The Association of Commonwealth Universities

Digital resources for research: a review of access and use in African universities

An issues paper prepared as part of an ACU study for Arcadia

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This paper draws on a literature review undertaken by the ACU, as part of a study commissioned by Arcadia (www.arcadiafund.org.uk) on the obstacles to accessing and using digital scholarly information in African universities.[1] It outlines the principal issues which have been identified through existing programmes, studies and reviews, and summarises existing initiatives in this area. In doing so, it highlights a number of areas to be explored in greater depth during the subsequent phases of the project.

1. Introduction

Good libraries are a critical part of any university's research and teaching, whether in physical or digital form. But, as numerous accounts have documented, many African libraries have struggled to maintain good collections in the face of falling budgets, rising purchasing costs, and expanding student numbers. Insufficient collections severely constrain research, as was repeatedly emphasised by participants at a recent conference on African social sciences and humanities research convened by the ACU and the British Academy, echoing many similar statements in the numerous reports on the problems facing African higher education (HE).[2] Such is the diversity of institutions and their facilities and resources that continental generalisations are not possible, or are of limited value. A few examples are, nevertheless, illustrative of broad trends. The library at the University of Nairobi, Kenya's top research institution, currently has some 600,000 print book and monograph volumes and around 60,000 print journal volumes, and serves around 36,000 students and 1419 academic staff.[3] However, a recent study of the Kenyan university system suggests that the library was originally built to house some 2.5 million volumes, and to serve just 6,000 students; similarly the libraries at Moi and Kenyatta universities, with seating space for 2,500, now serve over 10,000 and 12,000 students respectively.[4]

Information and communications technologies (ICTs) have, of course, brought substantial changes in the past two decades and, as new communications technology is developed and becomes more widely accessible within Africa, and as communications infrastructure improves, the prospects for digital access to research resources will undoubtedly improve significantly over the coming years. New high-speed cable connections are in the process of being laid along the African seaboard, some due for completion over the next two years, and a number of promising initiatives within the HE and research community are underway, such as UbuntuNet, which have the potential to transform broadband connectivity and with it the prospects for scholarly communication and information access. ICT facilities are improving in many universities, underpinned by a greater awareness of the need to place ICT at the heart of university strategy. The likelihood of significant developments in ICTs, broadband availability and digital library access means that this paper can at best provide only a review of progress to date and an assessment of immediate prospects as of mid-2009. While it also offers a fairly general picture of African universities, the focus of much published work – and prior donor funding – means that there is a particular concentration on a limited number of countries. More detailed studies of a number of Eastern and Southern African universities will be developed in the successive stages of the project.

[1] The terms 'electronic' and 'digital' are used interchangeably here to describe information accessed online or through local networked resources. A 'digital library' describes more than just the format of information, since it requires a combination of technologies, facilities and skilled staff to enable digital or electronic information to be collected, provided and accessed.

[2] Harle (2009b). The most recent of this run of World Bank reports is *Accelerating Catch-up: Tertiary Education for Growth in Sub-Saharan Africa* (2008: see p. 54. 92); this follows reports in 2000 and 2002. The point is also made by Sawyerr (2002).

[3] Data from a survey of ACU member libraries undertaken in 2008; and from the ACU's *Commonwealth Universities Yearbook 2008* (from 2009 this data will be available online only as part of the CUDOS service, see www.acu.ac.uk for details).

[4] Mwiria et al (2007), p.40; Teferra (2003); Sall et al (2004).

2. Background and sources

Poor collections have in the past been the result of the high cost – relative to African university budgets – of purchasing and shipping books and print journals from abroad, particularly as access to foreign exchange is often limited.[5] Domestic and regional publishing industries, particularly for academic titles, have also struggled to establish themselves, as have university presses. Africa-published journals have often foundered; production, storage and shipping costs are typically high, while markets are relatively small, with libraries and individual researchers unable to purchase new books or maintain subscriptions.[6] The ACU established its own print journal scheme, Protecting the African Library, in 2002, in an effort to assist member universities to improve their library collections at affordable prices, and many other book and journal donation or discount schemes have been run over the years. In recent years, libraries across the world have moved increasingly to the provision of electronic or digital information, first through the use of CD-ROM technology, and then driven particularly by a surge in academic journals publishing online. A number of studies undertaken in the mid to late 1990s, notably Diana Rosenberg's 3-volume 1997 study of 11 countries, capture the emergence of ICT use in African libraries, and provide a valuable historical picture against which the contemporary situation can be set.[7] New opportunities for digital information led to a number of access programmes being subsequently established, including the HINARI, AGORA and OARE schemes of the UN health, agriculture and environment agencies, and INASP's Programme for the Enhancement of Research Information (now known as PERii) (see section 7). The reduced costs incurred by publishers in delivering online publications (as printing, storage and shipping are eliminated or reduced) have allowed them to offer substantial discounts to developing country universities – sometimes as high as 95% of original cover prices – and pricing which is proportionate to local socioeconomic circumstances.

However, while the electronic shift has helped to alleviate some of the problems and costs previously associated with printed material, it has also presented its own obstacles, namely those of ICT infrastructure and internet connectivity. The savings associated with digital formats have made book and journal purchasing more affordable, but this has been met by an ever-growing need for substantial investment in computers, campus networks and internet access, meaning that, in many cases, the costs have simply shifted elsewhere. Much of this investment has been heavily or entirely supported by donor funding, and universities have struggled to sustain and maintain this. Beyond physical facilities, the move towards digital information has also highlighted areas where the skills of librarians, academics and students alike urgently need to be developed. Locating and accessing scholarly information online, rather than in print form, requires a very different set of skills and new approaches to academic resources. At the same time, new ways of delivering teaching and learning and of undertaking research, building on electronic and web technologies, are changing the landscape of HE across the world, and Africa is no exception. With the rapid expansion of HE across the continent, new types of programmes and methods of delivery – such as online and distance learning – being developed to meet demand, and new digital facilities and services required by researchers and students, libraries face many pressures. Their success in responding to these will be dependent in large part on their ability to provide and manage access to a range of electronic information.

This paper approaches the digital access question from a number of levels, and from technological and infrastructural aspects, as well as leadership, skills and awareness. Firstly, it looks outwards from the library, to consider the wider ICT and internet environments of African universities and their connections to national, regional and international communications networks. Secondly, it focuses

[5] See, for example, Manuh et al (2007) and Teferra (2004).

[6] See, for example, the section on publishing which draws on the contributions of James Currey, the experienced Africanist publisher in the UK, in Harle (2009b); Olukoju (2004) paints a similar picture.

