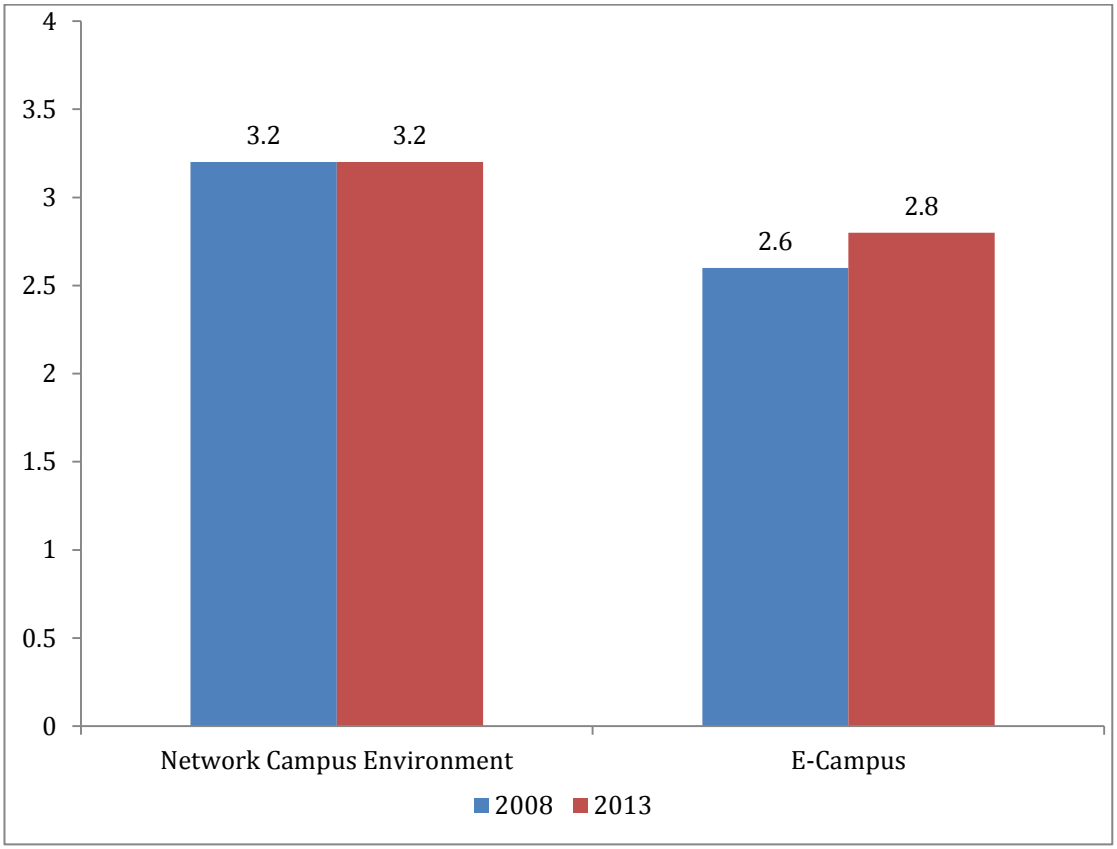
4 NETWORKED CAMPUS

4.1 Overall Staging for Networked Campus Category of Indicators

The networked campus category had two indicators – network environment and e-campus. The network environment category was measured using sub-indicators that included ICT power supply availability, security of ICT equipment and software, and availability of disaster recovery plans. The e-campus indicator measured the degree of automation of internal processes (i.e., availability of appropriate information systems) and electronic interactions of the campus with students, suppliers, and other stakeholders.

Figure 4-1 shows the overall networked campus staging for the 30 universities surveyed in 2013 compared to the 17 universities surveyed in 2008. The overall e-campus indicator was at stage 2.8 in the 2013 survey with minimal accession from the 2008 staging of 2.6, while the network environment remained unchanged at 3.2.

Figure 4-1: Overall Networked environment indicators comparison for 2008 and 2013



Source: KENET e-readiness data 2008, 2013

4.1.1 Network environment

At an average of stage 3.2 as shown in Figure 4.1, most of the universities were ready for extensive use of ICT to support teaching, learning, research, and management. For example, about 77% of all institutions had uninterruptible power supply for PCs in the offices and 100% of the campuses reported that they had backup diesel generators for all

their ICT equipment. However, only 57% of the PCs in the student labs were on UPS in 2013. This was not a significant change from the 53% of the universities that had UPS in student labs in 2008. Universities therefore still needed to invest in UPS infrastructure in the student labs in order to achieve 75% of PCs on UPS in student labs required for stage 4.

With respect to security of ICT facilities in campuses, about 70% of the universities had a firewall to protect their Intranets in 2008 compared to 90% in 2013. This was a marked improvement as three of the 30 universities reported that they did not have a firewall. These three were among the new universities chartered in March 2013. In 2008, about 37% of the 17 universities surveyed had an off-site back-up and 26% had a disaster recovery plan. In 2013, 57% of the 30 universities had offsite backup and 33% had a disaster recovery plan. *This means that most universities still did not have an operational disaster management by 2013*. This is a critical issue that needs urgent attention and should be included in institutional ICT strategic plans particularly in the smaller and newer universities.

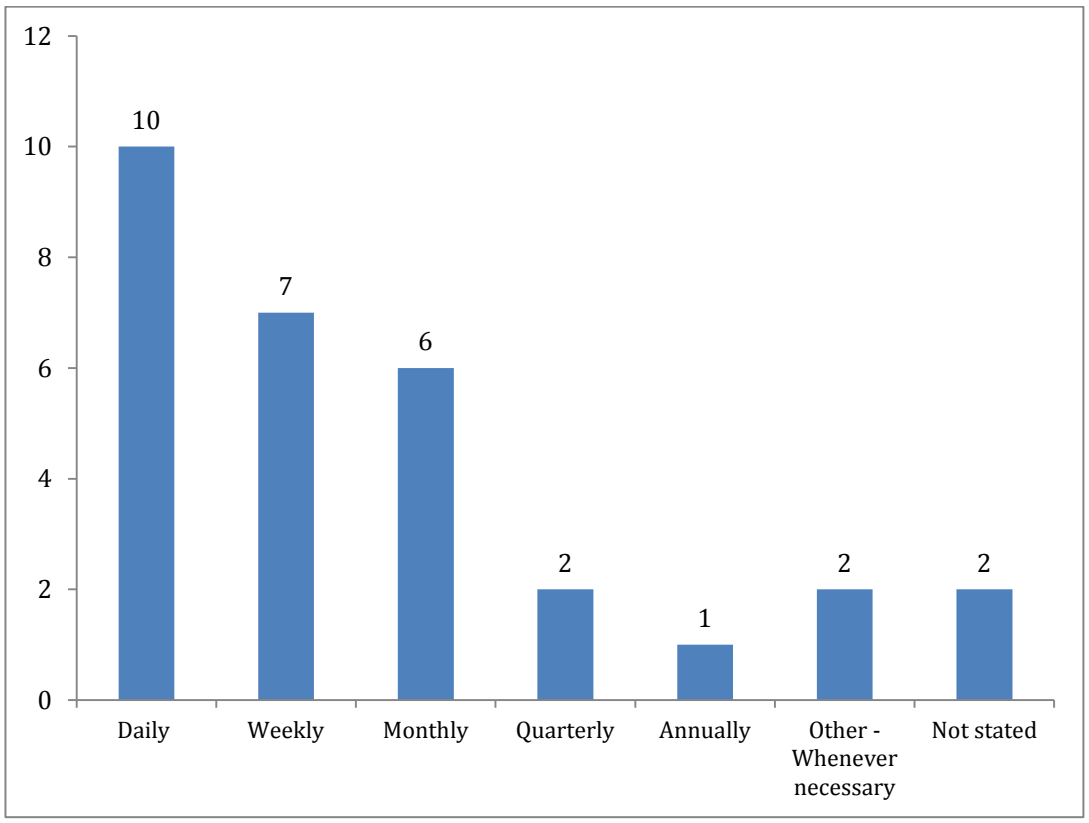
4.1.2 E-campus indicator

This indicator was measured using a variety of sub-indicators such as frequency of websites updates, extent of online interactions with suppliers, degree of automation of campus processes, and integration of information systems. Overall, the 30 universities were at stage 2.8 as shown in Figure 4.1. However, 14 of the universities were at stage 3 and above while 16 were below stage 3 with the mode being stage 2.5. This means that most of the universities surveyed still needed to improve their online and web-based interactions with students, faculty and external suppliers. This requires regular website updates and development of web-based applications of key student, financial and library information systems.

Website updates

The 2013 survey revealed that only 10 of the 30 universities updated their institutional websites on a daily basis as shown in Figure 4.2. Seven out of the 30 universities updated their websites weekly basis and about 20% of the universities updated theirs on a monthly basis. This means that most of the university websites did not provide up to date information to the students, faculty or suppliers. Most of the university websites were also not used to support any student or faculty services (e.g., a fully-functional student portal).

Figure 4-2: Frequency of website updates among universities



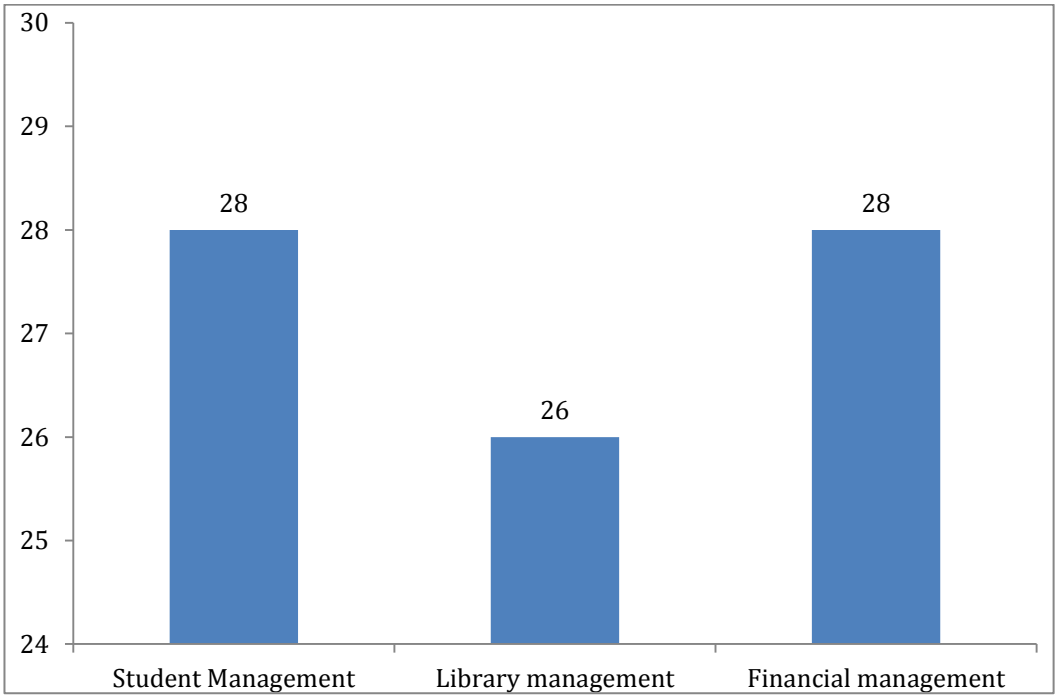
Source: KENET e-readiness data 2013

Electronic transactions and automation

Almost all the universities (29 of the 30) indicated some level of electronic interactions with external entities. For example, 28 universities had downloadable forms and 23 posted a contacts list on their websites. Three key information systems were considered critical for universities, namely, student information systems, financial information systems and library information systems.

Figure 4-3 shows that 28 of the 30 universities had functional student information system and financial information systems while 26 universities reported to have automated library information systems. However, data did not show if these applications were web-based and available to students and faculty on campus and off campus (e.g., if the universities had a fully functional web-based student portal). *However, perception data collected from faculty, staff and students indicated a low level of automation of critical information systems with limited availability of interactive and transactional websites*. This could be due to an incomplete automation, lack of awareness of the automation, lack of use of automated systems, etc. *This shall be an area of further research.*

Figure 4-3: Number of universities that have automated three key information systems



Source: KENET e-readiness data, 2013

4.2 Networked Campus Average Staging for Individual Universities

4.2.1 Networked campus staging for Kenyan universities

Table 4-1 shows networked campus overall staging for four very large universities while Table 4-2 shows the staging for the five large universities. The average staging for the four very large universities was 3.7 while the average for the five large universities was 3.0. Universities that were established in 2013, such as Chuka University and University of Eldoret, lowered the staging for the large universities for the e-campus indicator. The very large universities were also the oldest universities in Kenya and were well established.

Table 4-3 shows that six out of the 13 medium-sized universities were below stage 3 and only Egerton University reported to be at stage 3.8. Thus, almost 50% of the universities in this category need accession strategies to attain stage 3 and above in order to provide acceptable levels of ICT services to their stakeholders.

Table 4-1: ***Overall staging for very large universities***

	Networked campus		Networked campus average
University	Networked campus environment	E-campus	
1. University of Nairobi	3.8	3.5	3.6
2. Kenyatta University	3.8	3.0	3.4
3. Moi University	4.0	3.8	3.9
4. JKUAT	3.8	3.8	3.8
Average	**3.8**	**3.5**	**3.7**

Source: KENET e-readiness data 2013

Table 4-2: Overall staging for large universities

Overall staging for large universities			
	Networked campus		Networked campus average
University	Network campus environment	E-campus	
1. Masinde Muliro University of Science and Technology	3.1	3.1	3.1
2. Egerton University	3.8	3.8	3.8
3. Technical University of Kenya	3.6	3.3	3.5
4. University of Eldoret	3.0	2.5	2.8
5. Chuka University	2.6	2.3	2.5
6. Kenya Methodist University	3.7	2.8	3.3
Average	**3.3**	**3.0**	**3.1**

Source: KENET e-readiness data 2013

Table 4-3 also shows that only two of the eight small universities (2,000 to 5,000 students) were at stage 3 and above. Kabarak University was the only university at stage 3.7 among the small universities. The average was stage 2.8, which means that the small universities also needed to develop roadmaps for accession to stage 3 and above necessary for supporting ICT services in a university, particularly for the e-campus sub-indicators. This was unexpected and there is need to study the reasons why small universities are unable to provide acceptable network environment or to make effective use of the institutional websites. Twenty out of the 30 universities were in the small to medium-sized category of universities and all would require roadmaps for accession to stage 3.0 and above.

Table 4-3: Overall staging for medium-sized universities

Overall staging for Medium universities			
	Networked campus		Networked campus average
University	Network campus environment	E-campus	
1. Maseno University	2.3	2.5	2.4
2. Dedan Kimathi University of Technology	3.1	2.8	2.9
3. Meru University	2.9	2.3	2.6
4. University of Kabianga	3.3	2.0	2.7
5. Technical University of Mombasa	2.4	2.5	2.5
6. Pwani University	2.8	2.8	2.8
7. Laikipia University	3.4	2.5	3.0
8. Catholic University of Eastern Africa	3.2	3.3	3.2
9. KCA University	3.1	3.5	3.3
10. Strathmore University	3.1	3.5	3.3
11. St Pauls University	3.4	3.0	3.2
12. United States International University	3.4	2.5	3.0
13. Kisii University	2.8	3.0	2.9
Average	**3.0**	**2.8**	**2.9**

Source: KENET e-readiness data 2013

Table 4-4: Overall staging for small universities

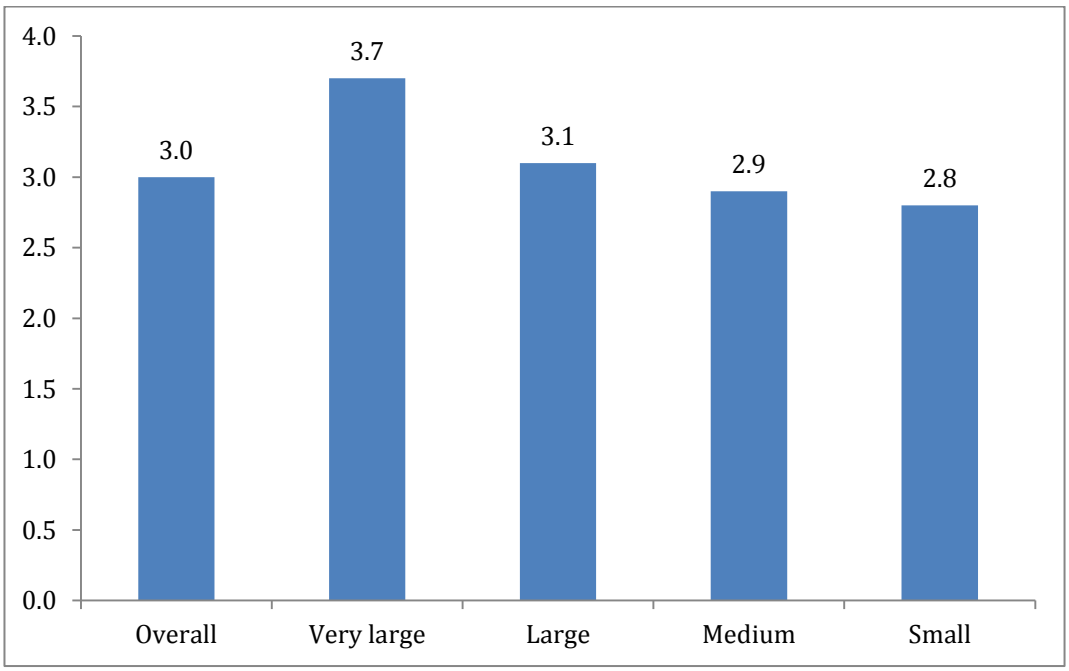
Overall staging for small universities			
	Networked campus		Networked campus average
University	Network campus environment	E-campus	
1. Maasai Mara University	3.0	2.0	2.5
2. Multimedia University	3.2	1.5	2.4
3. South Eastern University	2.3	2.8	2.5
4. Africa Nazarene University	2.8	2.5	2.6
5. Daystar University	4.0	2.0	3.0
6. Kabarak University	3.6	3.8	3.7
7. University of Eastern Africa, Baraton	2.8	3	2.9
Average	**3.1**	**2.6**	**2.8**

Source: KENET e-readiness data 2013

4.3 Networked Campus Average Staging by Size

Figure 4-4 shows the staging for the different categories of universities surveyed in 2013. It is clear that the very large universities were in higher stages of e-readiness in the overall networked campus category of indicators at stage 3.7 compared to 2.8 for small universities. The large and medium-sized universities were at stage 3.1 and 2.9 on average respectively. This was counter-intuitive because the researchers had expected that the smaller the university, the easier it was to provide a superior network environment and that the new smaller universities would have well developed network environment as part of new buildings and campus infrastructure.

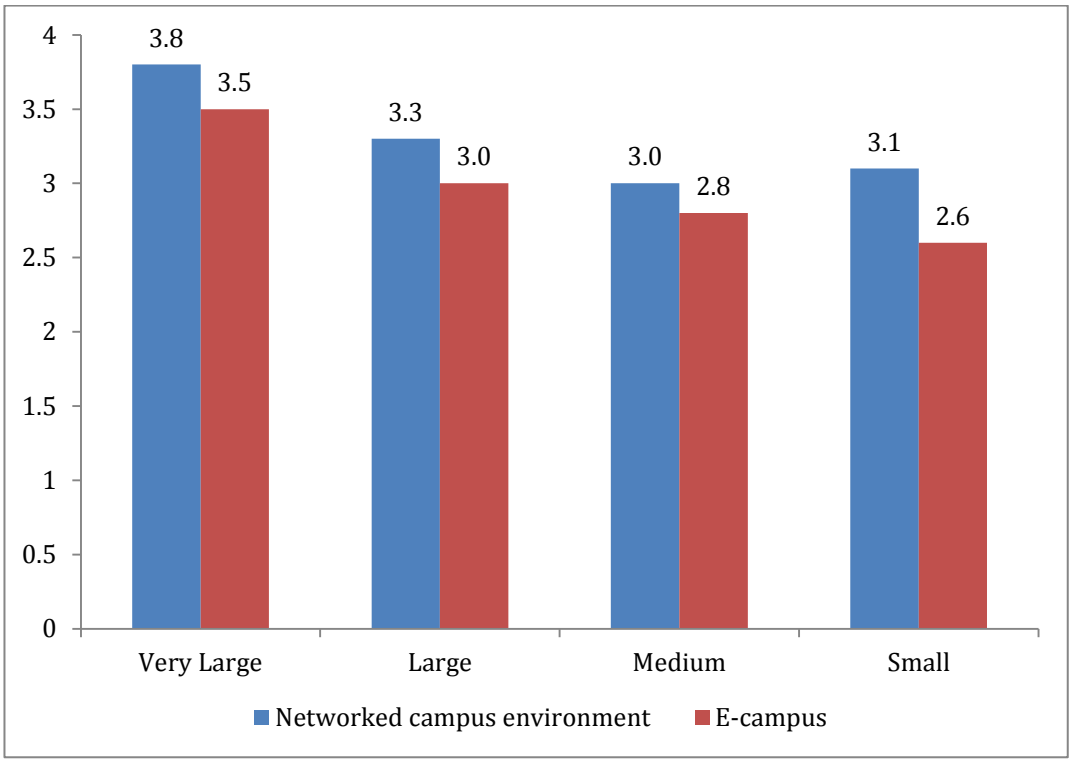
Figure 4-4: Networked campus staging of indicators by for 30 universities (Overall, very large, large, medium and small)



Source: KENET e-readiness data, 2013

Figure 4.5 on both the e-campus and network environment indicators shows that it was the small and medium that lowered the overall staging for networked campus staging. For example, the overall staging for the four very large universities (enrolment > 30,000) surveyed was 3.8 for networked campus environment and 3.5 for e-campus compared to only 3.1 and 2.6 respectively for the smaller universities category.