[7] Rosenberg (1997) (case studies of Botswana, Ethiopia, Ghana, Ivory Coast, Kenya, Mozambique, Senegal, Sierra Leone, Sudan, Tanzania, Zimbabwe); see also Levey (1993) and Lund (1998).

inwards to consider campus systems and connectivity, and local library development, services and systems. It documents significant existing support initiatives and, where evaluations or reviews of these initiatives are available, these are considered here. The Partnership for Higher Education in Africa (PHEA) has published or commissioned a number of reports on ICT and connectivity, in addition to studies of national HE systems, in its eight partnership countries.[8] The African Tertiary Institutions Connectivity Study (ATICS) undertaken in 2006 provides the greatest breadth, with data on connectivity at 54 institutions in 27 countries, while the Southern African Regional Universities Association (SARUA) has published studies on ICT and access to knowledge in the Southern African Development Community (SADC) region, although, of the 12 institutions covered by its 2008 survey, five are South African.[9] Looking specifically – and in considerable depth – at library development and access to information, INASP has produced a number of valuable reports and case studies as part of PERii.[10] A number of papers by African librarians, which offer accounts of local library systems and access issues, have been published in professional library journals, while evaluations of other initiatives offer useful perspectives of the success or otherwise of existing support programmes.[11] A 2008 ACU survey of Commonwealth libraries, which included responses from 41 African universities, also offers useful background figures and captures the general feelings of librarians on a range of issues related to this study. It is important to note from the outset, as with any study purporting to review the general situation in many institutions across a vast continent, that the picture is very mixed. Most obviously, South African universities are very different to their counterparts in other countries, but even within countries (and this is also true of South Africa) there is often substantial variation, with major national research universities enjoying better access and facilities, and with public and private institutions differing considerably.[12]

[8] Partnership for Higher Education in Africa (2002, 2003); Twinomugisha et al (2004); CET (2007); Mwiria et al (2007); and Manuh et al (2007). PHEA covers Egypt, Ghana, Kenya, Mozambique, Nigeria, South Africa, Tanzania, and Uganda.

[9] Gakio (2006); SARUA (2008). It should be noted that figures quoted from the SARUA survey are averages based on just 12 institutions: five in South Africa, and one each in Democratic Republic of Congo, Malawi, Mozambique, Tanzania, Zambia, and Zimbabwe.

[10] Rosenberg (2005); Mbambo-Thata (2007).

[11] AGORA, HINARI, OARE, (2007); Ochs (2005).

[12] This was confirmed by visits to two university libraries in Nairobi, Kenya in 2008.

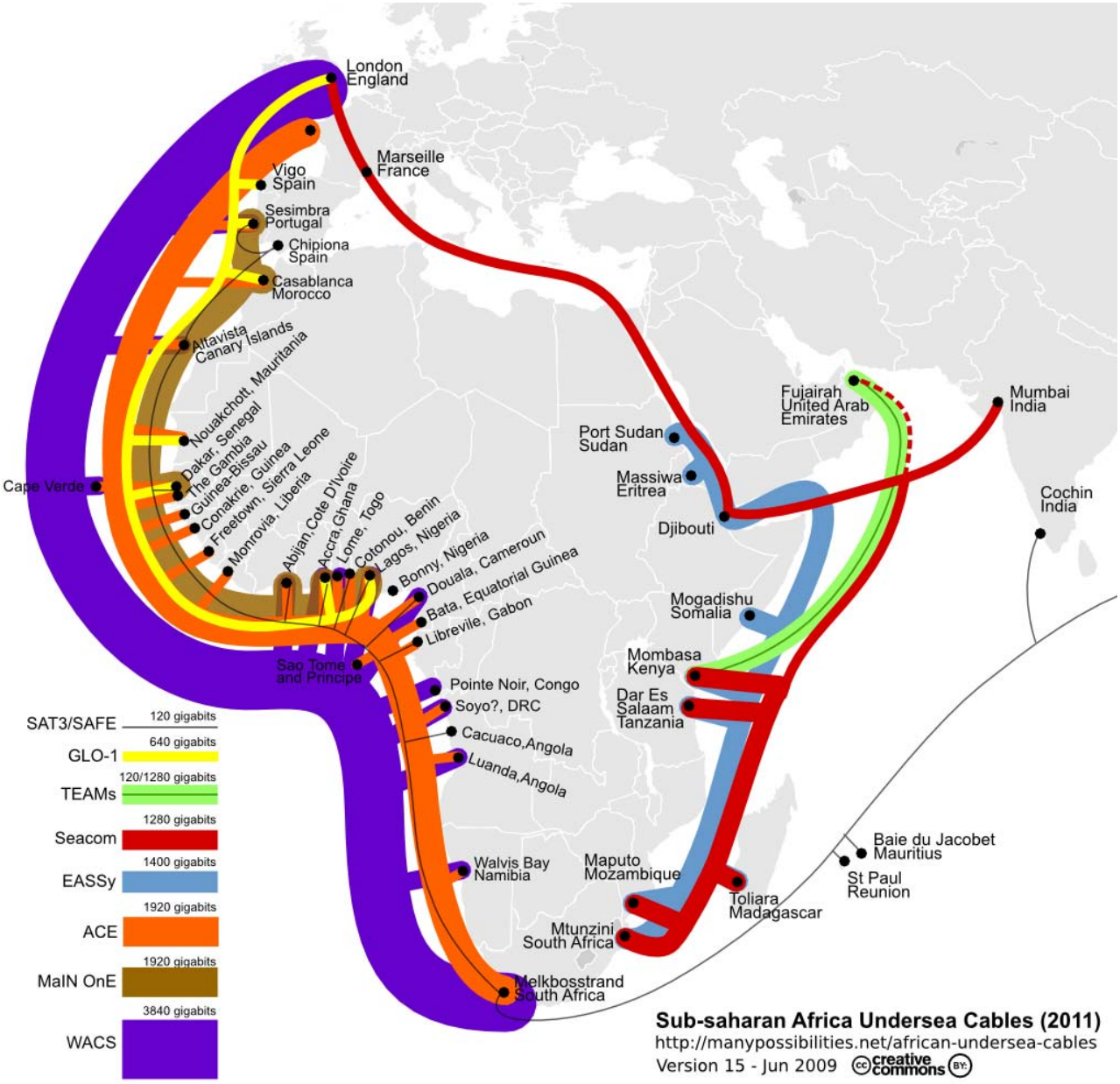
3. African links to the rest of the world: connections to international broadband networks

The majority of scholarly information is currently published outside of Africa, with its electronic form (online or e-journals and, to a lesser extent, online or e-books) also hosted outside of the continent. The extent to which African universities are able to develop digital libraries, therefore, largely depends on their access to international broadband networks and the speed and reliability of this. This is particularly important since most publishers work on a live access model, which prevents local archiving and requires individual articles to be downloaded afresh by each new user. Figure 1 below shows envisaged cable connections by 2011.[13] Currently, access across Africa is heavily dependent on more expensive satellite (VSAT) connections. Eastern Africa has no submarine connectivity at present, while some West and Southern African countries benefit from the SAT-2 and SAT-3 cables.[14] A number of new large-scale submarine cable projects are underway, which will progressively improve the links between other parts of the continent and European and Asian networks, and which will have great potential for substantially improving data communication for research and education when completed (see below).[15] Completion dates are, as with most large-scale infrastructural projects, uncertain, but Eastern and Southern African coastal states will reportedly be connected to the SEACOM cable, which will link to India and Europe, by mid 2009. A second cable project EASSy (The Eastern Africa Submarine Cable System), which links Eastern and Southern Africa, but does not itself make a connection outside of the continent, is envisaged to be completed by 2010. The greatest connection capacity currently projected will be that of the WACS (West Africa Cable System) project.