Figure 4-5: Networked campus indicators for different categories of universities



Source: KENET e-readiness data, 2013

Thus, size seems to be a significant determinant of readiness in this category of indicators. This was counter-intuitive because the researchers expected the small and medium universities to have used ICT more intensively in their internal and external processes, which was not the case. This will be an area of further study regarding the factors driving readiness of the networked campus category (age of university, availability of human capacity, availability of resources and sources of funding, etc.).

4.4 Conclusion

The network environment indicator for all the 30 universities was at stage 3 and above. Although this suggests that the universities were ready to deploy information systems to support learning, teaching and administration, only 10 of the 30 universities had disaster recovery plans and only 37% had off-site backup. Moreover, 100% indicated that they had a backup diesel generator though the study did not measure the availability of power on the campus. Anecdotal evidence suggests that the power availability was less than 98% mainly because many campuses did not regularly maintain the backup diesel generators.

This study shows that small and medium-sized universities were below stage 3 in the e-campus indicator. This means that the universities were not updating their websites

regularly and the automated information was not yet integrated. Although it was easier for small and medium-sized universities to automate their operations, many of them were new and still in the early stages of automation. Effective automation also requires high-end ICT talent to drive its implementation. Newer universities were struggling to attract and retain good ICT professionals especially in universities outside Nairobi.

In general, more data would be required to measure the degree of automation or the student portals. This was because the perception data collected in the survey suggested that universities were still in the early stages of automation of critical information systems, including off campus access to library systems or learning management systems. This is an area that requires further research.

Finally, all public university Vice Chancellors were required to sign performance contracts with the Ministry of Education. The 10th Cycle for Performance Contracting guidelines (GoK, 2013) indicated that all the universities were supposed to automate their operations and to spend up to 10% of their recurrent budgets on information systems. Therefore, every year public universities would be required to automate some processes, which has led many universities to automate their financial systems. However, the indicators for automation would need to capture the network environment and e-campus sub-indicators of readiness.

5 NETWORKED LEARNING

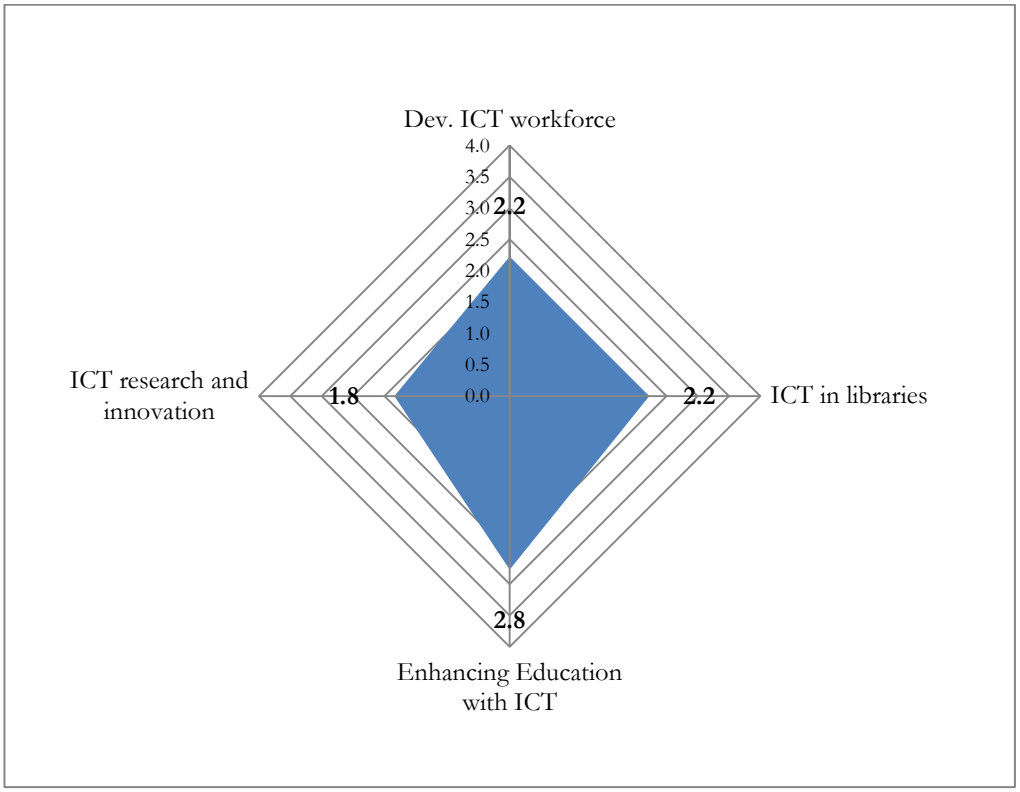
5.1 Overall staging for Networked Learning Category of Indicators

The networked learning category contained the following indicators:

(i) Enhancing education with ICT
(ii) Developing ICT workforce
(iii) ICTs in libraries
(iv) ICT research and innovation

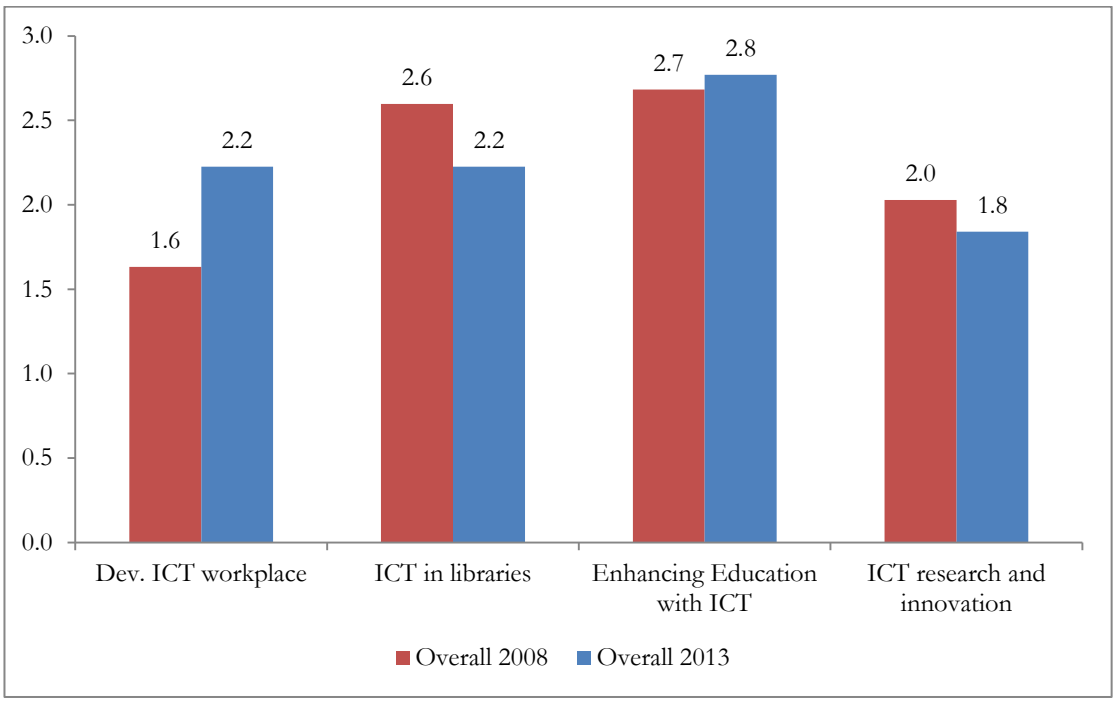
Figure 5.1 shows the overall staging for the four indicators. The overall staging for development ICT research and innovation remained below stage 2 and only the enhancing education with ICT indicator was above stage 2.5 at stage 2.8. None of the indicators were in stage 3 which suggests that universities were still not ready to use ICT to transform learning and research. Figure 5-1 shows that there was no accession to higher stages for all the indictors except enhancing education with ICT. This was despite the accession to higher stages in network access and networked campus indicators. This confirms the findings of the 2006 and 2008 studies that accession in staging of networked learning category of indicators requires strong institutional and academic leadership and not just availability or general use of ICT by students and faculty.

Figure 5-1: Overall staging for networked learning category of indicators



Source: KENET e-readiness data, 2013

Figure 5-2: Comparison of networked learning category of indicators for 2008 and 2013



Source: KENET e-readiness data, 2008 and 2013

5.1.1 Enhancing education with ICT

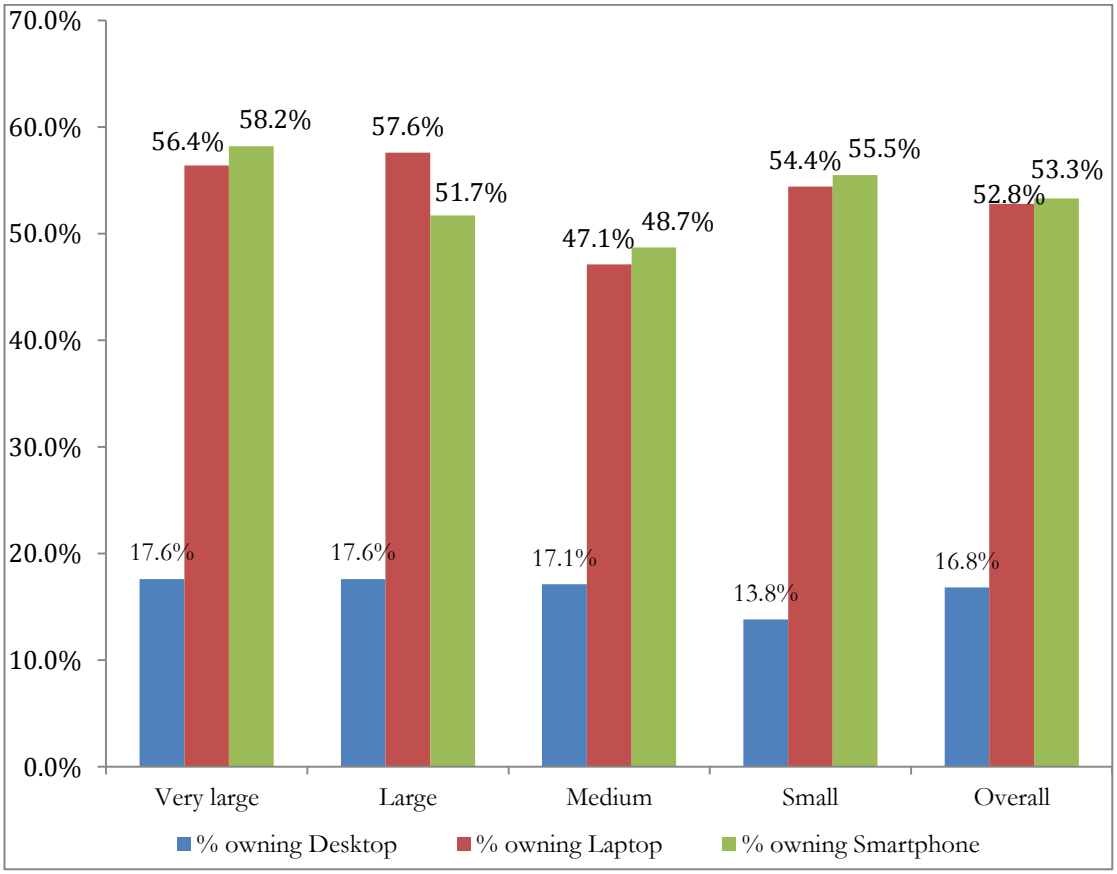
The sub-indicators for enhancing education with ICT include integration of ICT into the curricula, availability and use of e-learning platforms, and the use of ICT in student projects. Unlike the 2008 survey, additional sub-indicators were included to measure the use of technology in teaching by faculty and the preference of blended or online courses by students. These were obtained from the perception questionnaire that included questions on the effective use of technology in teaching, and percentage of students who considered e-learning platforms important or very important for academic success, and even the percentage of students who reported that a few of their courses were blended.

The fact that universities were at stage 2.8 means that institutions were still at the initial stages of using ICT in learning and teaching. For example, only 20 of the 30 universities reported that they used e-learning in some of their courses. Moreover, data on the percentage of courses supplemented by e-learning materials was not available for 63% of the 30 universities. As observed in the 2008 survey, most of the universities did not track progress of e-learning materials developed by faculty. Consequently, there was no significant accession in staging between 2008 and 2013 as shown in Figure 5-2 (moved from stage 2.7 to stage 2.8). This suggests that universities have not yet adopted effective strategies for accession to higher levels of readiness in networked learning.

As explained above, the 2013 survey included new perception questions on the learning environment and technology, and the university experience. Some of the sub-indicators that were used in the staging included percentage of faculty who taught a few blended courses, percentage of students who considered learning management systems (LMS) important, and percentage of students who had taken some blended courses among others.

The perception survey results revealed that 52.8% of the students owned a laptop, and 53.3% owned smartphones as shown in Figure 5.3. Over 56% of the students in the large and very large universities owned a laptop. On average, about 17% of the students owned a desktop computer. That means that almost 70% of the students either owned a laptop or a desktop. Moreover, close to 91% used mobile Internet. The perception survey also showed that students wanted to use these devices for learning in addition to personal or entertainment applications. This means students the owned devices that could be used to support e-learning.

Figure 5-3: Percentage distribution of students who owned desktops, laptops and smartphones by university size



Source: KENET e-readiness data, 2013

The ICT and university experience of the students was measured in the following way:

1. The ability to use personal hand-held mobile devices (i.e., smartphones or Internet-enabled feature phones) to access library resources, learning management systems, and learning materials.
2. The ability of the instructors and faculty to effectively use learning technologies for teaching.
3. The importance of electronic learning materials such as e-books and e-learning content hosted in university learning management systems.
4. The impact of learning technologies on the students' learning experiences.

Access to learning resources using mobile handsets

The perception survey revealed that only 24.1% of the students had very good or excellent experience in the use of their mobile handsets to access electronic library resources, including the university OPAC system. In addition, only 24.6% of the students had good or excellent experience in the use of their mobile handsets to access the university LMS that hosted e-learning courses. This suggests that the universities' electronic resources were not yet fully adopted for access using mobile handsets despite the high penetration of mobile handsets among students.

Apart from academic courses, only 26% of the students reported that they used mobile handsets to register for courses, 19.4% to order transcripts and 24% to check grades. Universities therefore need to develop more mobile applications to serve the students and improve the university experience using ICT. This might also be an indicator of the low degree of automation of administrative systems (e.g., student management systems). This is an area that will require further research since ICT directors of 28 of the 30 universities reported that they had already automated student management systems (see Chapter 4).

Student perception on the use of technology by faculty

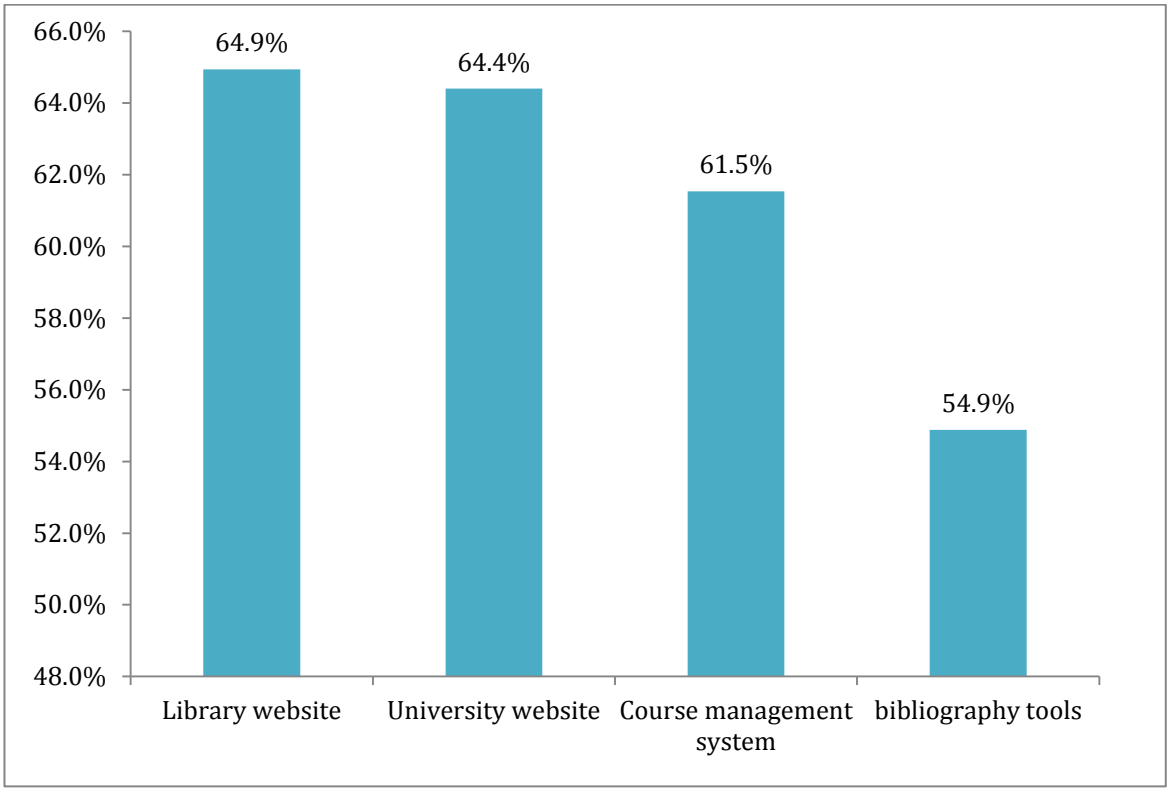
About 88% of the students stated that faculty members were making effective use of technology and 80% considered the faculty to be providing them adequate training in using technology in learning. Moreover, 87% of the students considered the faculty to be using the right kind of technology for teaching.

About 87% of the students stated that technology was helping them understand course materials and ideas. On the whole, students had very positive perceptions of their faculty use of technology when they did use technology. Thus, students were ready to use technology in learning and in fact want increased use of technology.

Importance of electronic resources for academic success

About 62% of the students considered the university LMS very important or extremely important for learning. This percentage increased to 73% if students who also considered the LMS moderately important were included. In fact, 42% of the students stated that they wanted faculty to increase their use of LMS.