The New Partnership for Africa's Development (NEPAD) has also established the ICT Broadband Infrastructure Network, with a sub-project focused on Eastern and Southern Africa and bringing together submarine and terrestrial segments.[16] It is envisaged that this will link existing cable projects to form a cohesive regional and subsequently continental plan for broadband connectivity. In addition, the East African Backhaul System (EABS), a joint venture among terrestrial cable operators in Burundi, Kenya, Rwanda, Tanzania and Uganda, seeks to link existing and emerging national networks to the respective coastal cables. The prospects for dramatically improving broadband connectivity appear to be good, but continental coordination for many of these initiatives nevertheless appears to be lacking, and there is considerable work to be done before the benefits will be realised for educational purposes. The NEPAD initiative is apparently competing directly with a Kenyan government project, emphasising that there is still much to be resolved beyond 'simple' technological development and investment. Much will also depend on national telecommunications systems, not only in terms of the development of national broadband infrastructure capable of extending high speed connections across the country, and in doing so to higher education institutions, but also in terms of the effective regulation and licensing of the sector to ensure that operators make access affordable. It remains to be seen how quickly this will be achieved, particular since there are already problems reported due to disagreement between governments on how cable connections and bandwidth supply should be managed.[17]

[13] See Jagun (2009) for a summary of the status of cable projects as of March 2009.
[14] Wadvalla (2008).
[15] More specific detail on the connections of Southern African countries is provided in SARUA (2008).
[16] www.eafricacommission.org/projects/126/nepad-ict-broadband-infrastructure-network
[17] Gedye (2007).

Figure 1: Map of existing or planned African submarine cables (as of June 2009)[18]



[18] Source: Steve Song (http://manypossibilities.net/african-undersea-cables).

Table 1: Coastal submarine cable projects in Africa[19]

East African seaboard	
EASSy (Eastern Africa Submarine Cable System)	Under construction. Connects: Sudan, Eritrea, Djibouti, Somalia, Kenya, Tanzania, Mozambique, Madagascar, South Africa. MoU signed in December 2003, construction began in March 2008. Completion scheduled for mid 2010. Capacity: 1.4 terabits/s. www.eassy.org
SEACOM (South East Asian Telecommunication Cable)	Under construction. Connects: UK, France, Djibouti, India, Kenya, Tanzania, Mozambique, Madagascar, South Africa. Commercial launch due June 2009.[20] Capacity: 1.28 terabits/s. www.seacom.mu
TEAMS (The East African Marine System)	Under construction. Connects: Kenya, United Arab Emirates. A parallel project to EASSy, and an initiative of the Government of Kenya. One of three cables was completed in June 2009. Capacity: 120 gigabits/s initially, 1.28 terabits/s ultimately.
West African seaboard	
SAT-2	Connects: South Africa, Tenerife. In service since 1993. Capacity: 560 megabits/s.
SAT-3/WASC/SAFE (South Atlantic/West Africa Submarine Cable/South Africa Far East)	Existing cable. Connects: Portugal, Spain, South Africa, and South Africa, Malaysia. SAT-3/WASC has been in operation since 2001, SAFE was commissioned in 2002. SAT-3 capacity: 120 gigabits/s, SAFE capacity: 130 gigabits/s. www.safe-sat3.co.za
West Africa Cable System (WACS)	Planned. Connects: UK, Nigeria, South Africa. Incorporates Uhurunet, African West Coast Cable and SAT-4 projects. Completion scheduled for mid 2010. Capacity: 3.84 terabits/s
MainOne Submarine cable project	Under construction. Connects: Ghana, Nigeria, Portugal, ultimately South Africa. Completion scheduled for 2010. Capacity: 1.92 terabits/s. http://mainonecable.com
GLO-1	Under construction. Connects: UK, Spain, Portugal, Morocco, Mauritania, Senegal, Ghana, Nigeria. Completion scheduled for 2009. Capacity: 640 gigabits/s
ACE (Africa Coast to Europe)	Planned. Connects: France, Portugal, Morocco, Canary Islands, Western Sahara, Mauritania, Cape Verde, Senegal, Guinea-Bissau, Guinea, Sierra Leone, Liberia, Côte d'Ivoire, Ghana, Togo, Benin, Nigeria, Cameroon, Equatorial Guinea, São Tomé and Principe, Gabon, Congo-Brazzaville, Angola, Namibia, South Africa. Completion scheduled for 2011. Capacity: 1.92 terabits/s.

[19] Jagun (2009); such is the pace of change that Steve Song's blog, which tracks cable development, is one of the best sources of up-to-date information: http://manypossibilities.net/african-undersea-cables

[20] Reuters (2009).

4. Broadband connectivity within Africa: regional and national broadband networks

As noted above, the potential of high-speed cable connections for higher education and research depends largely on the terrestrial infrastructure which is in place to connect tertiary institutions at national and regional level. National ICT policy frameworks within Africa have typically been developed to govern the private telecommunications sector and, as a result, have tended to overlook or ignore the specific needs of national higher education and research infrastructures. In many cases, ICT implementation in HE is also frustrated in part by the lack of an overall national technology plan which takes account of technology acquisition, replacement and funding.[21] Research and Education Networks (RENs), groups of tertiary education and research organisations collaborating to operate national or regional broadband networks, are an important part of research and university systems the world over. Although there are only a small number of extant RENs in Africa, new consortia are beginning to emerge and are making considerable strides in helping to drive the physical construction and infrastructural projects, and in acting as national purchasing and policymaking forums. Malawi's MAREN, hosted by its active library consortium MALICO, is particularly notable (see Table 2 below).[22]

The major initiative in this area is the UbuntuNet Alliance, a collaboration between national RENs (NRENs) in Kenya, Malawi, Mozambique, South Africa, Tanzania and Uganda. The alliance is also working alongside the Association of African Universities (AAU) to create a dedicated educational fibre optic network (a series of RENs) which would span Eastern and Southern Africa, and be the first stage in the creation of a high-speed (gigabit) connection across the continent.[23] The AAU has also established a dedicated REN unit.[24] UbuntuNet has already established a connection with the GEANT European network, and hopes to make similar arrangements with other consortia networks outside Africa. In particular, it will make use of the SAT-3 and Mombasa cable landings in Southern and Eastern Africa. A key part of its role will be to act as a bandwidth consortium to negotiate reduced costs for tertiary institutions, following the achievements of the Partnership for Higher Education in Africa's Bandwidth Consortium (see section 5) which has, for example, significantly advanced connectivity within its partner institutions and beyond, by the negotiation of discounts of around 30% for satellite (VSAT) connections.[25]

[21] Centre for Educational Technology (2007).

[22] See Association of African Universities (2007) and Pehrson and Ngwira (2006).

[23] UbuntuNet Alliance: www.ubuntunet.net; NRENs are reportedly in development in Botswana, Burundi, Ethiopia, Lesotho, Namibia, Somalia, Swaziland and Zimbabwe. A proposal to IDRC for a background study was recently submitted. The aim of the study would be to identify and design the infrastructure needed, and to look at the establishment of data centres, network operations centres, and connections to the international backbone. It would also consider how a common network architecture could be ensured across countries to enable cross-border connectivity.