Figure 5-4: Percentage of students who think library website, university website, course management system, bibliography tools were very or extremely important

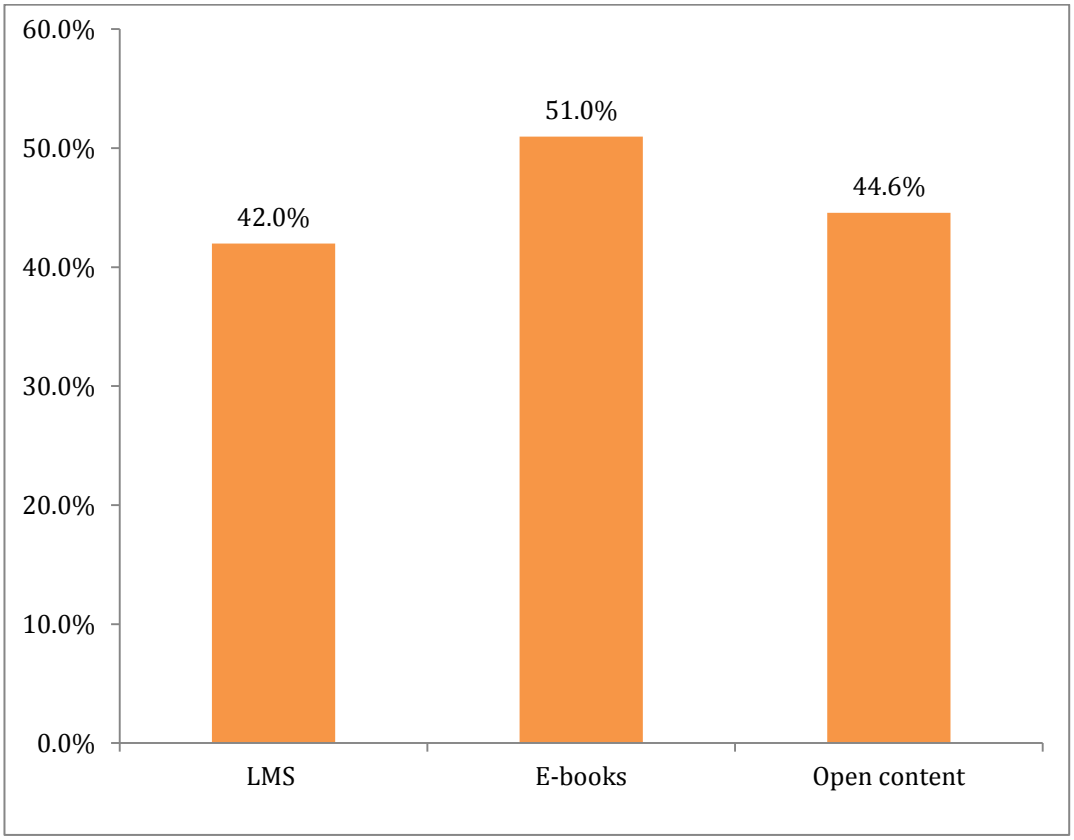


Source: KENET e-readiness data, 2013

Figure 5.4 shows that 65% of the students considered the library website very important or extremely important for academic success and while 61% of them also reported that they considered LMS very or extremely important.

Interestingly, 67% of the students also considered e-books to be either very or extremely important for academic success and up to 51% reported that they wanted the instructors to use e-books more in the future. This was despite the fact that most of the university libraries had not started purchasing e-books suggesting that students had access to free e-books on the Internet. In fact, 44.6% of the students reported that they wanted instructors and faculty to make greater use of open content beyond the campus such as Khan Academy or Open Courseware. Figure 5-5 summarizes the percentage of students who wanted faculty to use more e-learning content via LMS, e-books and open educational resources.

Figure 5-5: Percentage of students who want more instructors to use more e-books, LMS and open content



Source: KENET e-readiness data, 2013

Enhancing learning environments for students using ICT

The learning environment was measured in terms of the following

1. The demand and availability of students for blended or online learning
2. The use of social networking to support learning

The demand and availability for blended or online learning by students

The three main types of courses offered in a typical university are the traditional classroom-based courses; blended courses that use e-learning materials to supplement classroom-based course; and purely online courses that do not require students to attend any classes. The survey results indicated that on average 73% of the students preferred blended courses while 14.9% preferred online courses only. This preference should inform any e-learning strategies of the universities, particularly when considered with results of similar studies conducted in universities in USA (Student UG IT, 2013).

Only 11% of the students reported that nearly all, or all courses they took were blended, while about 78% reported that only a few or none of the courses were blended. This was a big disconnect because whereas the students preferred blended courses, such courses were not yet available. Surprisingly, 19% of the students reported they had taken at least one purely online course in the 2012/2013 academic year.

Use of social networking sites to support learning

Although 53% of the students reported that they agreed or strongly agreed that they should keep academic and social life separate, 69% reported that they used social networking sites to communicate with fellow students about their coursework. Moreover, 89% of the students believed that they needed an online forum to communicate with other students about coursework outside the classroom. About 57% of the students also reported that they were comfortable using social networks to communicate with their instructors and faculty.

These results have significant implications on the policies for learning environments in university campuses. For example, it might not be necessary to block social networking sites like Facebook or Twitter since the students were already using the social networking platforms to communicate with other students about coursework and group work outside the classroom. However, it is possible to implement LMS-based social networking and online forums in order to separate the academic networking from social networking.

5.1.2 ICT in libraries

At stage 2.2, there was low usage of ICT in libraries in 2013 compared stage 2.6 in 2008. For example, only 10 out of the 30 universities had online public access catalogue (OPAC) available off campus, indicating that most university libraries were not yet ready to provide digital library services. In addition, 20 of the 30 universities reported that they had fully automated library systems and were supporting users with ICT and performing all their back-end operations, including procurement, using ICT.

Accession in ICT libraries indicator was relatively easy to measure compared to enhancing education with the ICT indicator. This was because it largely depended on investments in library systems and availability of qualified librarians. It was noted that the average staging for the group of 17 universities that were also surveyed in 2008 dropped to Stage 2.4 after adding the sub-indicator of digital libraries and off campus access to OPAC.

Most of the universities had university librarians with a master's degree or higher (26 out of 30 universities). It was therefore not clear why the overall staging for the ICT in libraries indicators dropped to stage 2.2 in 2013. This is an area that requires further research to test the validity of the ICT in libraries sub-indicators defined in the staging framework.

5.1.3 ICT research and innovations

All the 30 universities surveyed had an ICT academic department (i.e., electrical engineering, computer science or information systems). One of the assumptions of the e-readiness survey was that there was a positive relationship between uptake of ICT in a university campus and the quality of ICT academic departments in a campus. However, there is need for further research to test this assumption.

The ICT research and innovation indicator was low at stage 1.8 and was measured indirectly using the following sub-indicators:

a. The availability of one or more ICT degree programs at undergraduate, master's and PhD levels. This was simply a Yes/No without any attempt to measure throughput or quality of degree programs.
b. Participation of students in national and international ICT exhibitions and competitions.
c. The presence of ICT incubation centers in the campus. This was a new sub-indicator added in the 2013 survey

The low score suggested that few institutions offered Master's and doctoral degrees in ICT or participated in international exhibitions and competitions. For example, only nine out of the 30 universities offered master's degrees in ICT and eight offered doctoral degree programs in ICT as of November 2013. Furthermore, only 23 of the universities participated in national or international exhibitions. This was despite the fact that all of the universities surveyed offered undergraduate degree programs in ICT.

Additional sub-indicators for measuring research output of universities

The survey questions for ICT research and innovations had included questions on the number of graduates for different degree programs, faculty qualifications, particularly the faculty with PhDs, and the number of conferences and journal papers published over a period of at least three years from the date of survey (2013). This additional data was not used in the 2006 and 2008 surveys because the researchers considered it to be incomplete or requiring further detailed verification. For example, most of the academic deans did not have accurate data on the number of papers published by the faculty or even the number of faculty with PhDs. This was also the case in 2013 and is an indication of inadequate management of performance data.

However, the researchers noted a marked improvement in the number of universities that provided additional data. It means that in future, the additional data will be used in staging or even in developing the proposed ICT readiness index.

The additional data that was collected but not used for staging was analyzed in order to provide further insight into the capacity of the academic departments to undertake research and innovations. Further detailed survey research will be required since most of the data was not held by either the DVC in charge of academic affairs or the deans of ICT as expected and maybe the universities were not collecting institutional capacity research data as required by many professional accreditation bodies, regulators and performance contracts of public universities.

The increased access to broadband Internet had made it possible for students, faculty and researchers in Kenya to access advanced research infrastructure hosted by research centers or universities in other developed countries such as South Africa, Germany or the USA, at no additional cost. This was possible because KENET had established the identity provider infrastructure required to authenticate Kenyan researchers who needed to use resources in academic research facilities in other countries as well as the emerging Africa Grid Infrastructure Science Gateway (see Africa Grid Science Gateway). For example, researchers in Kenya had access to high-performance computing facilities in other countries such as Italy, Germany or South Africa through the advanced research infrastructure operated by KENET. The survey therefore monitored the number of students or faculty that used such free advanced research infrastructures to support research at master's or doctoral levels.

Faculty with doctoral qualifications and master's and PhD throughput

To increase the master's degree and PhD throughput, a university ICT School or department requires a critical mass of doctoral faculty. When the deans of ICT were asked how many PhD or master's degrees had been awarded in the past five years (from the 2013 academic year), only two of the 30 universities (Jomo Kenyatta University of Agriculture and Technology and University of Nairobi) indicated that some PhD degrees had been awarded in the past five years in computer science and information systems. The deans however reported that no PhD degrees had been awarded in electrical engineering or related areas during that period. Although this data needs to be checked, the two universities reported that only 10 PhD degrees had been awarded in the five year period. It was therefore not surprising that the research and innovation outputs and staging were low.

Five of the 30 universities indicated they had awarded 213 master's degrees over the five-year period. Two of these were private universities that had awarded degrees in information systems or information technology. Unfortunately, data on the number of master's degree awarded in electrical engineering or related fields were not available. This again confirmed the low staging of the ICT research and innovation indicator. *Universities needed strategies for increasing the throughput in ICT at master's and doctoral levels.*

These results were not surprising since only 13.5% of the 535 faculty members teaching in ICT degree programs in the 30 universities had a PhD with all the rest having a master's degree. Although this data may not have included the electrical engineering faculties, this was a very small number. Only the University of Nairobi, the oldest public university in Kenya, had 15 faculty members in the school of computing and informatics out of a total of 32 full-time ICT academic staff. These were few, which indicates insufficient academic human capacity in ICT for accession to higher stages in ICT research and innovations.

Although advanced research infrastructure was accessible to all the 30 universities, only ICT departments in five of the 30 universities used it. Moreover, the universities had published only 366 papers or book chapters over the past five years. With about 535 full-time computer science and information systems faculty members, this represented a low research productivity of less than one publication per faculty over five years.

Thus, the additional data confirmed low levels of staging for the ICT research and innovations indicator at stage 1.8. Accession strategies should therefore include ways of increasing faculty productivity and PhD and master's degree throughput as well as attracting a critical mass of doctoral faculty. A consortium-based doctoral faculty development may be useful in the initial stages of increasing the pool of doctoral faculty in ICT. This may also apply to faculty and graduates students in non-ICT departments. However, this is an area for further research to establish the degree of use of advanced e-infrastructures by non-ICT departments that require high computing and broadband networking infrastructures (e.g., physics or bioinformatics).

5.1.4 Developing ICT workforce

Developing the ICT workforce indicators were measured using the following sub-indicators:

a. Percentage of staff, including faculty, trained on productivity tools
b. Availability of internal e-learning-based training for staff and faculty
c. Availability of internal ICT training
d. Percentage of ICT support staff with professional certifications

These sub-indicators, derived from the hard facts questionnaires completed by the ICT directors of the universities, show that universities were at stage 2.2 and there was limited accession to higher stages from the 2008 survey.

However, analysis of the university experience and learning environment questions included in the 2013 perceptions survey of faculty indicated that even with no training, a few faculty were using ICT to enhance their teaching. For example, 24% of the faculty reported that had taught a few online courses and up to 40.5% had taught a few blended courses. Moreover, 19% of the faculty stated that nearly all or all of their courses were blended. Private universities had much higher percent of faculty who had taught blended courses.

About 41% of faculty stated that they were comfortable using social networks and up to 74% were comfortable using social networks to interact with their colleagues. About 77% of the faculty agreed or strongly agreed that online forums were good for interacting with their students.

Thus, faculty members were in a high state of ICT readiness in the use of social networks and online forums but few were teaching blended courses. In future the faculty perception questions sub-indicators shall be included in the staging the sub-indicator on faculty training. However, further research is required to establish the reason for low uptake of blended or online courses despite the readiness of faculty members.

Apart from the faculty training, it appeared that the training for ICT support staff was still inadequate. Although professional certification can be a good indicator, ICT staff needed continuous training in advanced campus infrastructure areas, cyber security and information systems for automation. In addition, universities needed a critical mass of high-end ICT staff to design and manage the complex campus infrastructure and information systems. Unfortunately, questions on the ICT staff complement for different areas were not included in the 2006, 2008 and 2013 survey questionnaires. Anecdotal data suggests that most universities did not have adequate high-end ICT staff to manage the complex campus networks and information systems. This will be an area for further research.

5.2 Networked Learning Indicator Stages for Universities by Size

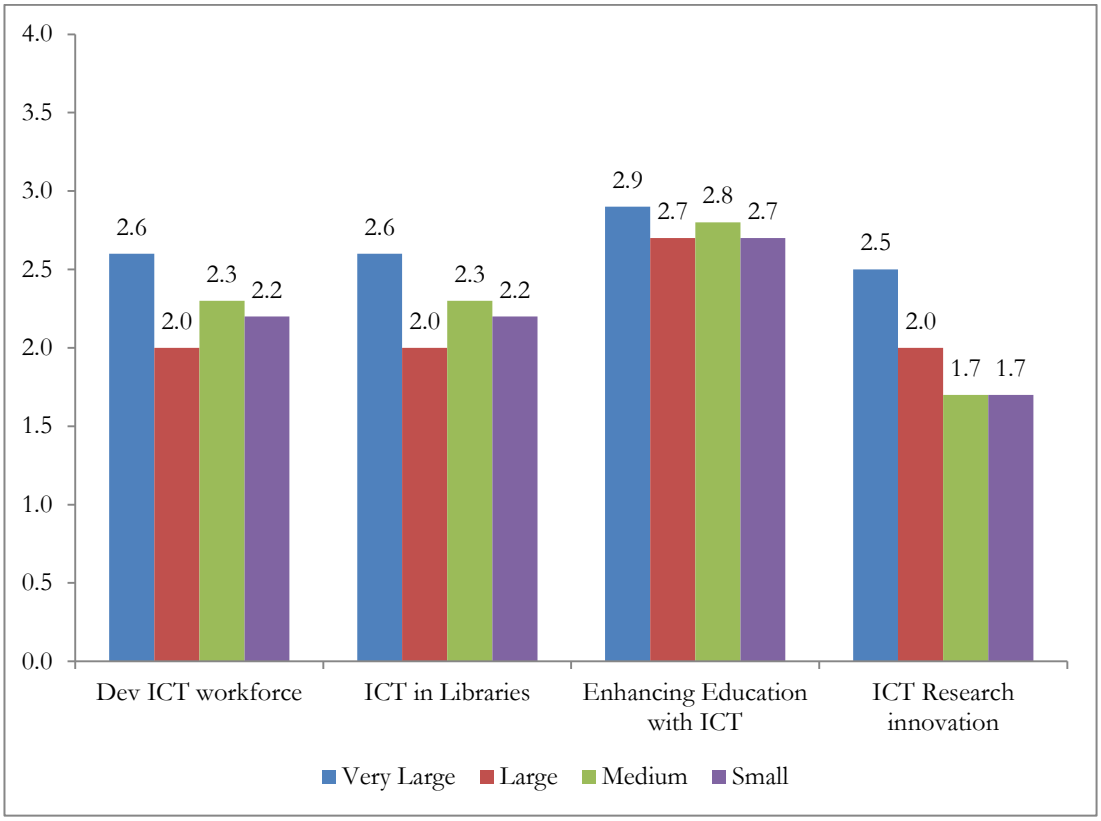
Figure 5-6 shows the overall staging of universities in networked learning category by size (small, medium, large and very large). The very large universities with over 30,000 students were consistently in higher stages of readines in all of the four indicators. The maximum staging for the very large universities was 2.9 for the enhancing education with ICT. The small universities with enrolments of less than 5,000 students were consistently in the lowest stages of readiness in all the four indicators, with the ICT research and innovation indicator at only 1.7.

The poor performance in ICT research and innovation by small universities may be because they lack a critical mass of doctoral faculty and do not offer master's and

doctoral degree programs in ICT. However, it was not possible to explain why the ICT in libraries staging was also low at stage 2.2. This was an area for further research.

Although the small universities had the lowest staging in all indicators, the more established small or medium-sized private universities like USIU or Strathmore University were in very high stages of readiness in networked learning category of indicators and were actually among the top two universities in overall ranking. Thus, it was possible for a university with strong academic leadership to accession to high stages even when they were relatively small. In general, the results suggest that accession startegies require to be customized for different sizes of universities.

Figure 5-6: Network learning stages by university size



Source: KENET e-readiness data, 2013

5.3 Conclusion

Networked learning category of indicators are some of the most important strategic indicators for motivating universities to invest in ICT infrastructure. For example, ICT in libraries could support the very large number of non-residential students. In fact, about 65% of the students considered the library website very important or extremely important for their academic success. However, the ICT in libraries indicator remained at below 2.5 for most of the 30 universities (only the four very large universities were at stage 2.6). It is possible that students and faculty were searching for learning resources, for example, open content and e-books, on the global Internet rather than university libraries.

The ICT research and innovations indicator was a good proxy for research and innovations in other areas. The data shows that universities had a relatively small number of doctoral faculty and were not even tracking the faculty productivity as part of institutional research. It was also not clear whether the university had doctoral or master's level throughput measures that were being tracked by senior leadership.

Although the enhancing education with ICT indicator was in stage 2.7 and above for all size categories of universities, the perception data showed that only 11% of the students took a few blended courses in the 2012/13 academic year. This means that although students wanted faculty to use LMS more, very few blended or online courses were available. This could suggest a lack of institutional leadership in e-learning despite the fact that most university had developed e-learning strategies. This will be an area for further research to establish why very few courses in Kenyan universities were blended or online. Two private universities, USIU and Strathmore University, reported close to 100% adoption of blended learning and use of LMS. This means it is possible in Kenya to increase the percentage of courses that were offered in blended mode or purely online.

The universities that were in high stages in the enhanced education with ICT indicator were also in high stages in ICT staff development indicator. Most of the universities were below stage 2.5 in ICT staff development indicator and yet it was a critical for accession to higher stages in all the other networked learning category of indicators.

Overall, accession in networked learning category of indicators will require leadership by heads and deans of academic departments as well as senior leadership of the universities at Vice Chancellor and Deputy Vice Chancellor levels. It cannot be driven by the technical ICT staff or ICT directors.

6 NETWORKED SOCIETY

6.1 Category of Indicators

The networked society category consists of the following indicators:

a) People and organizations online
b) Locally relevant content
c) ICTs in everyday life
d) ICTs in workplace

The *people and organizations online* indicator measures the use of Internet resources for learning, research, news and entertainment. It assumes that users have access to email as well as informational, interactive and transactional websites. Email accounts could be provided either by the institutions or other Internet service providers (ISPs).

The *locally relevant content* indicator measures the degree to which local online resources are available in Kenyan higher education institutions' websites or other websites hosted in Kenya. Such local websites could contain local news and entertainment or locally developed learning resources like databases or e-learning courses. The indicator measures the extent to which Kenyan Internet content has been locally developed and its relevance to the higher education academic community.