[24] See AAU (2007) and www.aau.org/renu

[25] Bandwidth Consortium members include in Ghana: the University of Ghana, the University of Education, Winneba and the Association of African Universities; in Nigeria: Ahmadu Bello University, Bayero University, Obafemi Awolowo University, Port Harcourt University, University of Ibadan, and University of Jos; in Kenya: the Kenya Education Network (KENET); in Tanzania: University of Dar es Salaam; in Uganda: Makerere University. See www.foundation-partnership.org/index.php?id=29 and www.forum.org.ng

Table 2: National Research and Education Networks[26]

KENET (Kenya Education Network) www.kenet.or.ke	Well established
MAREN (Malawi Research and Education Network) www.malico.mw/maren	Well established; VSAT network already exists, fibre network planned
MoRENet (Mozambique Research and Education Network) http://morenet.mct.gov.mz/en/index.htm	New; network planned
TENET (Tertiary Education Network of South Africa) www.tenet.ac.za	Well established; network exists
TERNET (Tanzania Education and Research Network)	New; network planned
RENU (Research and Education Network of Uganda) www.renu.ac.ug	New; network planned
RwNet (Rwanda Research and Education Network)	New
SUIN (Sudan)	New
Eb@le (Democratic Republic of Congo)	New
ZAMREN (Zambia Research and Education Network)	Emerging
NgRen (Nigeria Research and Education Network)	Emerging; commitment of 10 VCs to establish by end 2008. Led by the Nigerian ICT Forum
GARNET (Ghana Research and Education Network)	Emerging; policy dialogue ongoing
NAMREN (Namibia Research and Education Network)	Emerging
Cameroon	Emerging; government commitment
RENER (Senegal)	Emerging; policy dialogue ongoing
Cote d'Ivoire	Emerging; policy dialogue ongoing

[26] Status information compiled from UbuntuNet (www.ubuntunet.net) and Barry (2008).

5. ICT in African universities: implications for access to digital scholarly materials

The ability of individual institutions to derive full benefit from the cable and networking projects discussed above will depend on ICT and networking infrastructure at campus level. In general terms, ICT facilities are relatively underdeveloped in African universities. Funding has typically been limited, both for initial capital investments and for ongoing maintenance and systems development. According to the ATICS survey,[27] computers are shared by an average of 55 people in African universities; while SARUA gives better figures for the SADC region, with an average of 40 students (full-time and part-time) and 2 teaching staff per computer, this is no doubt improved by the relatively better ICT facilities of many South African institutions. While academic staff are reasonably well served, students and junior staff are not. In many cases, few PCs are available in the library, which has a particular bearing on their use for accessing scholarly information. Manda reports that the University of Dar es Salaam Library had 32 PCs available to serve its entire student population in 2004.[28] In many instances, poor internet access means students and academics alike are forced to use private internet cafes.[29] The Centre for Educational Technology (CET) in South Africa argues that ICTs have often been treated as supporting facilities and, as a result, have not been fully integrated into university activities, and their potential for teaching, learning and research has therefore been often under-realised.[30] This is echoed by Adams, who argues that the lack of well-established ICT strategies has been a major constraint to African universities' integration of technology.[31] The fact that, of more than 80 universities in Nigeria, only 19 had websites in 2007, and only 10 had library websites, is perhaps illustrative of this trend.[32] With many investments in ICT the result of donor funding to individual departments or projects, ICT development has often not been a centrally coordinated activity, so it is often hard for institutions even to track and monitor what they have, with no baseline from which to measure. Some universities, Dar es Salaam being a good example, have nevertheless made ICTs a particular focus. [33]

Where ICT facilities are available, the fact that students are likely to have had limited opportunities to explore the internet and use computers prior to university no doubt limits their ability to make best use of them for academic purposes, and they are accordingly likely to lack awareness of the scholarly potential of online resources. Similarly, good ICT facilities for academic staff have only recently been introduced to many universities, and many will only have only begun to make use of them for research purposes in recent years. This, coupled with problems of power supply, performance and slow internet speeds, means that they are often underused and have not been widely incorporated into approaches to teaching and research. A study of internet use in Kenyan and Nigerian universities demonstrated that internet use was relatively low, and was mainly for email or for accessing specifically recommended websites, rather than for academic research of significant depth.[34] Poor access and low use as a result of limited facilities have not only resulted in a general lack of appreciation of the potential of ICTs, but have also translated into considerably less pressure on policymakers and institutional leaders to make the necessary investments. SARUA, however, notes some indications of a more positive trend, with 92% of universities in the Southern African region operating a dedicated ICT unit reporting directly to top management and thus having considerable potential to push for change.[35]

[27] Gakio (2006).
[28] Manda (2008).
[29] Willinsky et al (2005).
[30] Centre for Educational Technology (2007).
[31] Adams (2003).
[32] Gbaje (2007).
[33] Adams (2003); Kiondo (2008).
[34] Adeya and Oyelaran-Oyeyinka (2002).
[35] Centre for Educational Technology (2007); SARUA (2008).

Campus backbones, connectivity and bandwidth[36]

While most African universities are connected to the internet in some way, this connectivity is often not effectively shared across the institution, and may be accessible only in a limited number of places. Campus networks are critical, since it is these that make an institution's external network available to multiple users, and enable data to be shared more effectively internally. A campus network is typically composed of a robust high-speed backbone which links individual networks within each campus building. Recent surveys have suggested that campus networks are reasonably well developed – nearly all (97%) institutions had one in 2006, half with a wireless element and half with some (high-speed) fibre optic links.[37] Makerere University, for example, has been able to make substantial investments in its campus networks with Sida support.[38] Nevertheless, very few universities have gigabit capacity, which is considered to be the emerging standard if African universities are to keep pace with their counterparts elsewhere and be able to handle the rapid growth of more demanding internet media and larger data transmission requirements. While the vast majority of Southern African universities had a fibre optic backbone in 2007, only 42% of these had one which was capable of delivering gigabit capacity.[39]

African universities typically pay extremely high charges for often relatively limited internet connectivity. It is often noted that the average African institution has access comparable to that enjoyed by a domestic user in Europe, North America or elsewhere, but pays between 20 and 50 times the price per unit to do so.[40] In 2006, the continental average for higher education institutions was 0.76/1.25 Mbps, 0.68/1.32 Mbps in Southern Africa, although this is likely to have improved since; in Southern Africa, for example, it has improved to 3.5/4.65 Mbps.[41] To put these figures into context, most American, European and Asian universities – seeking to access online journals and databases, and provide for academic and student email traffic and general web use – now aim for gigabit connections (1000 Mbps), far in excess of what is currently available to most African institutions. No Southern African universities had a connection approaching 100 Mbps in 2007, and only a third had more than 10 Mbps.[42] Initiatives such as the Bandwidth Consortium and the work of national and regional RENs (see above) are beginning to make inroads into pricing, through consortium negotiations with service providers, but the costs are still high and the available bandwidth restricted.

The impact of bandwidth on accessing and downloading scholarly material is typically recounted anecdotally; suffice to say that poor connections and insufficient bandwidth often mean that journal articles cannot be downloaded, even in relatively well-resourced institutions. As Musoke and Kinengyere note, 'when users do literature searches and/or try to download articles but find the internet down, some of them give up'.[43] In most cases, university internet connections are still predominantly satellite rather than terrestrial connections, which are both more expensive and harder to maintain, with higher failure rates.[44] Although high-speed fibre optic cables are being laid and national backbone networks established (see above), there is still a considerable way to go before these begin to open up

[36] Bandwidth, measured as a bit (data) rate per second, refers to the throughput of networks; the rate of data transfer is thus the capacity of the connection being used. Bandwidth is consumed by any use of the connection – sending and receiving emails, viewing webpages, downloading files, updating software, etc.

[37] Gakio (2006).

[38] Greenberg and Versluis (2005).

[39] Gakio (2006); SARUA (2008).

[40] See Rice (2008), Juma and Moyer (2008), and Read (2006). Bandwidth costs are constantly changing, particularly as consortia development enables new prices to be negotiated; in 2006, African institutions were paying an average of USD 4.58 per kbps (USD 4.78/kbps in Southern Africa). In Southern Africa, this had been reduced to USD 2.43/kbps by 2007. West African institutions tend to pay more than East African institutions.

[41] Figures are for upstream and downstream – respectively the link to and from the backbone network, and thus upload and download capacity; taken from Gakio (2006) and SARUA (2008).

[42] SARUA (2008).

[43] Musoke and Kinengyere (2008).

[44] ATICS (2006); Willinsky et al (2005).

greater connection speeds and bandwidth to African universities, although progress is encouraging. The actual bandwidth that is available to an individual user – determining what they can download in the way of academic materials – is furthermore a function of the number of computers sharing a connection. More computers may mean greater access to students and shorter queues to get online, but it also means that each user's access for a given period is poorer, if bandwidth is not increased comparably. While connections are better in Southern Africa, for example, better ICT facilities and a greater number of terminals sharing each connection means that bandwidth per computer, and thus connected user, is actually lower than elsewhere.[45]

Optimising bandwidth

With the majority of online scholarly materials hosted outside of individual institutions and outside of Africa, bandwidth is a critical determinant of access to academic information. It is not only limited and hugely expensive, but also very often ineffectively managed, as a result of insufficient ICT expertise in many universities. Attention has increasingly turned to optimising the use of the bandwidth currently available, rather than simply seeking to obtain more. Universities are increasingly recognising that they could get much better value out of what they are already paying for, and also that, whatever level of bandwidth is reached, more will always be needed as the demands of the internet grow. By monitoring internet – and specifically bandwidth – usage and managing it more effectively, an institution can ensure that internet access better serves academic and scholarly needs, and specifically that the returns on investments in equipment and journal subscriptions and the time of their staff and students are realised. A network experiencing greater demand than it is able to supply will see some requests be successful while others fail; which succeed and which fail – and thus which information can be sent or downloaded – is relatively arbitrary. Effective management can, however, make sure that access to academic-related services, such as publisher websites or journal and database hosting sites, is prioritised above other internet uses.

A useful example is provided by email use. The tendency of most academics to rely on private email services (such as Hotmail or Yahoo) can have a major impact on bandwidth use. A 6 kb message sent from an email client (e.g. Outlook) would use the same 6 kb of bandwidth if also received and downloaded through an email client. However, using an institutional webmail service increases its size to 14 kb; a private service such as Yahoo can increase it to as much as 1,010 kb, as a result of all the other demands which the provider's website makes on bandwidth (graphics and embedded advertising, for example).[46] In 2006, nearly half of institutions did not monitor their use of bandwidth at all, and those who did (42%) were unable to offer figures; although SARUA reports that 83% of institutions in Southern Africa were monitoring bandwidth, only half had solutions in place to manage it.

[45] Gakio (2006).

[46] Belcher (2008); see also INASP (2003) and their programme on bandwidth management and optimisation at www.inasp.info/file/54694be02f53f6491a1dcefedefc02d3/bmo.html

6. University library systems

Having considered the wider ICT and internet connectivity environments of African universities, the following sections now look specifically at university libraries and access to scholarly information. An early study of ICT and internet access in African libraries was undertaken by Diana Rosenberg in 1997, and as such gives a useful sense of the pace of library development in African universities over the last decade, and how contemporary support and access initiatives have grown in this time.[47] Reviewing ICT use in 11 countries and 18 libraries, it reports a fairly mixed picture: ICTs were beginning to be used to an extent, particularly with a move towards the automation of library systems, but typically this was only partial and was restricted to library serials lists, theses or special collections, rather than full holdings. Email use was reportedly low (it would also have been relatively low in Europe and North America at this time), although libraries were beginning to use it to interact with colleagues and gain advice when responding to user queries. Although the advantages of ICT were well recognised, high equipment costs and low budgets made it difficult not only to implement electronic systems, but also to maintain and sustain these, as hardware and software evolved. In many cases, the cost of basic ICT facilities outstripped total collection budgets, so donor funding was often the only way in which upgrades could be implemented. Where available, CD-ROM abstracts and databases and other resources had helped to increase awareness of what literature was available, but did not make it any more attainable in full-text form. This early study has since been well and substantially updated by INASP's work, including a further report by Rosenberg and a case study of the University of Zimbabwe's digital library, amongst others.[48]

Libraries are typically at very different stages of digital development, and this has implications for their ability to make use of electronic and online resources. In 2005, only 15% of African libraries were fully automated, and 21% had not yet begun the automation process, meaning that cataloguing and circulation were still operated manually, and suggesting very limited capacity to effectively manage access to externally-provided electronic resources.[49] The situation appears to have improved somewhat, with 59% of African libraries that responded to an ACU survey feeling that they had had reasonable success in establishing an e-library of some form; nevertheless, this left 41% who either had not experienced much success, or had not even embarked on such a project.[50] Figures quoted previously detail computer access in institutions as a whole, but facilities within the library are likely to be an important determinant of student access to electronic materials, since guidance and assistance from librarians will often be needed. Although almost all libraries own computers, in 2005, the majority had less than one for every 500 full-time students and, in many cases, fees were also charged for student internet access. While Dar es Salaam library has 32 computers, Manda notes that 61% of Tanzanian libraries reported students mostly accessing the internet outside of the library.[51] Whatever subscriptions are held by the library, access is likely to be severely restricted unless the student/computer ratio is considerably improved; as already noted, increasing computer access must also be matched by greater (or optimised) bandwidth, if users are to be actually able to download articles and search databases. While internet cafés are widely used, where access to subscription databases relies on IP address authentication, these will be unavailable outside of the institution.

[47] Rosenberg (1997, 1998). The libraries studied were: University of Botswana; Addis Ababa University (Ethiopia); University of Cape Coast (Ghana); University of Ghana at Legon; National University of the Ivory Coast; Catholic University of Eastern Africa (Kenya), University of Eastern Africa at Baraton (Kenya), Kenyatta University (Kenya); Moi University (Kenya); Universidade Eduardo Mondlane (Mozambique); University of Dakar (Senegal); Fourah Bay College, University of Sierra Leone; University of Gezira (Sudan); Muhimbili University College of Health Sciences (Tanzania); University of Dar es Salaam (Tanzania); Africa University (Zimbabwe); University of Zimbabwe (2 libraries).

[48] Rosenberg (2005); Mbambo-Thata (2007); Agaba (2004); Mathangani (2005).

[49] Rosenberg (2005).

[50] Harle (2009b).

[51] Manda (2008).