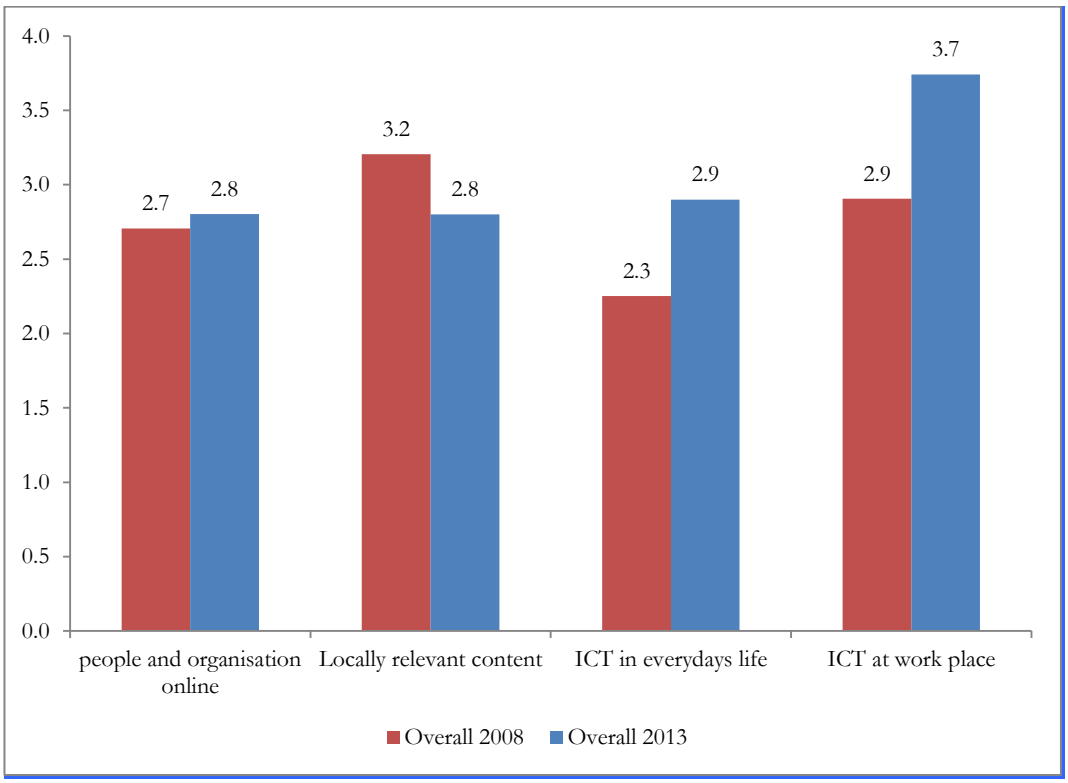
ICTs in everyday life indicator measures the readiness and use of a variety of ICT services and devices by the higher education community. For the purpose of this indicator, ICT devices are defined broadly to mean computers, personal digital assistants (PDAs), mobile phones or fixed line phones, televisions, and radios. Such ICT devices or services need not be provided by the institutions but could also be available at cyber cafés, at home or owned by the students or faculty. Data for this indicator was collected using the perceptions questionnaire as explained in Chapter 2.

ICTs in the workplace indicator measures the readiness and usage of ICT at work by academic and non-academic staff of higher education institutions. For an academic staff member, this means using ICT for classroom presentations or teaching, preparation of notes and e-learning content, and for web-based research. It also measures the use of ICTs for internal and external communication. Non-academic (administrative) staff, for example those in an accounts department could use institutional information systems for their daily work. Administrative staff could also use ICTs to interact with suppliers, government, off campus students and staff.

6.1.1 Overall staging

Figure 6.1 shows the staging of the networked society category of indicators for the universities surveyed in 2008 and 2013 respectively.

Figure 6-1: Networked society category indicators for 2008 and 2013



Source: KENET e-readiness data 2008, 2013

Although there were 13 additional universities sampled in 2013, the figure shows that the staging for ICT in the work place improved significantly, from 2.9 to 3.7. There was relatively smaller improvement in the staging for people and organization online indicator and ICT in everyday life. Moreover, there was a decline in the staging of locally relevant content indicator from 3.2 in 2008 to 2.8 in 2013.

6.1.2 People and organizations online

The average for all universities for this indicator was 2.8. As explained in Chapter 2, the following sub-indicators were used to derive the stage for this indicator:

(i) Percentage of students who have never used Internet
(ii) Percentage of students and faculty who consider Internet as being most important for email
(iii) Percentage of students and faculty using Internet daily
(iv) Percentage of students and faculty with email
(v) Percentage of students and faculty with institutional email
(vi) Percentage of institutional websites considered by students to be interactive or transactional
(vii) Percentage of students who do not know any type of institutional website
(viii) Percentage of students visiting local web portals
(ix) Percentage of faculty using the Internet for training

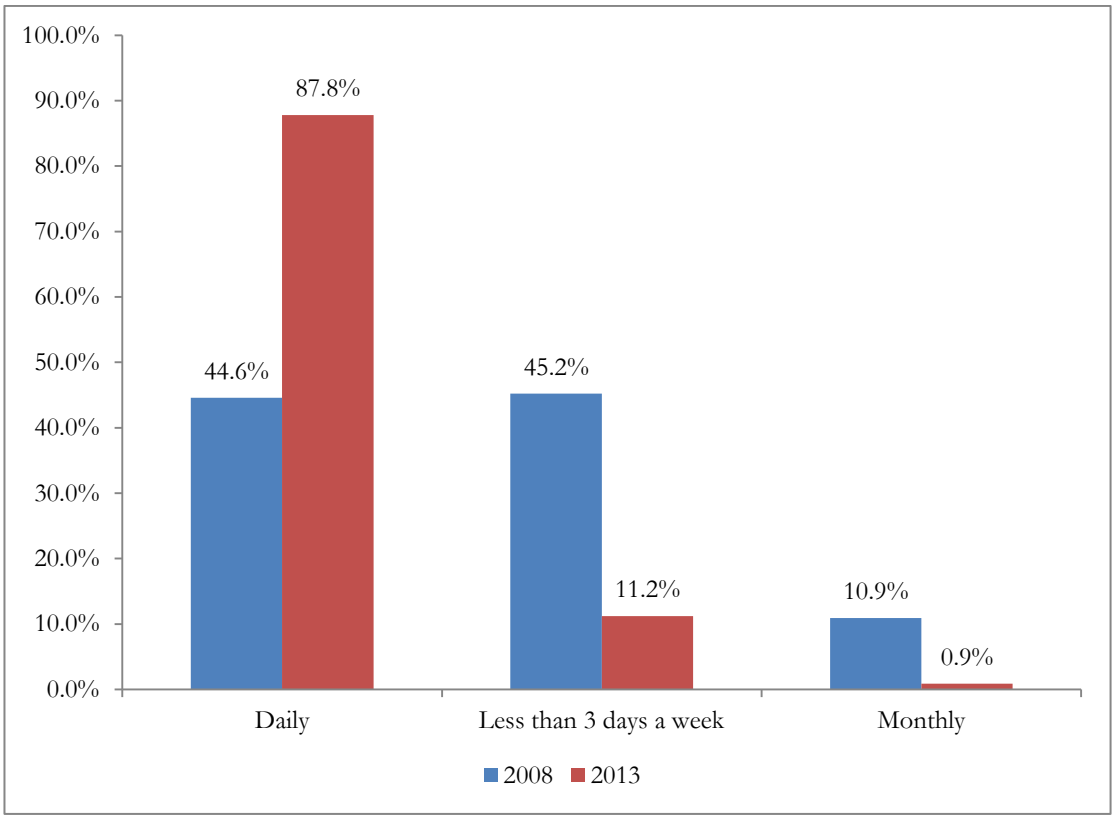
This indicator therefore was determined by the campus online environment. The score of 2.8 suggests that sampled staff and students had a more than average access to online resources for learning, research, news and entertainment from their campus networks. None of the universities was placed at stage 4, which required daily use of the Internet by

50% of the students. Only six universities had a score of 3.0 and above and all were private universities, namely: Daystar (3.3), KCA (3.2), Strathmore (3.1), St. Paul's (3.1), USIU (3.0) and Kabarak (3.0). This means that in these private universities, students and faculty were more intense users of online resources compared to the other universities. Only one of the new public universities scored less than 2.5. It therefore means that majority of the universities have a score of slightly less than 3.0.

Internet and email use

One of the sub-indicators for people and organizations online was the *percentage of students and faculty using Internet daily*. Figure 6-2 shows that 87.8% of all the communities in the universities used internet daily (stage 4) in comparison to less than 50% in 2008 (stage 2). This indicates that students, faculty and staff were now more dependent on email for their day-to-day operations. It can be noted that there was hardly anyone using the Internet on a monthly basis only.

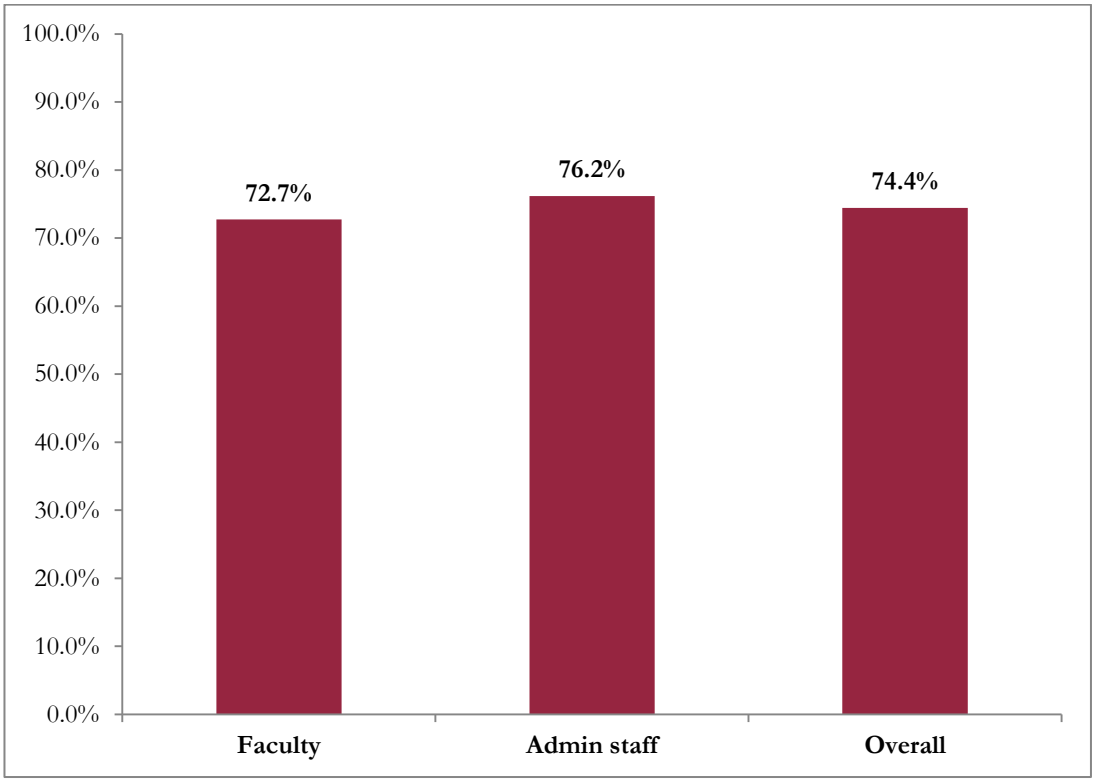
Figure 6-2: Frequency of use of Internet



Source: KENET e-readiness data 2008, 2013

There was also high usage of email for regular communication by faculty and staff with 74% of staff and faculty stating that they used email for regular communications as shown in Figure 6-3.

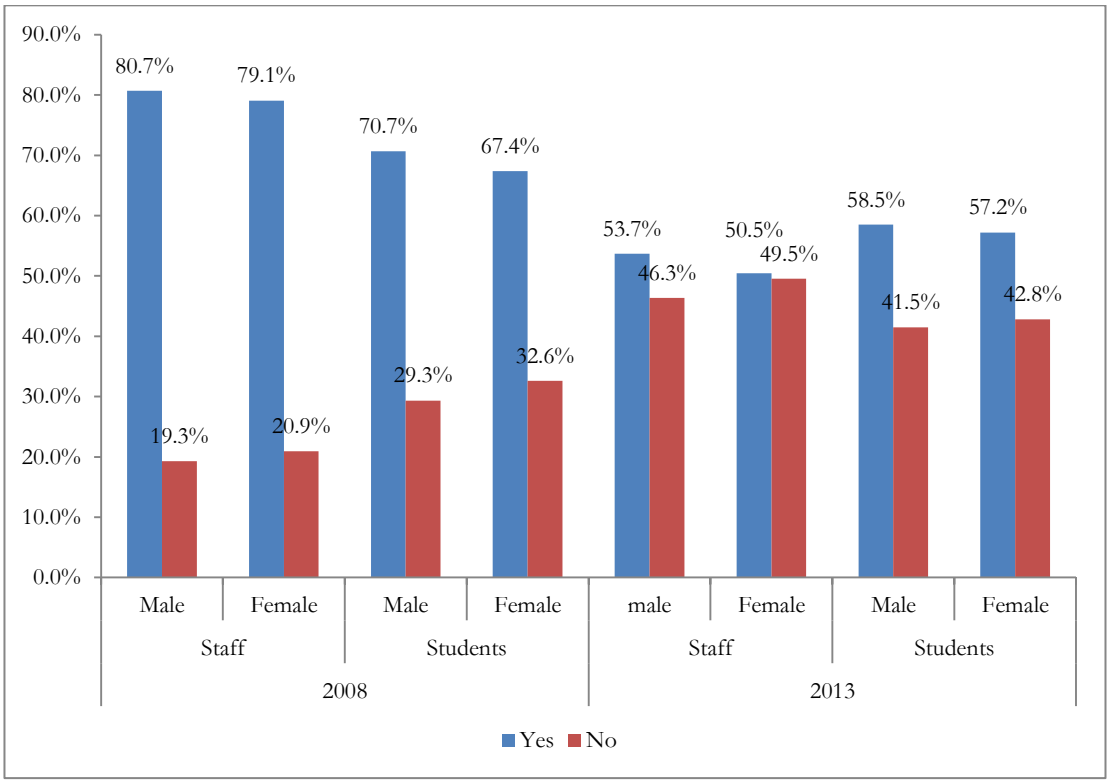
Figure 6-3: Use of email for regular communication



Source: KENET e-readiness data, 2013

Another sub-indicator for Internet usage was the *percentage of respondents who visited at least one web portal regularly*. *Figure 6-4* shows that there was a major positive shift in gender disparity in regular access to web portals in 2013, with almost an equal percentage of male and female having access and no access to web portals compared to 2008. The results suggest that the male respondents were more intense users of the Internet than female users in 2008 and this disparity was significantly narrowed in 2013. It can be noted that among students, there was hardly any difference while among staff; there was a slight difference in favor of the males. However, the 2008 data shows that up to 80% of male students were visiting web portals regularly while in 2013 only about 58% were visiting web portal regularly. This was probably due to the increased use of social media sites rather than web portals.

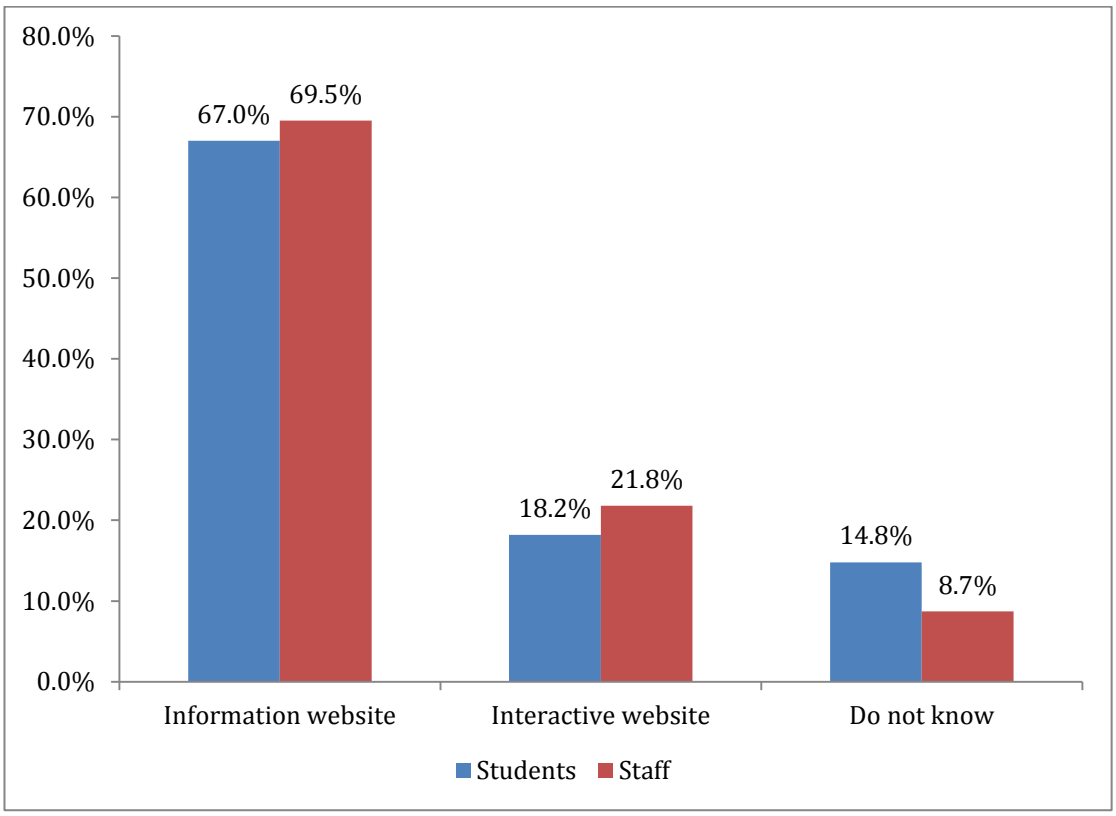
Figure 6-4: Regular visit to web portals by gender



Source: 2013 and 2008 e-readiness studies

Another sub-indicator for people and organizations online was the *percentage of institutional websites considered by students to be interactive or transactional*. Figure 6.5 shows that the percentage of students who thought their institutional website was interactive was only 18.2%. This was stage 3. Stage 4 requires that at least 25% of students consider their institutional website as interactive. The figure shows that most users (nearly 70%) thought that their institutional websites were informational. This suggests the universities surveyed will need to make their websites more interactive by automating their internal processes and establishing operational information systems (e.g., student information systems, financial information systems or other enterprise resource planning (ERP) systems) and linking these systems to the institutional portals.

Figure 6-5: Classification of institutional websites by users



Source: KENET e-readiness data, 2013

The Figure 6-5 also shows a significant proportion of both staff and students did not know much about their institutional websites with about 15% of students having no idea about the nature of their institutional website. This may imply that either the websites did not have a lot of content that is deemed relevant to these stakeholders, or the institutions do not publicize their websites internally, or both.

6.1.3 ICTs in everyday life

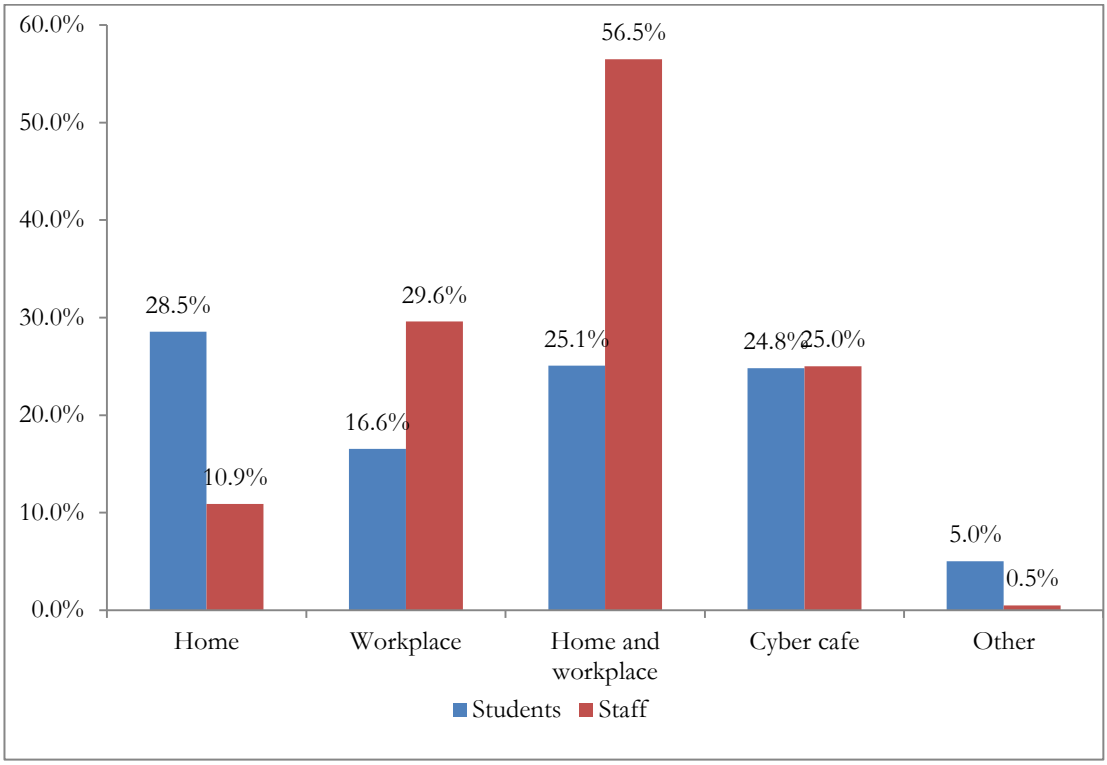
The key sub-indicators for the ICTs in everyday life were:

(i) Percentage of faculty with fixed line
(ii) Percentage of students, faculty and staff with campus access to computers
(iii) Percentage of students, faculty and staff with their own laptop computers
(iv) Percentage of students, faculty and staff with their own desktop computers
(v) Percentage of students whose main access to computers is the cyber café
(vi) Percentage of students and staff using computers for Internet and email
(vii) Percentage of students and faculty using computers for word processing
(viii) Percentage of students and faculty using computers for entertainment

The overall score of the ICT in everyday life was 2.9, up from 2.3 in 2008, which suggests an improvement in the use of ICT by students and faculty.