Providing electronic services and resources

Many libraries are unable to afford the subscription rates needed to maintain good collections across all subject areas, even when rates are substantially reduced; many depend on external funding to pay for subscriptions (either on individual bases, or as part of national licensing arrangements). There are, however, a number of access schemes which together enable African libraries to access a huge volume of academic material at low or no cost, including the substantial collections available through the well-known AGORA, HINARI, OARE, PERii and eIFL programmes (see section 7). Of course, the provision of free resources does not mean that access itself is free, since the costs associated with purchasing and maintaining ICT equipment and managing access to resources must also be accounted for. In fact, as a recent INASP's study argues, with so many free or discounted access initiatives available, the problem is far from a lack of access to electronic resources, but instead an issue of libraries' capacity to make full use of these and to access what they are entitled to.

In better-resourced libraries, an explosion in electronic resources is being followed by increasingly sophisticated library systems, catalogues and websites, and even then managing access can be complex. In many African libraries, automation is incomplete, library systems are insufficiently developed, or staff lack the web-authoring skills to develop good library websites which allow them to manage access systematically and in a way which allows users to navigate resources more easily. Libraries who feel unable to manage electronic access adequately may also be discouraged from registering to use resources in the first place. An evaluation of access in Tanzania, for example, revealed that e-resources were underused on the whole and some Tanzanian libraries had not even registered for access to those offered, despite the central coordinator, based at the University of Dar es Salaam, advertising these each year.[52] Furthermore, the problem of poor bandwidth and connectivity means that actually accessing and downloading material is also not always possible. Half of the libraries covered by the Tanzanian review reported that slow connection speeds and unreliable connections caused significant problems in accessing available literature. The need to manage multiple passwords and to access multiple platforms and differing interfaces, which are not always easy to search, can also make access to and use of existing material difficult.[53]

In addition to managing access to externally-provided academic resources, an important and growing part of African libraries' work is supporting the development of online publishing facilities for African research. This is an essential role if locally produced research is to be made accessible within and outside of African institutions. Digitising content and establishing institutional research repositories are, therefore, growing concerns for university libraries. 64% of African libraries are developing or have developed an institutional repository, and over half have developed some form of online publishing facility, while at a continental level the Association of African Universities manages the Database of African Theses and Dissertations (DATAD), which is now being expanded to enable full-text documents to be uploaded locally by librarians, either in original digital form or scanned from print.[54] African Journals Online (AJOL) is another notable initiative which has made a major contribution to the availability of African published material, both within and outside of the continent, through a journal hosting platform and document delivery service.[55]

[52] Manda (2008).

[53] Kiondo (2008).

[54] For repository figures see Harle (2009a); Paul Zeleza, quoted in Rosenberg (1998), argues that 'the real challenge, then, is not simply to fill empty library shelves and acquire gadgets for faster information retrieval, but to produce knowledge in the first place; for Africa to study, read, and know itself, to define itself to itself and the rest of the world, and to see that world through its own eyes and not the lenses of others'.

[55] www.ajol.info

Library leadership and skills

The provision of electronic resources is a professional rather than simply a technical matter. The academic status of librarians has long been recognised as important in determining what they and their libraries are able to achieve, affecting retention and morale of staff and their influence within institutional decision-making. It is likely to be increasingly important, as the centrality of digital information puts librarians in new relationships with academics and managers. Prior studies, including a recent ACU survey, a Sida review of its support to Makerere University in Uganda, and the experiences of those running access and other support programmes, have, unsurprisingly, emphasised the critical importance of leadership and strategic management from head librarians in determining the success of internal development activities, as well as the value of external support initiatives.[56] Connections between libraries and higher levels of institutional leadership, and support from senior management, are also important, as is evidenced by the ACU study, where relationships with senior management were felt to be the most important factor influencing the ability of libraries to deliver their various services successfully. Without this level of internal support and vision, the changes needed to ensure budgets are allocated appropriately, infrastructural investments made, and staffing needs addressed are unlikely to occur.

Supporting librarians' professional development, in particularly their ICT and web skills and expertise, will also be vital if electronic access and use is to be improved. The ACU survey revealed these to be the second most important factor for African libraries' ability to develop good collections and services, while an INASP survey rated skills more highly than connectivity and bandwidth as challenges to e-resource provision.[57] Manda notes that a major challenge for Tanzanian libraries is the lack of a 'pool of expertise with formal training in computers and ICT-related fields', while Adeyoyin reports relatively low levels of ICT skills amongst professional librarians in the West African region: 48% of these were reportedly ICT-literate, and just 16% of paraprofessionals.[58]

With more sophisticated ICTs now being used in HE, and with developing web technologies relating to information access and publishing becoming more sophisticated, libraries need to continually upgrade the technical skills of existing staff and to enable and encourage them to develop new expertise. Librarians increasingly need to become 'digital librarians' if they are to harness and provide the full potential of electronic information for their users. 90% of African head librarians indicated that greater ICT skills are needed, and under half felt that the current skill levels of their staff were sufficient.[59] A study of the University of Zimbabwe's digital library suggests that a critical factor in its success was the creation of a dedicated ICT unit within the library, requiring its own technically skilled staff.[60] Sida's review of its ICT programme at Makerere also noted insufficient ICT expertise as a major constraint. Similarly, a study of ICT skills among information professionals in Nigerian universities argues that too great an emphasis has been accorded to infrastructural rather than human resource development, noting that most libraries surveyed indicated that the lack of a strategic approach to electronic information development at national level, too few technologically-literate staff in libraries, and a lack of skilled staff to manage ICTs were major problems.[61] In addition to developing existing staff, improved training at African library and information schools will also be important in preparing the next generation of librarians, yet many such teaching programmes do not produce graduates with the e-management abilities that their libraries will increasingly require.[62]

[56] Greenberg and Versluis (2005); Kiondo (2008); Harle (2009a).
[57] Harle (2009a); Rosenberg (2005).
[58] Manda (2008); Adeyoyin (2006).
[59] Harle (2009a)
[60] Mbambo-Thata (2007); the same point is echoed by Manda (2008).
[61] Ashcroft and Watts (2005).
[62] See, for example, Manda (2008).

E-resource use and awareness – staff and student skills

Although electronic resources are available in many universities, they are often underutilised by staff and students. With infrastructure and facilities steadily improving, and with significant investments already made or committed, addressing the use of rather than access to electronic resources should perhaps receive greater attention. All too often, academic and student users are either unaware of what is available to them, uncertain of its use and value, or unable to find their way to and into the resources provided for them. The range of electronic sources now available to researchers is dizzyingly wide, and they can be confusing and complex to identify and locate, with so many publishers, aggregators, portals and databases. Adam notes that universities need to work hard to promote a high level of critical thinking among students, if they are to successfully negotiate the vast array of information available, and if higher education is not to be compromised by the profusion of low-quality and more easily accessible sources.[63] A number of reviews point to low use, despite good awareness. A study at Makerere University, Uganda, revealed that, while there was relatively high awareness of resources among academics, only 56% had actually made use of these, while Sida's review suggests that, while access has improved, the long period of poor access has led to a decline in the overall academic reading culture.[64] Insufficient ICT facilities were noted to be a particular obstacle at Makerere (although 61% had a computer, more than half of these had no internet connection, and 25% had poor connection speeds), as was an overall lack of time to investigate and explore electronic materials, presumably related to slow internet speeds, the high cost of access at internet cafés, and problems with passwords or other authentication issues.[65] As Sida's report notes, there can also be a considerable difference in access across faculties, with some having full internet access and others only partial.[66]

In Tanzania, the University of Dar es Salaam has had subscriptions to e-resources since 2001, but this is still a relatively recent development in an environment where basic familiarity with library information services was quite low (demonstrated by low use of the library's online catalogue). As Manda and Kiondo argue, libraries need to improve their marketing strategies if usage is to be increased, and to address the disparity between students and academics. Users must also be given the skills to identify and locate what they need for their work – and this is true of both students and academic staff. An account of usage in Ghana emphasises that, while resources are available, many users lack the skills to locate what they need effectively, while Musoke and Kinengyere similarly note that 70% of trained users made use of e-resources at Makerere, compared to only 36% of those who were not trained.[67] While university students are likely to have encountered the internet and ICTs to some extent prior to their studies, generally low levels of access across the continent, relying on private internet cafés, for example, is unlikely to have enabled them to develop good information retrieval skills, while for many older academics computer and internet facilities will only have been encountered relatively recently, and thus may not be fully incorporated into research strategies.[68] Having recognised that the basic ICT and information skills of their users are important in determining how able they are to make good use of the resources available to them, many libraries have sought to develop training programmes for students and researchers – 82% of African libraries have embarked on the delivery of information skills sessions for undergraduates, and 62% contribute to research skills training.[69]

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[63] Adam (2003).

[64] Agaba (2004); Greenberg and Versluis (2005).

[65] Agaba (2004); see also AGORA, HINARI, OARE (2007).

[66] Greenberg and Versluis (2005).

[67] Asamoah-Hasan and Fremong (2008); Manda (2008); Kiondo (2008); Musoke and Kinengyere (2008). 41% of Tanzanian libraries trained their users, a low level due to the lack of librarians.

[68] e.g. for ICT penetration and broadband access, see ITU (2009). Chisenga (2004), for example, notes that, while public libraries typically provide internet access, few offer web-based information services. Citing a Nigerian study by Jagboro in 2003, Watts and Ibegbulam (2005) note that over half of health science students at the University College Hospital, Ibadan, could not use a computer.

[69] Harle (2009a)

7. Existing support programmes for African university libraries

In recent years, a number of organisations have developed programmes or initiatives designed to support libraries in developing countries more broadly. Many of these have focused on providing access to scholarly information, particularly academic journals, although a number have also addressed other areas of library development, ICT and user training. The following tables summarise firstly the major support programmes, and secondly journal access schemes. It is worth noting, however, that compiling and interrogating the information presented below was a time-consuming and often confusing exercise, despite being undertaken with full access to the internet and with a relatively good starting knowledge; it is likely to be a much more demanding exercise for the average librarian with a poor connection and other demands on their time.

Table 3: Programmes supporting African university libraries

INASP (International Network for the Availability of Scientific Publications) www.inasp.info	Established in 1992, INASP's work focuses broadly on access, use, management and communication of research information in developing countries. Its core Programme for the Enhancement of Research Information (PERii) has four strands, with a particular emphasis on training librarians and ICT professionals: • Information delivery: working with publishers and library consortia to enable access to research materials. • Library development: working with librarians to develop digital libraries, focusing on enhancing the skills of librarians. Includes work on information literacy, developing curricula in library and information schools, supporting national library consortia and professional associations, and implementing digital repositories and library automation systems. • Publishing support: working with editors, authors and publishers to support writing, publishing and communication of research from developing and emerging countries. Include a journals online programme (see AJOL below), training for journal editors, and the AuthorAid mentoring programme for researchers. • ICT training: working with ICT professionals and NRENs to support the development of infrastructure, facilities and skills needed to provide access to scholarly information. Includes work on bandwidth management and optimisation and ICT training in technical and policy areas.
eIFL (Electronic Information for Libraries) www.eifl.net	Established in 1999, eIFL works to increase access to electronic information in transitional and developing countries. Its principal areas of activity include: • licensing negotiations: for discount subscriptions to academic journals and databases (see below) • consortium building and development: delivering training, advice, troubleshooting visits, fundraising workshops and advocacy • open access: work to support libraries to publish locally-produced information through a network of open access repositories hosted by libraries. eIFL have been involved in a Southern African project to pilot the use of Greenstone software to create institutional digital repositories • intellectual property: advocacy on balanced copyright laws and access to knowledge • free and open source software: installing integrated library systems and providing training in their use
BookAid International www.bookaid.org	BookAid's principal focus is on supporting reading at lower educational levels, but it also provides support to a number of university libraries in Africa, in the form of regular book donations. Applications for support are coordinated at a national level by the national library services. It currently supports university libraries in Cameroon, Ethiopia, Malawi, Namibia, Somalia, Tanzania, Uganda and Zimbabwe.

Publishers for Development ACU/INASP www.inasp.info www.acu.ac.uk	Publishers for Development was launched in 2008 and is a joint initiative of the ACU and INASP. It is a forum for information and discussion aimed at exploring some of the challenges that developing country libraries, researchers and publishers experience. In doing so, it seeks to improve publishers' knowledge of the specific needs of developing country colleagues, and generate a greater level of discussion amongst publishers about the issues of access, connectivity and software.
AuthorAid www.authoraid.info	Managed by INASP, this initiative focuses on supporting academics in developing countries to publish their work, thereby increasing the volume of developing country research accessible via scholarly journals and other publications. It provides an online mentoring service designed to connect senior and junior researchers, and in so doing to help researchers in developing countries to publish and otherwise communicate their work.
Information Training and Outreach Centre for Africa (ITOCA) www.itoca.org	ITOCA is a training hub and user support centre in Africa which supports the HINARI, AGORA, OARE and TEEAL access initiatives (see below). Training is provided to librarians, researchers and students through workshops at African institutions. ITOCA also supports the development of ICT programmes, and offers technical assistance.

There are many access schemes aimed at universities and higher research organisations in Africa and elsewhere. The details below do not include open access initiatives, since these are not specific to African or other developing country universities.[70] There are also many smaller schemes delivering individual journals, or specific to the journals of a particular publisher, such as Oxford University Press' developing countries offer. Further information on access schemes is provided by INASP's Directory of Resources.[71]

Table 4: Access schemes available to African libraries

The number of schemes and initiatives seeking to support African universities to gain access to academic materials, in print or online, is so great as to make a comprehensive listing impossible. While there are some major and well-known schemes, there are many more smaller initiatives, supporting specific countries or institutions, or focusing on specific fields. Some of those relating specifically to research in the arts, humanities and social sciences are listed here.

Access to academic journals

HINARI www.who.int/hinari	Led by the World Health Organization (WHO) with Yale University Library, plus other donors and publishers. Provides access to 6,200 journals in health and medical fields to developing country libraries and researchers. Access is free for the poorest countries (most of Africa), and is reduced for others. Training in information skills is now also offered, via ITOCA (see above).
AGORA www.aginternetwork.org	Led by the Food and Agriculture Organization (FAO) with Yale University Library, Cornell University Mann Library, plus other donors and publishers. Provides access to 1,278 journals in agricultural subjects to developing country libraries and researchers. Access is free for the poorest countries (most of Africa), and is reduced for others. Training in information skills is now also offered, via ITOCA (see above).