Campus access to computers

Figure 6-6: Location of user access to computers



Source: KENET e-readiness data, 2013

Two sub-indicators of ICTs in everyday life were the *percentage of students with campus or workplace access to computers* and *percentage of staff with campus or workplace access to computers*. Figure 6-6 shows only a small proportion of both students and staff accessed computers from campus, while a significant number used cyber cafés. In 2008, the universities sampled were all in stage 1 for both students and staff (less than 25%). In 2013, only access by staff had moved to stage 2 (between 25% and 50%) with access by students remaining in stage 1. It therefore means that universities were not doing enough to increase access to computers on campus by students and staff. With about a quarter of both students and staff accessing computers from cyber cafés, the results show there was a huge access problem in university campuses.

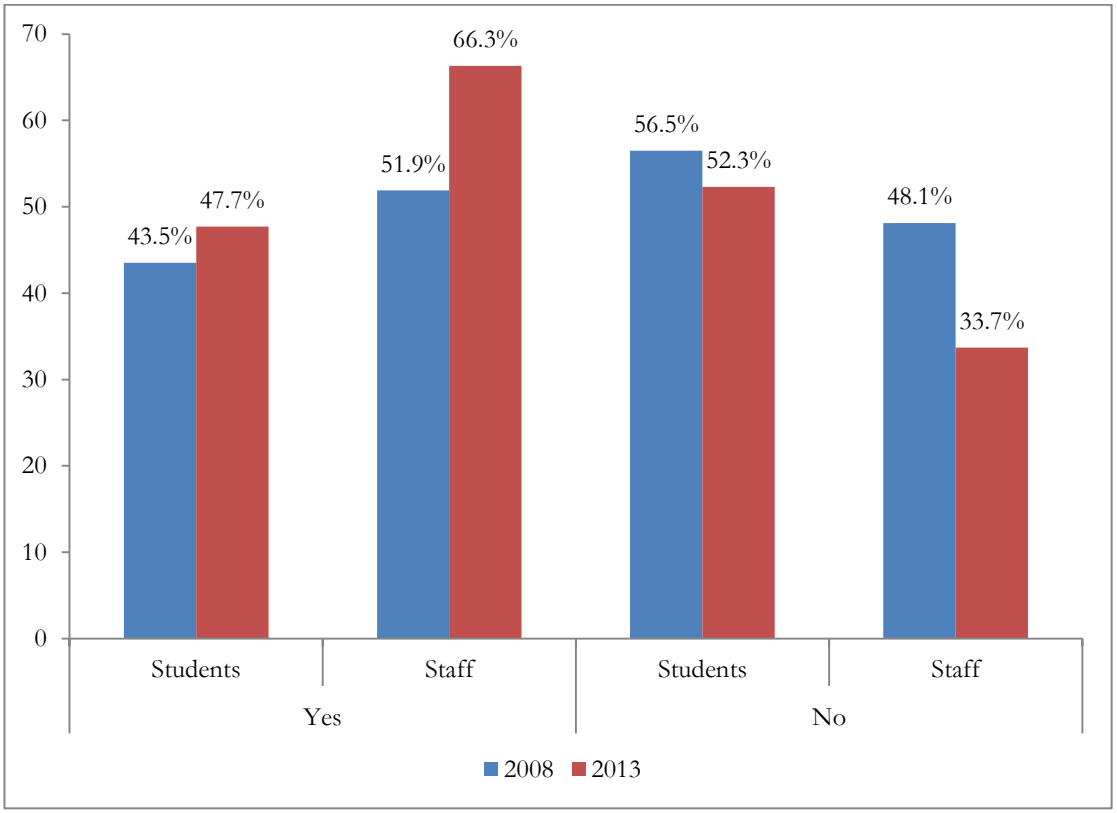
This also means that students were ready to pay for internet services in cyber cafés. In addition, more students accessed computers from home (28.5%) than from campus (16.6%). This represents a challenge for the universities, especially for e-learning. Universities therefore have to do more to increase access to computers from campus, especially for students.

Campus network speeds compared to cyber cafés

In the 2013 survey, over 52% of the students and almost 34% of staff were of the view that cyber cafés provided better Internet speeds than their campuses networks (see Figure 6.7). This is a slight improvement over the 2008 data when 56% of students thought Internet speeds from cyber cafés were better than the campus networks. This was surprising because the Internet bandwidth per 1,000 students had increased 10 times

from 2008 and yet this had not resulted in perceived faster Internet speeds. This means that universities need to improve the quality of their campus network infrastructure and further upgrade their Internet bandwidth per 1,000 students. Although this means increased investments in campus network infrastructure, including wireless access, it could also mean that the quality of the network support staff was inadequate.

Figure 6-7: Perception of whether Internet speeds in campus are better in cyber cafés

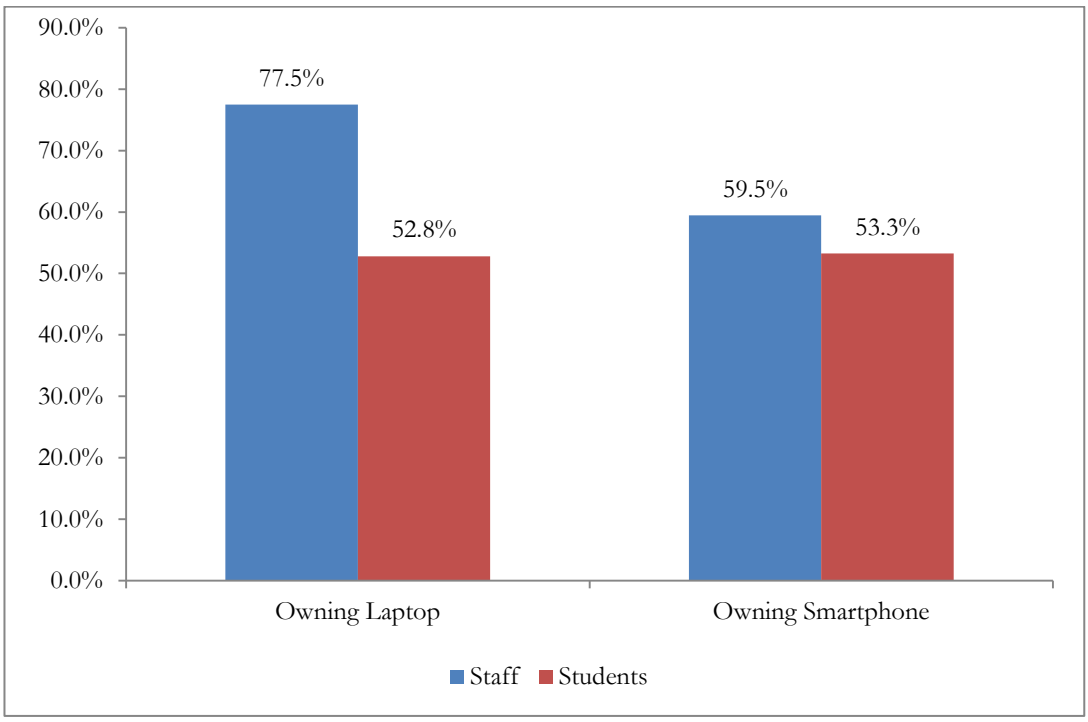


Source: KENET e-readiness data 2008, 2013

Laptop computer ownership in universities

In addition to using computers dedicated to students, the results show an increasing number of students owning and using their own laptop computers. Figure shows that ownership of laptop computer by students was over 52%. The study also shows that ownership of smartphones was about 53%. Laptop ownership among faculty was even higher at 77.5% while smartphone ownership was about 60%. This implies that universities needed to develop bring your own device (BYOD) policies in order to increase network access by simply taking advantage of the high percentage of students and faculty who could use their own devices. While this would reduce pressure on investing in student computer labs, it would in turn increase ICT support costs for the user-owned devices and investments in campus Wi-Fi networks and also increase demand for Internet bandwidth by the students and faculty.

Figure 6-8: Ownership of laptops



Source: KENET e-readiness data, 2013

Use of Internet/email and word processing

Other sub-indicators of ICTs in everyday life were the *percentage of respondents using computers for Internet/email, for word processing, and for data analysis*, respectively. Table 6-1 shows the results for both 2008 and 2013. In 2008, the use of computers for word processing was at stage 2 for both staff and students. In 2013, this had moved to stage 3 for students and remained at stage 2 for staff. However, the use of computers for Internet/email for both staff and students moved from stage 3 in 2008 to stage 4 (more than 75%).

Table 6-1: Purpose for using computers by staff and students

Year	Occupation	Purpose for using computers (%)				
		Word processing	Data analysis	Email/Internet	Entertainment	Others
2008	Staff	49.0%	56.3%	71.1%	37.0%	1.2%
	Students	42.9%	33.6%	72.9%	52.3%	1.8%
2013	Staff	39.5%	26.9%	77.8%	39.2%	0.0%
	Students	65.0%	52.7%	75.5%	39.8%	5.3%

Source: KENET e-readiness data 2008, 2013

For students, the increase of computers for word processing was for assignments. The increased use of internet/email by both students in 2013 could indicate that Internet access was considered important for academic success. It should be noted that about 40% of the students were using computers for entertainment, probably for movies and music.

6.1.4 ICTs in the workplace

The key sub-indicators for the ICTs in everyday life were:

(i) Percentage of faculty using Internet for academic work
(ii) Percentage of faculty using email for regular internal communications
(iii) Percentage of faculty access to Internet from office computer
(iv) Percentage of respondents using mobile internet services

The average for this indicator was stage 3.7, up from 2.9 in 2008, which suggests improved access to ICTs on campus.

Faculty access to internet from office computers

Table 6-2 shows that faculty access to Internet from various departments. Although the access was not uniform for all departments, on average, close to 90% had access to internet on campus in 2013, which represents stage 4. There was significant improvement for faculty in human and social science from 77.5% in 2008 to 89.1% in 2013. Overall, there was an improvement from 83% in 2008 to 93% in 2013 which shows that universities were providing most faculty with office computers with access to the Internet.

Table 6-2: Faculty Academic Departments' access to internet from office computers

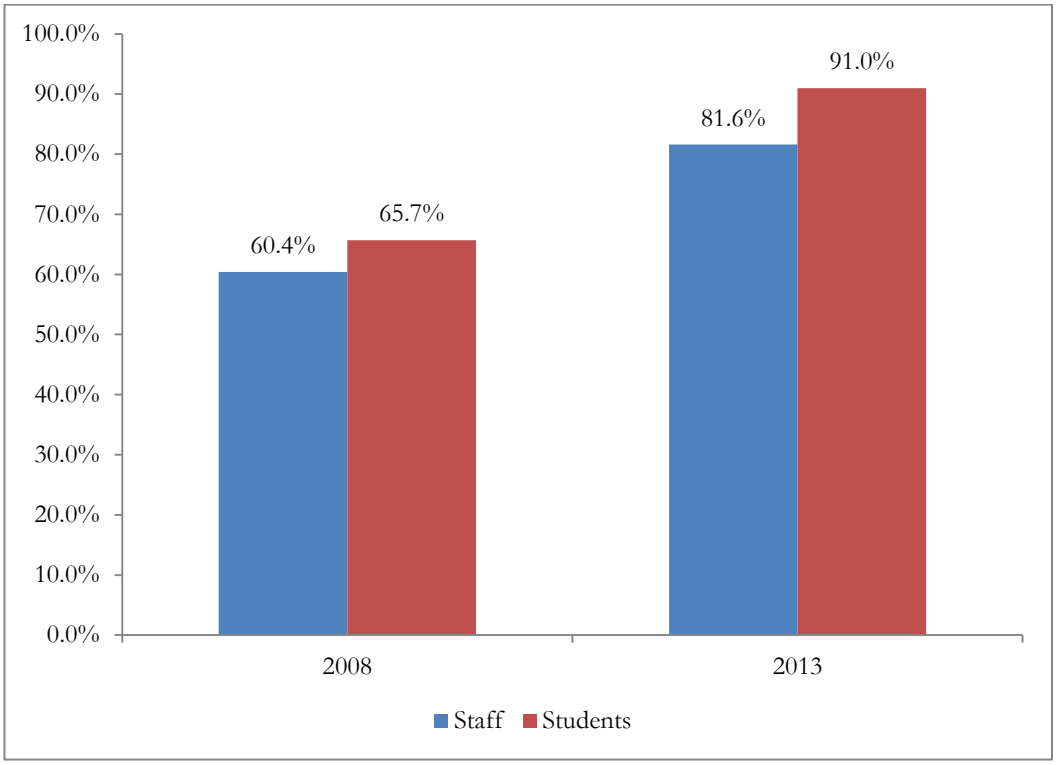
Academic Department	2008	2013
Human and Social Sciences	77.50%	89.1%
Languages, Communication, Journalism	78.8%	85.7%
Computing (IT, IS, CS, CE)	93.6%	98.4%
Engineering (Electrical, Mechanical, Civil)	83.7%	94.4%
Biological Sciences, Physical Sciences	73.8%	80.9%
Education	75.0%	87.5%
Medical Sciences	78.0%	88.6%
Business or Commerce	88.2%	92.3%
Other	75.0%	92.1%
Total	83.1%	93.0%

Source: KENET e-readiness data 2008, 2013

Use of mobile internet services

One of the sub-indicators for ICTs in the workplace is the *percentage using mobile Internet services*. Figure 6-9 shows that staff members had significantly increased the use of mobile Internet services, moving from 60% in 2008 (stage 2) to 81.6% in 2013 (stage 4), indicating an explosion in the use of mobile internet from 2008. This was confirmed by about 95% of students having access to mobile Internet services as shown in Figure 6-10. This may be attributed to the high percentage of students who owned laptops or smartphones (53%) and availability of affordable 3G services in Kenya. However, the survey data did not distinguish between use of mobile Internet on campus and off campus. This will be an area for further study.

Figure 6-9: Mobile Internet usage by staff and students



Source: KENET e-readiness data 2008, 2013

6.1.5 Locally relevant content

The key sub-indicators used for staging the locally relevant content included:

(i) Percentage of students and faculty visiting one to two local websites
(ii) Percentage of faculty looking for local academic information
(iii) Percentage of students looking for local news and entertainment
(iv) Percentage of institutions updating local websites daily

The overall score for locally relevant content was 2.8, down from 3.2 in 2008, which suggests that students and faculty had less access to locally relevant content.

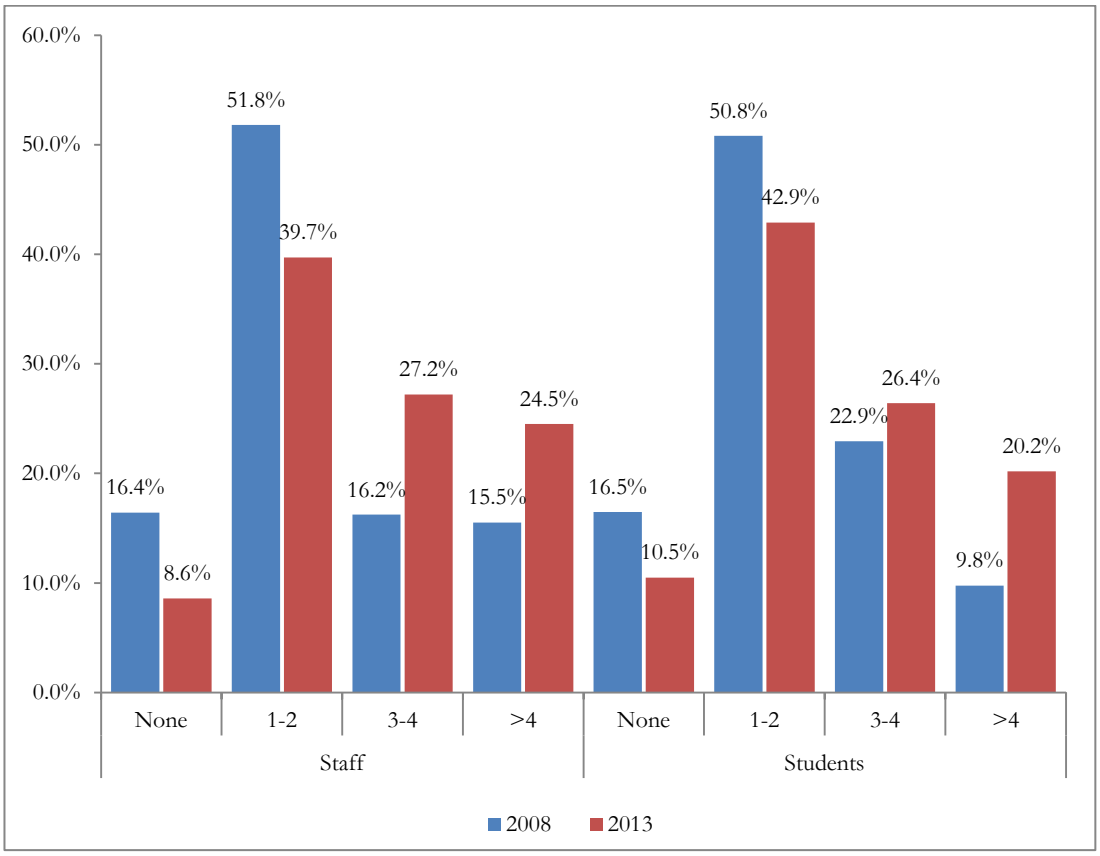
Students and faculty visiting local websites

Two sub-indicators of locally relevant content were *percentage of students visiting local websites* and *percentage of staff visiting local websites*. Figure 6-10 shows the percentage of students and staff visiting local websites. About 8.6% of the student respondents did not visit any local websites in 2013 compared to 16.5% in 2008. There was also a decline in the percentage who visited one or two local websites from 50.8% in 2008 to 42.9% in 2013. It is not clear why there was a drop in the percentage of students visiting local websites and this would be subject to further research.

About 39.7% of faculty respondents visited one or two local websites (stage 3) down from 51.8% in 2008. Again, it was not clear why there was a drop in the visitors to local websites. Stage 4 for these sub-indicators required that more than 50% of students or faculty visit at least one or two local websites. Consequently, the staging for both

indicators fell from stage 4 to stage 3 in 2013. This was unexpected given the increased Internet penetration in Kenya at 52.3% and the uptake of online courses.

***Figure 6-10*: Local websites visited by the users**

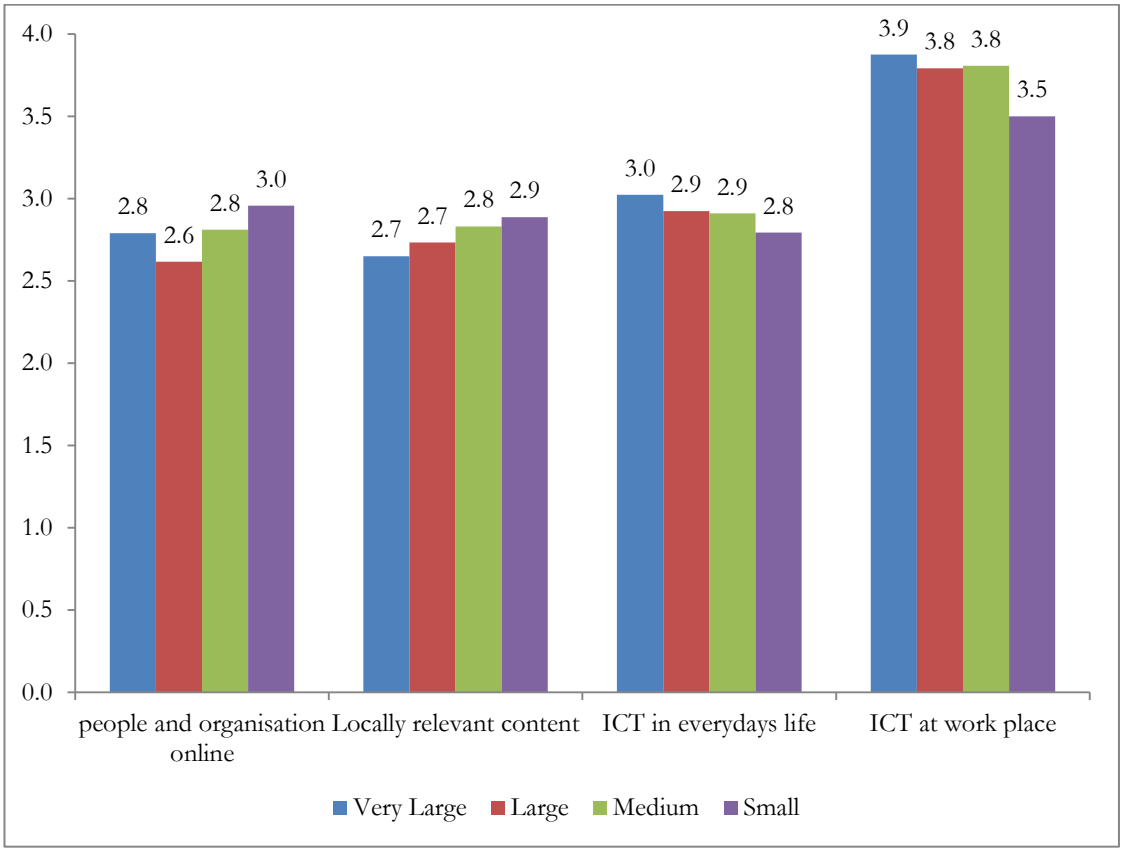


Source: KENET e-readiness data 2008, 2013

6.2 Networked Society by Size of University

This study also analyzed the networked society indicator category for different sizes of universities. Universities were grouped into four categories: small (less than 5,000 students), medium (5,000–10,000 students), large (10,001–30,000 students) and very large (over 30,000 students). Figure 6-11 shows the results for all categories of universities.

Figure 6-11: Networked society staging by category of universities



Source: KENET e-readiness data 2008, 2013

All categories were at stage 3 for ICTs in the workplace, and very close to stage 4, except for small universities. For the other indicators, all the categories of institutions were just less than stage 3. *Overall, the results implied that the readiness of this community was almost independent of the size of the university.* This was partly because most of the sub-indicators in the networked category of indicators were determined by the country's ICT environment rather than the university campus.

7 INSTITUTIONAL ICT STRATEGY

7.1 Introduction

The institutional ICT strategy category of indicators is composed of three indicators, namely:

i. ICT strategy
ii. ICT financing
iii. ICT human capacity

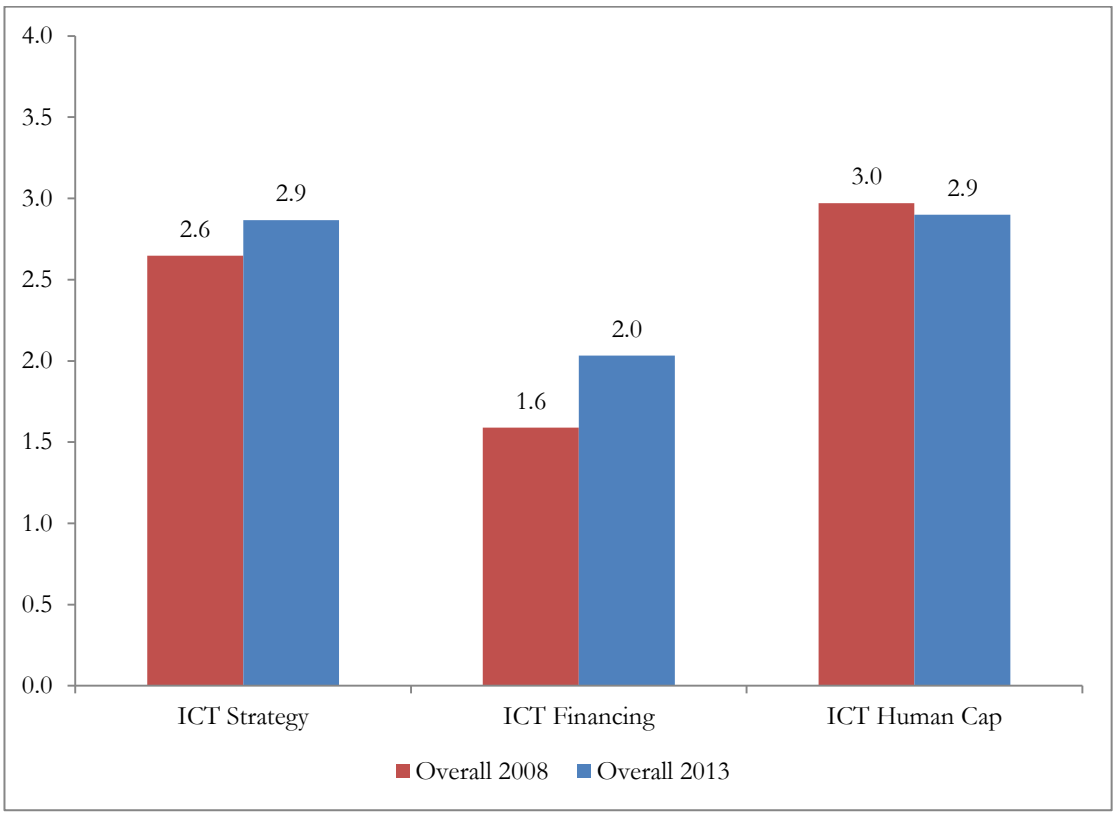
ICT strategy was measured using several sub-indicators that included the alignment of ICT strategy to the corporate strategy, the extent of ICT strategy implementation, and the reporting levels of the head of ICT. Data was collected using the hard facts questionnaire completed by ICT directors.

ICT financing was measured using the sub-indicator of percentage of annual institutional expenditure used to purchase Internet bandwidth. Although a sub-indicator that measures the percentage of budget allocated to ICT was specified, as described in Chapter 2, most of the institutions could not provide the required data to calculate the percentage in 2008. Internet bandwidth expenditure as a percentage of annual institutional expenditure was therefore used as a proxy for percentage of total recurrent expenditure allocated to ICT. The Internet bandwidth expenditure was provided by KENET, the suppliers of Internet bandwidth to the 30 universities, while the chief finance officers provided data universities' total expenditures.

The ICT human capacity indicator was measured using several sub-indicators that included the business and technical experiences of the head of ICT, the frequency of upgrading the skills of the ICT staff, and the retention of ICT staff. Again, this data was collected using the hard facts questionnaire completed by the ICT directors.

Figure 7.1 on the overall staging of the institutional ICT category shows a staging of between 2.0 and 2.9 for the three indicators in the 2013 survey.

Figure 7-1: Overall staging of the institutional ICT strategy indicator



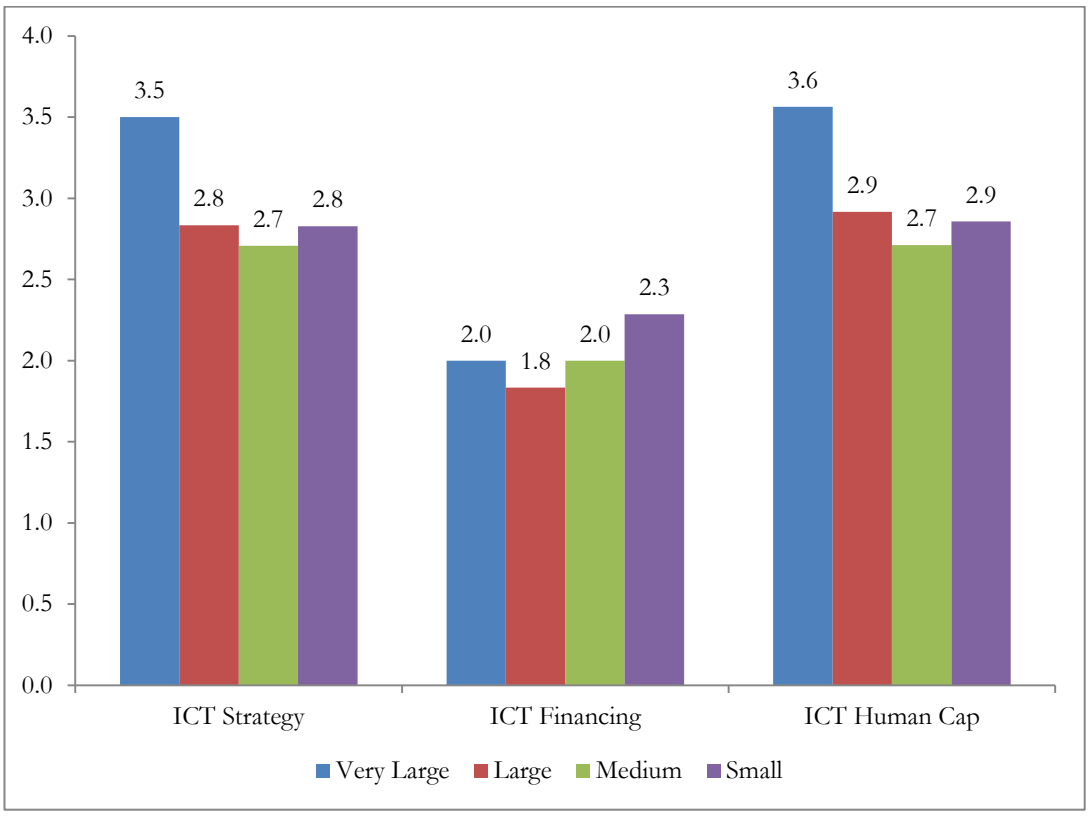
Source: KENET e-readiness data 2008, 2013

In comparison to 2008, it also shows a slight improvement in the staging of ICT strategy (at 2.9), a slight drop in ICT human capital staging (from 3.0 to 2.9) and a slight improvement in ICT financing staging from 1.6 in 2008 to 2.0 in 2013. It was noted that ICT financing was lowest at only stage 2.0 which is consistent with the overall low Internet bandwidth expenditure of only 0.5% of total institutional recurrent expenditure. As explained earlier in this report, spending up to 1.5% of recurrent expenditure would result in stage 4 for the Internet affordability indicator.

Does size of university matter?

An analysis of the staging for the indicators for the different sizes of universities as shown in Figure 7-2 suggests that it was the very large universities that achieved high stages of readiness in ICT strategy and ICT human capital indicators at stage 3.5 and 3.6 respectively. The small universities (2,000–5,000 students) were at stage 2.3 in ICT financing compared to stage 2.0 for the very large universities.

Figure 7-2: Average staging of categories of institutions in 2013



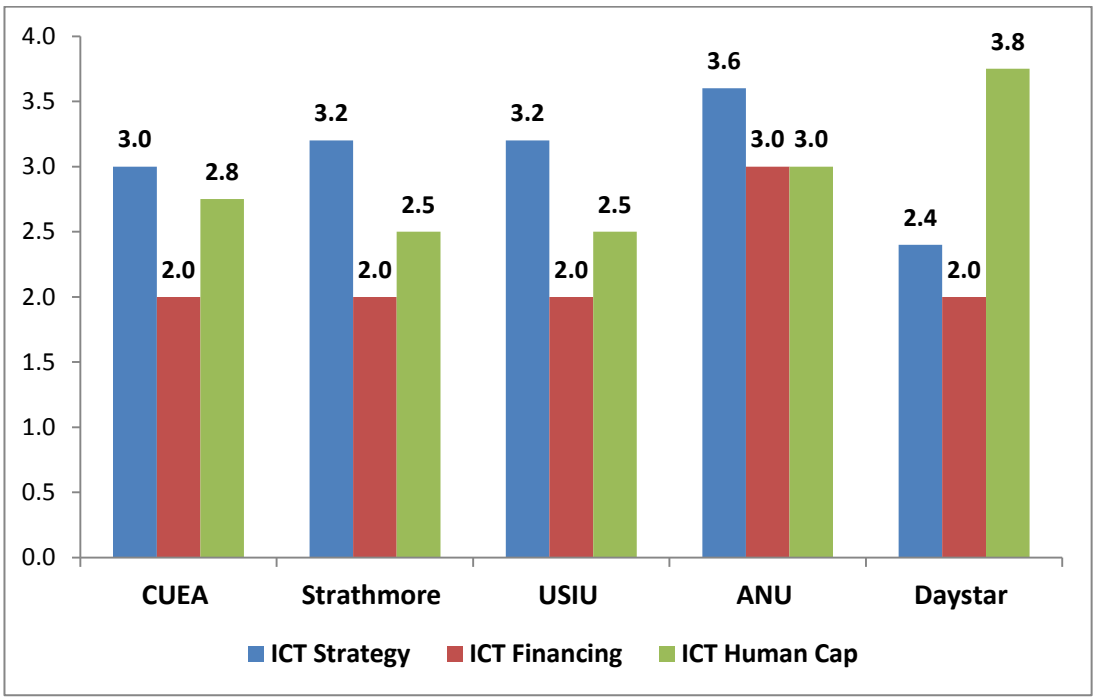
Source: KENET e-readiness data, 2013

A possible explanation for overall superior state of readiness for the very large universities was that they were also the oldest; were in higher stages of maturity in adoption of ICT; and had developed a critical mass of ICT human capital. This is also the case for the older and more established private universities in the small and medium-sized categories as shown in Figure 7.2. Three of the private universities were at stage 3.0 and above in ICT strategy and all were in stage 2.5 and above in ICT human capacity with Daystar University attaining stage 3.8.

Staging analysis for established private universities and new public universities in the small and medium size categories

Figures 7-3 and 7-4 show the staging for five selected established private universities and five selected new public universities.

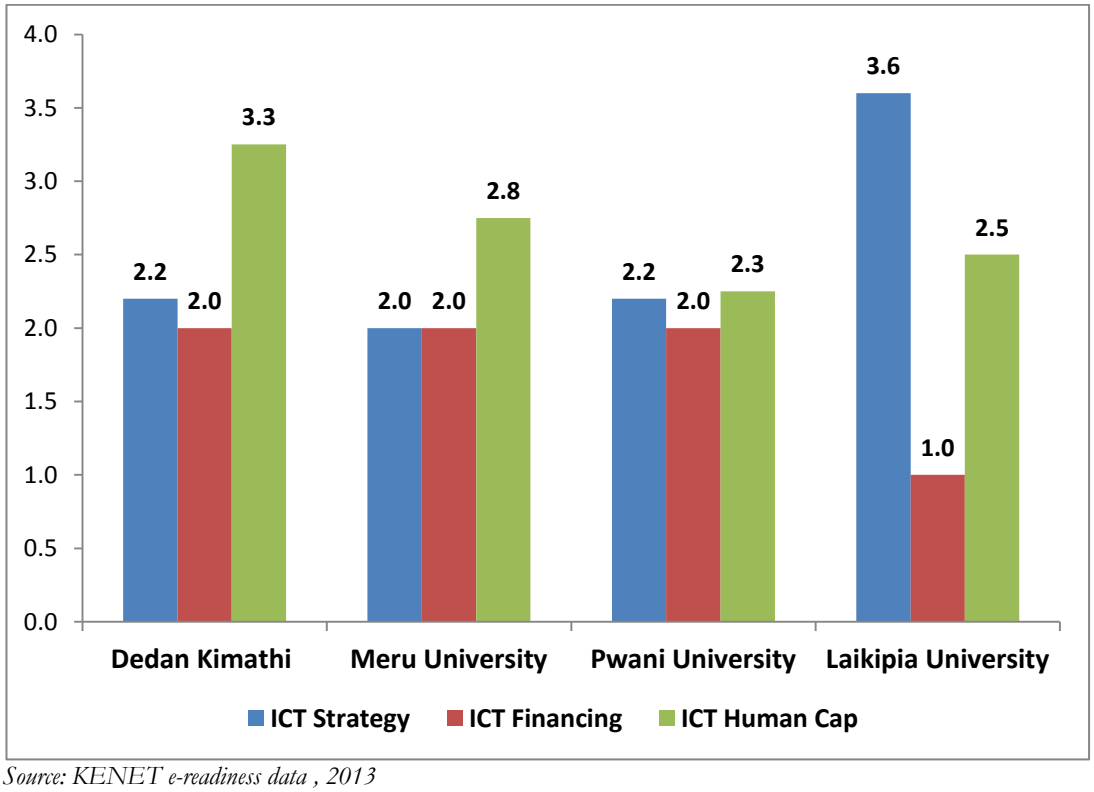
Figure 7-3: Staging of selected old private universities in 2013



Source: KENET e-readiness data, 2013

A comparison with Figure 7-4 for relatively new universities (i.e., the new public universities chartered in 2013) shows that most are struggling with ICT strategy indicator at about stage 2.0 and three were below stage 3.0 in ICT human capital.

Figure 7-4: Staging of selected new public universities in 2013



Source: KENET e-readiness data , 2013

However, all the universities were struggling to allocate adequate ICT budget or Internet budgets. Moreover, the hard facts questionnaires used for staging this category of indicators did not include the perceptions of the users in terms of ICT support or even alignment or implementation of the ICT strategies. Future studies shall include perception questions for faculty, staff and students.

7.2 Perceptions of the Impact of ICT by Senior Leadership

Data was collected from senior staff (librarians, ICT directors, academic deans of ICT, finance officers (FOs), registrars and DVCs for academic affairs) on their perceptions of the impact or value of ICT. They completed different sections of the hard facts questionnaire. An example of the question posed to the registrars is shown below:

> To what extent do you think implementation of ICT has enabled the realization of the following outcomes in your campus?
>
> a) Reduced operational cost
> b) Increased the efficiency of operations/processes
> c) Improved quality of service delivery to students, faculty and accreditation bodies
> d) Increased transparency and accountability

These perceptions were measured on a 5-point linear scale, from 1 for strongly disagree to 5 for strongly agree. The results are shown in Table 7-1.