[70] eIFL and the Directory of Open Access Journals both maintain listings of free and open access e-resources: www.eifl.net/cps/sections/services/negotiations/free-e-resources/other and www.doaj.org

[71] www.inasp.info/file/26280b439d6e401131b8c9eb0077f2b8/file732-inasp-directory-of-resourceshtml.html

OARE www.oaresciences.org	Led by the United Nations Environment Programme (UNEP) with Yale University Library, plus other donors and publishers. Provides access to 2,990 journals in environmental subjects to developing country libraries and researchers. Access is free for the poorest countries (most of Africa), and is reduced for others. Training in information skills is now also offered, via ITOCA (see above).
Programme for the Enhancement of Research Information (PERii) www.inasp.info/perii	Run by INASP, with the support of major publishers. Negotiates national licenses on behalf of partner countries, with reductions of around 98% available to educational and research institutions in developing countries. Includes access to over 25,000 online journals (18,000+ full-text), 11,000 e-books, citation and bibliographic databases and document delivery from the British Library. National country coordination teams make selections, with subscriptions paid by national consortia, through INASP support and sometimes the support of other agencies. The overall aim is to move to sustainable funding in country. Access is through institutional libraries.
eIFL access scheme www.eifl.net/cps/sections/services/negotiations	eIFL negotiates affordable prices for member countries with publishers and aggregators. Resources are available to educational and research institutions in developing and transition countries. eIFL's broader programme is described above.
JSTOR African Access Initiative www.jstor.org/page/info/participate/new/fees/africanAccess.jsp	An initiative of JSTOR, the online journals archive established by the Mellon Foundation, to make its collections (in arts, humanities and social sciences) freely available to African universities. Archives contain over 1,000 academic journals across these fields, as well as select monographs and other materials. Contents are full-text searchable and the archive begins with the first issue of each journal and runs to a moving wall of 3-5 years (the most recent issues of journals are thus not included). Includes ALUKA (see below).
TEEAL (LAN) http://teeal.cornell.edu	Run by Cornell University's Albert R Mann Library, with the support of major publishers. Provides a digital library 'in a box', by means of an external network drive containing over 130 agricultural full-text journals. Libraries purchase an annual package of journals at a heavy discount. Between 1993 and 2007, TEEAL cost USD 7,500 with annual updates supplied for USD 1,000; the estimated value of the journals on the current version is over USD 2 million. The package includes a searchable database. No internet or phone line required is required; the drive can be used on a standalone PC or shared across a local area network. Training provided by ITOCA in Harare (see above).
African Journals Online (AJOL) www.ajol.info	Run by NISC; originally established by INASP as an online journal hosting platform for Africa. Over 340 journals are available in full-text form online or via document delivery free of charge to African universities, and services are provided to enable existing journals to publish online or new online journals to be established. Supported by fees charged to non-African libraries.
Electronic Journals Delivery Service (eJDS) www.ejds.org	An initiative of the Abdus Salam International Center for Theoretical Physics. Supplies full-text maths and physics articles via email to scientists in developing countries where insufficient bandwidth or unaffordable connections prevent access.
Project MUSE via the Global Development Network http://muse.jhu.edu www.gdnet.org	Managed by the Johns Hopkins University Press. Developing country researchers registered with the Global Development Network can access 400 full-text titles from 100 publishers.
Protecting the African Library www.acu.ac.uk	Run by the ACU, with the support of publishers. Enables ACU member universities to purchase discounted print subscriptions to journals from over a dozen academic publishers. Subscriptions are typically 25% or less of original cover prices and 14 publishers are involved.

Journal Donation Project www.newschool.edu/centers/jdp	Run by The New School, New York. Provides free journals to a number of Nigerian universities, either on the basis of donations from publishers, or by paying for subscriptions with donor funding.
eGranary www.widernet.org/digitalLibrary www.egranary.org	Run by the University of Iowa. Creates copies of digital educational materials, including journals and educational websites, on a hard drive which can be connected to a university's local area network. Updates are delivered 2-3 times a year. Also organises ICT and technical training for Nigerian universities.
Elsevier, AAU http://libraryconnect.elsevier.com/lcn/0603/lcn060304.html	A collaboration to offer *ScienceDirect* and *Scopus* on a deeply discounted basis to universities in Central, East and West Africa. Will encompass the African Virtual University, headquartered in Kenya.
Social Science Library www.ase.tufts.edu/gdae/education_materials/ssl.html	Will contain around 3,000 full-text journal articles and book chapters in anthropology, economics, history, philosophy, social psychology, sociology and political science on CD, distributed free of charge to libraries in 137 developing countries. Will also include bibliographic references to approximately 9,000 articles. A first volume has been distributed to eIFL members, while it was also reportedly being tested in Ghana and Nigeria.
African e-Journals Project http://africa.msu.edu/AEJP	Collaborative effort of Michigan State University with the Association of African Universities and the African Studies Association. Offers two major resources: a directory of journals about Africa provides information on where to find tables of contents and abstracts, full text of articles online and journal webpages, where they are available; and a full-text archive of back issues of 11 scholarly journals published in Africa in the social sciences and humanities.

Access to other research materials

Database of African Theses and Dissertations (DATAD) www.aau.org/datad	Initiative of the Association of African Universities to develop a digital repository of African university research theses and dissertations, and to make these freely available online to African institutions.
Aluka www.aluka.org	Online digital library of scholarly resources from and about Africa, now part of JSTOR (see above). Ranges from archival documents, periodicals, books, reports, manuscripts, and reference works, to three-dimensional models, maps, oral histories, plant specimens, photographs, and slides. Access is free to all institutions within Africa.
African Online Digital Library (AODL) www.aodl.org	Developed by the MATRIX unit and the African Studies Center at Michigan State University, in partnership with universities and cultural heritage organisations in Africa. A portal to multimedia collections on and about Africa to support research.

8. Conclusion

This paper has sought to briefly outline the principal areas which impact on African universities' abilities to access scholarly information in digital form. It has highlighted technical and infrastructural issues external to African universities, in the form of national and regional broadband connections and networking, in addition to those matters within universities which impact on their ability to manage and make use of scholarly information delivered via the internet. The emphasis of many prior studies and programmes seeking to improve access to information has been on the technological and infrastructural aspects, and this is now beginning to pay off, as improvements are slowly being made, notably the growth of broadband research and education networks (RENs). Nevertheless, the focus on technical solutions has meant skills and leadership, and the internal dynamics of and relationships within African institutions, have tended to be somewhat neglected (training and skills development have, however, featured heavily in the programmes of INASP and eIFL, for example). The recent evaluations of INASP's PERii point strongly towards the need for a better understanding of these less easily identifiable obstacles, particularly now that, in terms of the volume of information available and the relative affordability of resources, the initial problem of access, while not yet eliminated, has been well addressed. Much greater attention now needs to be focused on how the resources that are now available to African university libraries are incorporated into the teaching and research activities of their researchers, lecturers and students, if access is to be translated into use, and use into a strengthened research system and a high-quality teaching and study environment.

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