Table 7-1: Results of perceptions of the impact of ICT

	1. Strongly disagree	2. Somewhat disagree	3. Neither agree nor disagree	4. Agree	5. Strongly agree	Total
Librarian						
Reduced operational costs	3.7	3.7	3.7	44.4	44.4	100.0
Increased the efficiency of operations/processes		3.7		18.5	77.8	100.0
Enhanced competitiveness of university	3.7	3.7	3.7	22.2	66.7	100.0
Improved quality of service delivery to students and faculty		3.7		18.5	77.8	100.0
Increased transparency and accountability	3.7	3.7	7.4	44.4	40.7	100.0
Dean ICT						
Enhanced the quality of teaching	10.3	0.0	0.0	48.3	41.4	100.0
Enhanced quality of learning	3.4	6.9	3.4	48.3	37.9	100.0
Improved research productivity, e.g. no. of research papers published	3.4	3.4	17.2	48.3	27.6	100.0
Expanded research opportunities, e.g. collaboration opportunities	3.4	3.4	17.2	41.4	34.5	100.0

	1. Strongly disagree	2. Somewhat disagree	3. Neither agree nor disagree	4. Agree	5. Strongly agree	Total
Increased the efficiency of operations/processes	6.9	3.4	6.9	41.4	41.4	100.0
Improved quality of service delivery to students and faculty	6.9	6.9	6.9	27.6	51.7	100.0
Increased transparency and accountability	6.9	10.3	24.1	34.5	24.1	100.0
Finance officer						
Reduced operational cost	3.5	6.9	13.8	37.9	37.9	100.0
Enhanced revenue	6.9	13.8	13.8	44.8	20.7	100.0
Expanded opportunities for revenue generation	6.9	6.9	27.6	37.9	20.7	100.0
Increased the efficiency of operations/processes	3.4	3.4	0.0	37.9	55.2	100.0
Improved quality of service delivery to students, faculty and accreditation bodies	3.4	3.4	3.4	24.1	65.5	100.0
Increased transparency and accountability	3.4	3.4	13.8	37.9	41.4	100.0
Director ICT						
Enhanced the quality of teaching	7.1	3.6	0.0	46.4	42.9	100.0
Enhanced quality of learning	7.1	3.6	0.0	42.9	46.4	100.0
Increased the efficiency of operations/processes	10.7	0.0	0.0	21.4	67.9	100.0
Enhanced competitiveness of the university	7.1	3.6	10.7	42.9	35.7	100.0
Improved quality of service delivery to students, faculty and accreditation bodies	7.1	3.6	3.6	35.7	50.0	100.0
Increased transparency and accountability	7.1	3.6	14.3	32.1	42.9	100.0
DVC AA						
Reduced operational cost	0.0	0.0	11.5	26.9	61.5	100.0
Expanded opportunities for revenue generation	0.0	0.0	23.1	46.2	30.7	100.0
Enhanced the quality of teaching	0.0	0.0	3.8	42.3	53.8	100.0
Enhanced quality of learning	0.0	0.0	4.0	56.0	40.0	100.0
Improved research productivity, e.g. no. of research papers published	0.0	7.7	26.9	34.6	30.8	100.0
Expanded research opportunities, e.g. collaboration opportunities	0.0	0.0	19.2	46.2	34.6	100.0

	1. Strongly disagree	2. Somewhat disagree	3. Neither agree nor disagree	4. Agree	5. Strongly agree	Total
Increased the efficiency of operations/processes	0.0	0.0	0.0	46.2	53.8	100.0
Enhanced competitiveness of the university	0.0	0.0	11.5	38.5	50.0	100.0
Improved quality of service delivery to students, faculty and accreditation bodies	0.0	0.0	3.8	38.5	57.7	100.0
Increased transparency and accountability	0.0	0.0	19.2	38.5	42.3	100.0

Source: KENET e-readiness data, 2013

Taking the total percentage that agreed (4) plus percentage that strongly agreed (5) that was greater than 75% as significant. Table 7-2 gives a summary of the responses.

Table 7-2: Summary results of perceptions that stakeholders agreed or strongly agreed on impacts of ICT

	DVC AA	Dean ICT	FO	Registrar	Librarian	Director ICT
Enhanced quality of teaching	✓	✓				✓
Enhanced quality of learning	✓	✓				✓
Improved research productivity		✓				
Expanded research opportunities	✓	✓				
Enhanced competitiveness	✓				✓	
Reduced op. costs	✓		✓	✓	✓	
Enhanced revenue						
Enhanced opportunities for revenue generation	✓					
Increased efficiency	✓		✓	✓	✓	✓
Improved quality of service delivery	✓	✓	✓	✓	✓	✓
Increased transparency & accountability	✓		✓	✓	✓	

Source: KENET e-readiness data, 2013

Table 7-2 shows that all respondents agreed or strongly agreed with the outcomes that were relevant to them. For example, the registrars believed that ICT had reduced operational costs, increased efficiency, improved quality of service and increased transparency. Surprisingly, only the DVC academic affairs believed that ICT had enhanced opportunities for revenue generation.

However, it was not clear if there was any evidence to support the perceptions of the respondents. For example, the DVC academic affairs did not believe that ICT had improved research productivity. These are therefore areas of further research to establish the drivers of the perceptions. In summary, all of the senior leaders of the 30 universities considered ICT to be critical to achieving the strategic outcomes of the universities. This was an encouraging result.

PART 3: OVERALL E-READINESS FINDINGS, CRITICAL ISSUES AND CONCLUSIONS

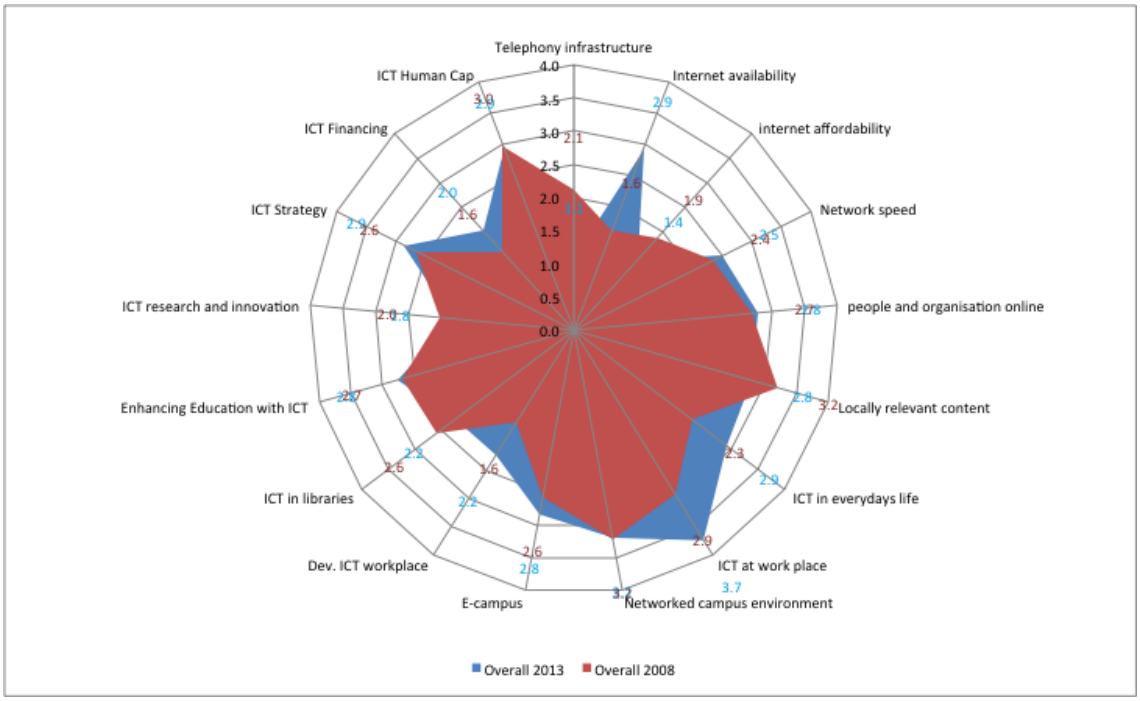
8 OVERALL E-READINESS INDICATOR FINDINGS AND ASSOCIATED CRITICAL ISSUES

8.1 Overall Staging and Accession to Higher Stages of Kenyan Universities

This study analyzed the aggregate staging for each of the five categories of the e-readiness indicators. Detailed results for each of the 30 universities that participated in the survey have been posted on the e-readiness survey results database and are available to authorized users of the universities (http://ereadiness.kenet.or.ke). The universities could use the results as part of monitoring and evaluation of their ICT or corporate strategic plans, or for regular review of strategic plans.

Figure 8.1 summarizes the overall results for the 2008 and 2013 surveys. It is evident that in the five years between the surveys there had been limited accession to higher stages for most of the 17 indicators. In fact, only two indicators; ICT in the workplace and network environment; had accessioned above stage 3.0 by 2013. All the other 16 indicators remained below stage 3.0. However, the Internet availability indicator changed from stage 1.6 to stage 2.9 in 2013. As explained in Chapter 4, this was mainly due to the increase of about tenfold in the Internet bandwidth per 1,000 students sub-indicator.

Figure 8-1: Average staging for 17 indicator for 2008 and 2013



Source: KENET e-readiness data 2008, 2013

In general, the results suggest that accession to higher stages is a slow process and universities were not able to achieve stage 3 for 15 of the 17 indicators. For example, the networked learning category of indicators that requires strong academic leadership, had not achieved any significant changes since the last survey in 2008. This was despite the fact that that senior academic leadership (e.g., DVC academic affairs, librarians and deans of faculty or schools of ICT) all considered ICT to be important or very important for achievement of the academic mission of the universities.

8.2 Critical Issues and Recommended Accession Strategies

This section identifies some of the critical issues, around 10 of the 17 e-readiness indicators, which need to be addressed for accession to higher stages and makes recommendations to be implemented by the senior leadership of the universities.

8.2.1 Critical issues for network access category of indicators

Table 8-1 shows critical issues for three of the four categories of network access indicators. The Internet availability indicator did not have any critical issues since it had accessioned from stage 1.6 to stage 2.9 because of the corresponding increase in Internet bandwidth per 1,000 students.

The *telephony infrastructure* indicator staging dropped from stage 2.1 to stage 1.1 in the five years. This is probably due to the large number of new universities that have not yet invested in telephony infrastructure. The lack of telephony infrastructure reduces the effectiveness of staff and faculty due to lack of effective internal communications and is a critical issue. It also means that staff and faculty were not being prepared for web conferencing or video conferencing that are effective in reducing costs of communication and collaboration among staff and faculty.

We therefore recommend that all universities invest in telephony infrastructure as well as the associated video and web conferencing infrastructure that uses the same backbone infrastructure as the campus networks.

The key actions in this area require the support of chief finance officers. However, it is the ICT directors who should demonstrate the institutional efficiencies and capacities possible with investments in telephony and video conferencing infrastructure.

The *Internet affordability* indicator was at stage 1.4 in 2013 down from stage 1.9 in 2008. This drop was mainly due to the increase in student enrolment without a corresponding increase in Internet budgets. This was especially important for institutions outside urban areas where the average Internet bandwidth costs were up to 50% above the urban areas. This was an area that required the intervention of the Vice Chancellors. However, it was the ICT directors who needed to demonstrate the value of ICT in learning, teaching and administration using concrete data and case studies.

The *network speed and stability* indicator remained almost unchanged in the five years at stage 2.5 despite the tenfold increase in Internet bandwidth per 1,000 students. As noted earlier, this suggests that the campus networks were not well designed, needed to be upgraded to cope with large numbers and Internet bandwidth, or were not well managed. Anecdotal data suggested that there were few experienced network administrators or network engineers at most university campuses.

Accession strategies for this critical indicator requires investments in campus network infrastructure (including wireless networks to support student-owned laptops and smartphones), service management, as well as a critical mass of network and systems administrators.

Although ICT directors play a critical role in building the ICT human capacity, setting up an effective service management operation and developing new cyber security and bring your own device (BYOD) policies, it was the chief finance officers and Vice Chancellors who needed to make the necessary investment decisions to upgrade the networks. *In general, campus networks need to be upgraded every five years*. These critical issues therefore need to be addressed along with the institutional ICT strategy critical issues as described in the next sub-section.

Table 8-1: Critical issues for network access category of indicators

E-readiness Indicator	**Critical Issue**	**Recommended Accession strategies**	**Action by**
1.Telephony infrastructure	The telephony infrastructure indicator dropped to stage 1.1 from stage 2.1 in 2008. The critical issue is that lack of telephony diminishes the quality of working environment and efficiency of staff. Lack of telephony infrastructure means faculty and staff are also not being prepared for IP-based video and web-conferencing services.	Implement voice over Internet protocol (VoIP) telephony system to ride on the backbone campus networks for all campuses. Explore the possibility of a shared telephony gateway for all universities with KENET as a service bGoKer and/or provider of services. Implement video and web conferencing to supplement telephony infrastructure especially for universities with multiple campuses.	VC/ DVC AA /ICT director
2. Internet affordability	Universities were spending < 0.5% of total expenditure on Internet bandwidth. Consequently, universities dropped from stage 1.9 to 1.1.	Universities should aim to increase Internet expenditure to at least 1% of the total recurrent expenditure. Enforce the Government of Kenya mandated guidelines of allocating up to 10% of the recurrent expenditure to ICT, including salaries for public institutions. This figure was under 2.4% for most universities.	VC/ CFO /ICT director

3. Campus Network Speed and Stability	Campus networks are perceived to be unstable and provide slow Internet speeds in comparison to cyber cafés or 3G mobile Internet. A significant percentage of students (24%) access computers and Internet About 24% computers at cyber cafés. A large proportion of student own smartphones and laptops (53%) and will want to use them in university campuses	Universities must upgrade, redesign and in some cases replace the old campus networks to ensure they are stable and fast. Campus networks must be redesigned to accommodate the large number of student and faculty-owned devices. This will include automated on-boarding of user-owned devices. Annual campus network investments must be increased significantly to accommodate new services and increased number of user-owned devices. Increase Internet bandwidth and implement appropriate bandwidth management policies. Universities must set up campus-based helpdesks to support the users. Develop and implement a BYOD policy.	VC/ICT director/ Registrar

8.2.2 Institutional ICT strategy

The institutional ICT strategy category of e-readiness indicators includes ICT financing, ICT human capacity, and ICT strategy implementation. Figure 8-1 shows that ICT financing had only accessioned from stage 1.6 in 2008 to stage 2.0 in 2013. The ICT human capacity indicator dropped slightly from stage 3 in 2008 to stage 2.9.

Although it may seem like the critical issues are only in the area of ICT financing, the poor performance in the network speed and stability indicator suggests the lack of the necessary technical ICT human capacity. The critical issues that affect accession in ICT financing and ICT Human Capacity indicators are shown in Table 8-2.

Table 8-2: Critical issues for Institutional ICT strategy

E-readiness Indicator	Critical Issue	Recommended Accession strategies	Action by
ICT financing	Expenditure per 1,000 students was only $7,339. This was mainly because student enrolment increased by over 100% between 2008 and 2013. This is inadequate given the large number of student-owned devices on campus.	All universities should aim to spend at least $21,000 per 1,000 students per year, which translates to only 10 Mb/s per 1,000 students. Allocate adequate ICT capital recurrent budgets to enhance network environment, upgrade and expansion of campus ICT infrastructure, ICT staff salaries and training. Explore innovative ways of funding ICT capital and recurrent expenditure, for example, by providing low-cost on and off campus Internet access charges in collaboration with the NREN.	VC/CFO/ ICT director

Internet affordability	Shortage of critical mass of qualified network engineers to design and operate campus network. (Campus networks are perceived to be unstable and slow by over 50% of the students). Bandwidth management policies are not yet implemented especially for many universities providing relatively low Internet bandwidth because of lack of ICT staff.	Recruit and develop high-end ICT professionals and network engineers required to design and maintain the complex campus backbone and wireless networks and services. Provide continuous capacity building for network and systems administrators supporting campus network and services. Develop and enforce appropriate bandwidth services to give priority to academic services for students and faculty.	ICT director /CFO

ICT financing

The critical issue for ICT financing is also related to the ICT affordability indicator. Institutions were only spending on average 0.5% of their total expenditure on Internet bandwidth which needed to be increased to about 1%. It appears that universities were not allocating adequate funding for the Internet budget to cope with the large number of students. An increase of the average expenditure to $25,000 per 1,000 students would move the indicator from stage 2 to stage 3. However, it appears the problem was how ICT was funded. It was not clear from the study whether it was from tuition or from student lab fees. It was also not clear where funding for other ICT capital projects required to upgrade the campus infrastructure would come from.

ICT directors therefore need to identify new sources of funding to increase the annual expenditure per 1,000 students or the total expenditure allocated to Internet bandwidth by submitting funding proposals to the government, donor agencies and the private sector. It is also important for ICT directors to start charging for services provided to different schools and departments of the universities. Moreover, the student laboratory fees should be used exclusively for recurrent ICT costs and not considered as another source of revenue for the universities.

ICT human capacity

Despite attaining a relatively high stage at 2.9, ICT human capacity is an area that needs urgent attention. While the universities did not appear to have an ICT staff retention problem, the actual technical capacity of the ICT staff was not measured. The fact that 60% of the students considered the campus network unstable suggested low ICT technical capacity, as most of the universities did not have the necessary staff complement with the requisite qualifications to manage large and complex campus networks.

The recommended accession strategies could therefore include external audit of the technical capacity of the ICT staff. This could be done in collaboration with KENET or other external ICT consultants. A staff development program would then be developed and funded to develop the advanced technical capacity required. This would include developing capacity in project management, service management, and ERP operation and administration. This also requires full-time and competent ICT directors; who would not only develop the capacity of the staff and create a conducive working environment, but also influence the senior leadership to invest in high-end ICT professionals.

8.2.3 Networked campus

The networked campus indicators of network environment and e-campus were at stage 3.2 and 2.8 respectively. Thus, it appears there were no critical issues associated with these indicators. However, the data used to stage these indicators suggests that there were some critical issues around each of the two indicators as shown in Table 8-3.

Networked environment

The networked environment data shows that only 10 of the 30 universities had disaster recovery plans and most did not have off-site backup sites. Only 56.7% of the student labs were on UPS and this contributed to the perception that campus networks were unstable. These critical issues could be addressed by additional investments in setting up disaster recovery centers and also providing clean power and UPS power at the campuses.

In general, enhancing the network environment with clean power is not always an ICT function but needs to be driven by the Vice Chancellor and the chief finance officers. However, it was the responsibility of the ICT directors to demonstrate that the network environment indicator was critical for supporting ICT academic and administrative operations and supporting teaching, learning and research activities.

E-campus

Data for the e-campus staging indicates that most of the university websites were only informational and did not support interactions with users or transactions. Most were not updated daily and could not be considered a portal for the university students. Thus, the universities were not yet ready to support online transactions and the interactions were mainly via email.

To address these critical issues, the senior leadership must first understand that institutional websites and web portals were essential for efficient operations of the universities and for attracting new students and faculty. Awareness raising could be done through workshops as part of ICT capacity building for the senior leadership of universities. This should be a priority in to improve the stages of the sub-indicators of e-campus.

Once the senior leadership have fully appreciated the strategic value of their institutions' websites, the Internet and social media for the future of a university, competent ICT directors with experience in ERP roll out, project management and communication, should be recruited to drive the automation projects. All new ERPs should be web-enabled and the learning management systems should be capable of supporting the large number of students in the universities.

Thus, accession to stage 4 in these two indicators will require the support of the entire senior leadership led by the Vice Chancellor and competent and full-time ICT directors to drive the changes. Table 8-3 summarizes the critical issues and recommended actions.

Table 8-3: Critical issues for networked campus category

E-readiness Indicator	Critical Issue	Recommended Accession strategies	Action by
Network environment	Lack of ICT disaster recovery plan with only 10 out 30 universities with an off-site backup setup. Up to 25% of the students' labs are also not on UPS. Cyber security awareness was relatively low.	Implement a shared disaster recovery plan in collaboration with other universities or KENET in order to reduce costs. Invest in clean power for the campuses as well as backup generator s and, UPS. Develop cyber security technical staff in collaboration with the NREN	VC/ICT Director
E-campus	Most of the university websites do not support interactive or transactional services. This is mainly because library and student information systems are not yet available online or off campus. Websites are not updated regularly on a daily basis with some universities updating websites once a month. Universities are not using the websites and social media to communicate with students, faculty and prospective students.	All automated applications should be web-enabled. Implement online procurement system and change the processes accordingly. Promote student portals as source campus news and all student services, including e-learning services. Appoint web and social media communication officers to engage students, faculty and prospective students.	VC/registrar /CFO/ICT director

8.2.4 Networked learning

Networked learning group of indicators are critical for the achievement of university mission of teaching, learning and research. Figure 8-1 shows that all the indicators in this category were below stage 2.5 except for enhancing education with ICT that was at stage 2.8. However, even for the enhancing education with ICT indicator, the accession in the period from 2008 to 2013 was insignificant (accession from stage 2.7 in 2008 to 2.8 in 2013). The ICT in libraries indicator dropped to stage 2.2 down from stage 2.6 in 2008 and the ICT research and innovation also dropped to stage 1.8 down from 2.2 in 2008.

Table 8-4 summarizes the critical issues identified and the recommended actions to achieve higher stages.

ICT in libraries

One of the critical issues for this indicator is that many OPAC and library websites did not provide off campus services despite most students living off campus and reporting

that they considered the library website as very important or extremely important for their academic success.

Another critical issue was the fact that e-books and open educational resources (OERs) were not yet integrated in the digital libraries. This could be achieved without much additional investments as long as a library had qualified staff. However, continuous capacity building was necessary for library staff and ICT support staff. Thus, university librarians with the support of the DVC for academic affairs and ICT directors could address most of the critical issues without significant increases in ICT funding for libraries.

Enhancing education with ICT

The underlying data used to stage this indicator suggested that there were two critical issues that needed to be addressed:

a. Limited availability of e-learning courses for university students. The data indicated only 11% of the students had taken a few blended courses in the 2012/2013 academic year. This was despite over 75% of the students reporting that they preferred blended courses according to the perception survey of 2013. Thus, e-learning strategies of most of the universities have not been implemented.
b. Universities were not taking advantage of the mobility of students who increasingly own smartphones and laptop computers (53% in each case).

Both of the above critical issues are related to transformation of teaching and learning using ICT and could only be driven by deans of academic departments and the DVC academic affairs, with the ICT directors playing a supporting role. It would also require a lot of faculty development, which was part of developing the ICT workforce indicator (it was only at stage 2.2).

Apart from developing the capacity to teach blended or online courses, developing e-learning content even with open educational resources is a labor-intensive activity and would require reduction in teaching workload for faculty developing this content. Instructional designers would also be required to support the faculty in e-learning development. Thus, adopting ICT in teaching and learning would require strong academic leadership and would also initially increase the cost of instruction.

ICT research and innovation

At stage 1.8, this indicator raises many critical issues as it was considered as a proxy for research and innovation indicators for all other disciplines in a university. As explained in Chapter 7, universities with strong ICT academic departments tended to achieve higher stage of e-readiness in most indicators, probably due to availability of local expertise and champions among faculty and the low cost of ICT support labor from the students in the ICT academic departments.

Three critical issues were identified from the underlying data used for staging the indicator:

a. Low percentage of faculty with PhDs in ICT which limited the capacity of the university to undertake advanced ICT research.
b. Low throughput of doctoral and master's programs in ICT which limited the ICT research output.
c. Limited number of university-based ICT innovation incubators. This was an indication that universities were not promoting ICT innovations at the undergraduate despite offering ICT degree programs

Table 8-4: Critical issues for networked learning

E-readiness Indicator	Critical Issue	Recommended Accession strategies	Action by
1.ICTs in libraries	Library services, including OPAC, not widely available off campus. Open educational resources (OER) and e-books not yet integrated into library systems.	Libraries could implement digital libraries to serve the off campus and e-learning students. This will ensure off campus access to OPAC, open educational resources and e-books. Libraries could offer training courses, online and face to face for the large number of students unable to visit campuses and libraries physically.	University librarian
2.Enhancing education with ICT	Low numbers of e-learning courses were available to students despite preference for blended learning by over 70% of students. Only 11% of students took a few blended courses in the 2012/2013 academic year. Universities are not yet taking advantage of the mobility of students who own laptops and smartphones. Most of the students study off campus	Encourage faculty to develop e-learning and OER materials in their courses. Prepare faculty for developing e-learning materials and teaching online or blended courses. This could include a certification system for faculty teaching online or blended courses. Set and monitor annual targets for percentage of online or blended courses taught by faculty per semester. Recruit instructional designers to support faculty in developing e-learning materials. Reward faculty developing e-learning materials and teaching online. Develop e-learning materials that can be delivered to laptops and smartphones to take advantage of the large number of off campus students who own mobile devices. Podcast of lectures would especially be appropriate for the mobile and commuting students.	DVC, academic affairs/ deans of schools

E-readiness Indicator	Critical Issue	Recommended Accession strategies	Action by
ICT research and innovation	Low percentage of faculty with PhDs and low throughput of master's and PhD degree programs. Lack of university-based innovation incubators.	Increase the throughput of PhDs in ICT from the leading research universities in Kenya. This would include offering PhD scholarships. Recruit and retain doctoral-level faculty from Kenya and neighbouring African countries. Reward faculty and institutions that graduate PhD candidates with institutional and individual research grants.	VC/DVAA and Deans/ Chairman of ICT departments

Senior academic leadership of the universities as well as the deans of faculties or schools of ICT are the only ones who could address the above critical issues. Increasing the PhD throughput or even attracting more faculty with PhD in ICT disciplines requires that universities enhance the research environment by among other things making it easy for faculty to access research grants or to achieve a balance between teaching and research workloads. Setting up an ICT innovation incubator requires that some of the faculty focus on grant writing and setting up the new organizations and establishing relationships with industry.

This requires a change in the model of the university from being predominantly a teaching university to a research university. It is unlikely that all the 30 universities will be successful in achieving higher stages in this indicator. The researchers expect only about 10 Kenyan universities to develop the capacity ICT research and innovations with the others remaining teaching universities. Universities will need to make strategic decisions in this area.

Each of the above critical issues requires the attention of senior leadership of the universities and not just the ICT directors. Anecdotal evidence suggests that in most Kenyan universities, ICT is considered a technical issue to be handled by the ICT director and technical staff rather than an enabler of the strategic vision of the universities. The researchers therefore recommend that an executive ICT program be developed to build the capacity of the senior leadership to view ICT as providing a strategic role rather than merely as an ordinary operational expense.

In the next section, we classify the recommendations as short-term to be implemented within one fiscal or academic year or medium-term recommendations that require at least two academic or fiscal years for implementation. The implementation of short-term and medium-term recommendations would result in accession to stage 3.0 within two fiscal years.

8.3 Short-term and Medium-term Recommendations

Section 8.2 has summarized all the critical issues and recommended action plans. We have focused on only 10 of the 17 indicators that were mostly in stage 3.0 and below (only two of the 17 indicators were in stage 3 and above). The researchers believe that once stage 3 has been achieved, it would be possible to achieve almost all of the benefits of ICT in teaching, learning, research and institutional efficiency.

In the following section, we classify the recommendations in Table 8-1 as short-term or medium-term. *Achieving stage 3 should never be considered a long-term initiative spanning more than two years*. However, achieving stage 4 in all indicators could be considered a long-term initiative spanning about 5 years.

8.3.1 Short-term recommendations

The campus ICT infrastructure recommendations identified in Table 8-1 are considered as short-term and universities should aim to implement them within one fiscal or academic year. Specifically, this should include conducting an audit of campus networks and then upgrading them.

For example, the new campus network would need to be capable of supporting two to threefold increases in devices that join the campus networks on a daily basis (i.e., assume 30% of the students would bring their own devices to campus and join the campus network.

Although a BYOD policy reduces the pressure on the universities to build additional student labs, it translates to an increase in cost in terms of expanding the wireless network coverage and increased ICT support costs as the network supports a much larger number of concurrent users. *Thus, BYOD should never be justified in terms of cutting down costs* – instead, it should be seen as providing flexible computing without relying on special university-owned computer labs. Initially, it increases the cost but then improves the learning environment and the overall university experience of the students.

8.3.2 Medium-term recommendations (two academic years)

Most of the indicators under networked learning are expected to take more than one fiscal or academic year to implement. Initially, there will need to be capacity building workshops to explain that accession to higher stages for the non-infrastructure e-readiness indicators.

Implementation of the recommendations will then require a review of the corporate strategic plan and the associated performance contract signed with each of the members of senior leadership. This process of reviewing the strategic plan and capacity building would likely be concluded in the first fiscal or academic year. So it is only in the second academic year that full implementation and monitoring could start. The 2015 e-readiness survey is expected to assess the implementation of both short-term and medium recommendations. The next section presents the conclusions and recommendations for future research work.

9 CONCLUSIONS AND RECOMMENDATIONS

9.1 Summary of the 2013 Survey Methodology and Analysis

The e- readiness 2013 survey was the third since the first one that was conducted in 2006. The survey covered 30 universities consisting of 20 public universities and 10 private universities. These included all 17 universities that participated in the 2006 and 2008 e-readiness studies. The total student enrolment for the 30 universities was 423,664 and was estimated to be about 80% of the total university enrolment in Kenyan universities.

The e-readiness survey assessment was campus-based and included 42 campuses of the 30 universities that participated in the survey. The data was collected over a one-month period from mid-October to mid-November 2013.

As in the past surveys, the data for the 2013 e-readiness survey of the 30 universities was collected using hard facts and perception questionnaires originally developed in the 2006 survey but modified in 2008 and 2013 to collect additional data (e.g., laptop ownership by students). The modified hard facts questionnaire was divided into six parts completed by the chief academic officers, chief finance officers, registrars, deans of ICT, university librarians, and directors of ICT.

The perception questionnaires were administered to a statistically significant sample for each of the 42 campuses surveyed. The total sample was 1,497 teaching and non-teaching staff and 14,974 students. The sample sizes for perceptions questionnaires took into account the student population, different categories of students (undergraduates, post-graduates), faculty and staff. The resulting confidence interval was about 1% with 95% confidence level.

The results have been analyzed in Chapters 3 to 8 of this report with the 17 e-readiness indicators represented in radar diagrams. All of the results have also been analyzed for each of the 42 campuses and available to authorized of each universities on the e-readiness 2013 website (http://ereadiness.kenet.or.ke).

9.2 Conclusions

Although research results presented in Chapter 7 and 8 of this report show that the senior leadership of the universities understood the full value of ICT in achieving the university mission, there had been limited accession to higher stages for most of the 17 indicators in the five years since the last survey in 2008. In fact, only two indicators, namely, *ICT in the Workplace* and *Network Environment* had accessioned to stage 3.0 and above by 2013. All the other 15 indicators remained below stage 3.0 (see Figure 4-1). The notable change was in the Internet availability indicator that moved from stage 1.6 to stage 2.9 in 2013. This was largely due to the increase by a factor of 10 in Internet bandwidth per 1,000 students sub-indicator. The results therefore suggest that accession to higher stages was a slow process that requires strong academic and ICT leadership. This was the same conclusion in 2008.

The 2013 e-readiness survey collected data on device ownership by students and faculty for the first time. We found that on average, 53% of the students owned a laptop computer and 17% owned a desktop. This translates to over 220,000 laptop computers and over 70,000 desktop computers owned by students. This was a huge number considering that the university campus networks only had about 16,174 computers in the student labs and only 13% of the students laptops were registered with the campus networks.

However, the results show that that on average, 25% of the students were accessing computers and Internet in cyber cafés and only 17% accessed computers from their campuses (see Figure 6-6). The results suggest that the percentage of students in a particular university accessing computers and Internet from cyber cafés was related to the percentage of students who owned laptops. In some universities, almost 50% of the students accessed computers and Internet from cyber cafés. Moreover, 56% of the students still considered the campus networks unstable and slower than cyber café Internet access.

Universities therefore still needed to invest in student computer labs to serve the students who are unable to purchase laptops or those who may be unwilling to carry their laptops to university campuses. Universities also needed to expand their campus backbone and wireless networks in order to cope with the large number of student-owned laptops, desktops or smartphones that students might bring to the campuses (only 13% of the student-owned laptops were registered in campus networks in 2013). However, anecdotal evidence suggests most students were not bringing their laptops to campuses because of insecurity and theft of laptop computers. Universities will also need to hire and build the capacity of the high-end ICT professionals required to design and manage the complex campus networks serving a large number of students (e.g.,. network engineers).

The results show that universities were spending only 0.5% of their total recurrent expenditures on Internet bandwidth and 2.4% on ICT including salaries for ICT staff. The Internet bandwidth expenditure needed to increase to at least 1% of the total recurrent expenditure in order to move from current stage 2.0 in Internet financing to stage 3 or 4. Moreover, universities needed to increase their total ICT expenditure to about 5% in order to support the expanded campus networks and provide acceptable levels of services to students, faculty and staff. In the USA, research universities spend up to 4% of their recurrent expenditure on ICT while teaching universities spend up to 5% on ICT (ECAR, 2013). In Kenya, the 10th cycle for performance contracting sets the target as 10% but most universities were unable to achieve such targets.

The throughput of the master's and PhD degree programs in ICT was very low. In addition, only 13.5% of the 535 faculty members teaching in ICT degree programs in the 30 universities had a PhD with all the others at master's level. This percentage was too low for universities offering undergraduate and master's level degree programs and reduced their capacity to undertake research and generate innovations. Consequently, the staging for ICT research and innovation was below stage 2 at 1.8 in 2013 survey. The ICT research and innovations indicator was a proxy for research and innovation in other academic areas. It shows that availability of broadband connectivity does not translate to accession in the research and innovation readiness indicator. Universities needed to increase the percentage of faculty with doctoral degrees and to invest in faculty development.

The survey found that the 73% of university students preferred blended courses compared to only 14.9% who preferred only online courses. However, only 11% of the students reported that the nearly all or all courses they took were blended in the 2012/2013 academic year. This means that most of the universities were not yet offering blended courses and even fewer were offering purely online courses. At the same time, 51% of the students wanted greater use of e-books and 44.4% preferred to make greater use of open content available outside campuses (e.g., from Khan Academy or other courses available on YouTube). In addition, only about a quarter of the students had good or excellent experience in the use of their mobile handsets to access the university learning management system that hosted e-learning courses. These findings need to inform e-learning strategy in universities.

9.3 Recommendations

Chapter 8 identified some of the critical issues that need to be addressed for accession to higher stages of e-readiness to be achieved. In this section, we make key recommendations that could be implemented by Vice Chancellors and the senior leadership of universities, relevant government departments, and regulators of ICT and university education. We also include some recommendation for further e-readiness research.

9.3.1 University campus networks and implementation of the bring your own device policies

As described in Chapter 8, the development, upgrade and expansion of campus network infrastructures is a top priority. This is partly to address the perception by students and faculty that campus networks were slow and unstable despite the increase in Internet availability of about 10 times since the 2008 survey. The senior leadership of universities need to understand that campus network infrastructures have to be upgraded every four to five years.

Another reason for the upgrade and expansion is to accommodate the large number of student-owned devices that will need to use the campus networks. The 2013 survey indicates that 53% of students own laptops and 53% have smartphones. Universities therefore need to implement BYOD policies in the next few years. This will require dramatic expansion of the campus wireless local area networks and electrical power outlets to accommodate the over 220,000 student-owned laptops that are not yet on campus networks. Although implementing the BYOD policies will reduce the need for general student labs and the demand for cyber café services, universities will still need to invest in specialised ICT labs.

9.3.2 ICT human capacity development for universities

Some of the reasons that campus networks are perceived by students to be unstable was the lack of effective network support and poor campus network design and bandwidth management practices. A key recommendation was that universities should hire a critical mass of network engineers, systems administrators and effective helpdesk staff to support the students and faculty. The ICT professionals also need to be trained regularly, especially in the areas of cyber security and bandwidth management.

In addition to the ICT staff members required to design and maintain the campus networks, universities also need to develop ICT capacity for supporting the automated systems and ERPs being deployed in university campuses. The actual number of high-level ICT staff required depends on the particular university.

Although most of the universities had recruited either an ICT director or ICT manager, there was also a need to develop their capacity in areas of ICT strategy implementation, budgeting, and technical capacity development. ICT directors also needed to be full-time staff members that were part of the senior management of universities. We note that only the Vice Chancellors could empower the ICT directors.

9.3.3 ICT financing

The 2013 survey results show that universities were spending only about 0.5% of their total recurrent expenditures on Internet bandwidth. The universities on the average were spending about 2.4% of total recurrent budget on ICT. This was way below the 10% institutional ICT allocation (including salaries) recommended in the 10th Performance Contracting Cycle Guidelines (2013) issued by the division of performance contracting in the Ministry of Devolution and Planning (GoK, 2013). For example, the campus network infrastructures investments were inadequate since most the networks were still perceived to be unstable and slow. Moreover, universities did not have the critical mass of high-end human staff needed to support the campus infrastructures and applications.

We therefore recommend that university managers adopt this government recommendation, with at least 1% of the total recurrent expenditure dedicated to Internet bandwidth in order to achieve stage 3 and above. The key challenge for most universities is to identify the source of revenue for supporting ICT expenditure. Most of the universities surveyed were charging student lab fees. Previous studies by KENET suggest that the student lab fees could support all recurrent ICT expenditures, including ICT staff salaries. The practice in universities in developed countries is for ICT departments to charge for services provided to other departments (e.g., finance, academic affairs, etc.) as a way of financing ICT operations and investments.

9.3.4 Promoting doctoral research and innovations in Kenyan universities

The study revealed that there very few academic staff with PhDs in ICT programs. Moreover the PhD and master's degrees in ICT throughput was very low even for the leading research universities in Kenya. The research productivity measured in terms of journal papers per faculty member was also low. These indicators were also not being tracked by the university senior leadership and had to be extracted from the raw data collected in this study.

We therefore recommend that research universities need to recruit and retain new faculty, initially from outside Kenya (e.g., neighbouring countries). The research universities also need to balance teaching and research workloads, reward faculty and institutions that produce PhD graduates, and institute mechanisms to dramatically increase PhD graduate throughput.

The government also needs to prioritize and fund doctoral training in ICT programs (e.g. offering PhD scholarships and providing incentives for PhD graduate production) in order to increase the percentage of faculty teaching in ICT degree programs to at least 50% in the two years.

This is possible using the new National Research Fund to be established under the Science, Technology and Innovation Act of 2013 (GoK, 2013b). We note that increasing the throughput of PhDs in ICTs is also one of the targets in the National ICT Master Plan 2017 (GoK, 2014).

We also recommend that that at two of the 30 universities that already had significant PhD in ICT degree programs (including electrical engineering) be given special funding in the next two years to scale up their doctoral degree programs. The Universities Funding Board to be established under the Universities Act 2012 will provide the criteria and additional funding for more universities to train PhD candidates (GoK, 2012b).

9.3.5 Faculty development for blended and online teaching and learning

The fact that 73%students preferred blended learning but only 11% of students in the academic year 2012-2013 had taken all or nearly all courses in blended mode means that most of the courses were not yet blended. Only 24% of the faculty reported that they had taught a few blended courses. Over 50% of the students also wanted their instructors to make greater use of e-books and open content.

This means there was a need to develop the capacity of faculty to develop e-learning materials that could be used to teach blended or fully online courses. The e-learning materials could incorporate e-books and open content materials available over the Internet. The faculty should also be facilitated to teach in blended or fully online mode.

These changes need to be driven by chairmen, deans, and DVC for academic affairs (i.e., the chief academic officers). The ICT directors would only provide an infrastructure supporting role. Universities would also need to hire instructional designers to support faculty in materials development suitable for delivery over laptops as well the mobile handset devices owned by the students, including smartphones. The academic officers should set clear targets for percentage of courses to be taught online or in blended learning mode.

9.3.6 Key university ICT indicators and targets

The e-readiness study defines 17 indicators that are derived from over 88 sub-indictors. In the early stages of e-readiness, university leadership needs to track a limited number of indicators that are critical for accession to higher stages of readiness. The researchers recommend the following indicators and targets that should be part of the institutional strategic plans and could be tracked on annual basis by the senior leadership of the universities:

a. Annual Internet bandwidth expenditure per 1,000 students (target is > $37,000 per 1,000 to achieve stage 4)
b. Internet bandwidth per 1000 students (target is 10 Mb/s per 1,000 students)
c. PCs per 100 students (target 10 PCs per 100 students)
d. Estimated % of students with laptops (target should 70% on the average)
e. % of students who took nearly all or all online courses (target 50%)

The first three indicators (i.e., a) to c) could be tracked using hard facts data maintained by ICT directors and CFOs. Although indicators d) and e) were collected in this survey using the perception questionnaires, they could be validated by hard facts data in the course and ICT authorized users' databases maintained by ICT directors with a proper university identity management system in place.

9.3.7 Further e-readiness research and the national ICT observatory

The e-readiness survey series of studies have provided universities and university education regulators with concrete indicators for measuring progress in implementation of their ICT strategies. The Vice Chancellors fully understand foundational indicators like Internet availability measured in terms of PCs per 100 students and Internet bandwidth per 1,000 students. The above section has introduced three more indicators that can easily be measured and tracked in the institutional ICT strategies and could be made part of performance contracting targets.

There is a need to conduct further research to establish the relationship between the five indicators and accession in staging over a period of five years. The e-readiness framework also needs to be expanded and simplified to measure the e-readiness of schools, colleges, research institutes and government departments.

There has also been an increasing demand for an ICT readiness index for higher education that could be used to rank universities. Development of such an index is potential research project that could be developed as part of a doctoral research project.

The e-readiness survey results have served as ICT readiness observatory for universities. Since 2006, only three surveys have been conducted. It would be best if the surveys were conducted every two years and expanded to cover all higher education and research institutes. Such an observatory would provide benchmarking results for participating institutes.

All of these research studies require external funding from the government through the National Research Fund or by the ICT regulator through the Universal Access Fund. This would be in addition to research funding of smaller scale studies that could be funded by development partners and foundations. The capacity of KENET as a grantee of research grants from different sources will be expanded in the future in order to attract higher research funding and to promote research collaboration.

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