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The Performance of South African and Kenyan Universities on the World Wide Web: a Web Link Analysis

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Abstract

The study used Link Analysis to compare Kenyan and South African universities according to several Web-based indicators, some of which include the number of pages, and the number of in and out-links. The authors examined the external out-links in order to determine the institutions targeted by South African and Kenyan universities. Also investigated were the networks or links between universities. Web Impact Factors (WIFs) were calculated and reported in order to compare the universities' web influence. Results indicate that Kenyan universities, like most African universities, have embraced the Internet and its constructs fairly recently, hence most of their websites are at initial stages of construction. Comparatively, South African universities have made remarkable progress in their web presence, which is at an advanced stage of development, equaling counterparts in more developed countries. The study recommends that regional webometric studies be conducted periodically in order to investigate and map the web-related developments of African universities. It concludes that African universities, though not comparable to counterparts in developed countries, can have their websites evaluated webometrically.

Keywords

Webometrics, link analysis, universities, Kenya, South Africa

1. Introduction

The emergence of the Internet and the World Wide Web (WWW) has revolutionalized not only scholarly communication (although publishing on the WWW is yet to gain as much recognition as traditional scientific publishing) but also the manner in which institutions and individuals offer information concerning their services and products. Studies indicate that the Web is becoming a significant communication medium for science and scholarship (Cronin & McKim, 1996). Institutions of higher learning, and particularly universities, have embraced the WWW and its many features, enabling activities such as the: provision of online library catalogues; promotion of the

existence and achievements of individuals, research groups, institutes and departments; and the dissemination of research findings, either through hosting online articles or publishing summaries, data sets or tools (Noruzi, 2005). This scenario has provided scholars with additional tools with which they can and/or have already used to evaluate universities. Thus, evaluation of universities, which was previously limited to the use of bibliometric analyses (publications count, citations analysis and patent analysis), expert reviews (peer-reviews), the economic rate of return, case studies, surveys, the analysis of competition for funds, and retrospective analysis (e.g. The Time's Higher Education Supplement [2005]; ARWU: Shanghai Jiao Tong University [2004]; Cybermetrics Lab, 2005), can now also be conducted webometrically.

The aforementioned studies made use of a range of indicators (including informetric analysis) to rank institutions of higher learning, and in the process revealed that the performance of African universities is dismal. African universities did not feature in the Times list's 200 top ranking universities, and only the University of Cape Town (*r=251*), the University of Witwatersrand (*r=395*), the University of KwaZulu-Natal (*r=469*), and the University of Pretoria (*r=480*) made an appearance in the top 500 of the Shanghai Jiao Tong University's list [see **http://ed.sjtu.edu.cn/rank/2006/ARWU2006/ARWU2006.xls**]. A webometric ranking of world universities conducted by Cybermetrics Lab (2005) lists the top African university (i.e. University of Cape Town) at number 356. The absence or low ranking of African universities from/within world rankings has raised many concerns. Although many have queried the methods and criteria of evaluation, there has been general concern as to whether or not African Universities are really ready for cybermetric studies, given the region's poor economic and technology related developments, which have led considerably to the ever increasing digital divide between African countries and the developed world. Despite this, we acknowledge the fact that there are now several link analysis studies on university web sites. The application of bibliometric/informetric approaches by library and information scientists to web related studies is growing increasingly common. Several studies have applied publications count and citation analysis techniques whilst studying patterns of web information production, organization, storage, retrieval and use, and the influence of websites on each other. These studies have led to the establishment of webometrics as a viable field of research in Library and Information Science (LIS). Examples of LIS-related webometric studies include Björneborn (2004), Björneborn & Ingwersen 2004), Candan & Li (2002), Ingwersen (1998), Jana & Chatterjee (2004), Thelwall (2002a, 2002b, 2003), and Vaughan & Hysen (2002), to name a few. University Websites have been commonly evaluated using Link Analysis in order to: measure their web impact factors (Thelwall, 2002a); find the most important web pages (Thelwall, 2003); identify link relationships between universities (Thelwall, 2002b; 2002c); classify link types in academic environments on the Web (Bar-Ilan, 2005); and finally, to rank universities (Cybermetrics Lab, 2005).

To the best of our knowledge, however, there are no comprehensive studies that have been conducted to report on the performance of African universities on the Web. This study provides the preliminary findings of a broader research project aimed at measuring and comparing the visibility and influence of African universities on the Web using several web indicators.

2. Research questions

The paper takes the form of an exploratory study that employs Link Analysis to measure the performance of Kenyan and South African universities on the web. The study considers a question many have raised, i.e. are African institutions of higher learning ripe for cybermetric studies? In order to respond to the above, the current study focused on the following research questions:

- What is the total number of universities in the two countries that have websites?
- How visible are the universities on the Web?
- How much Web influence do the universities have?
- Which are the most targeted institutions by the universities in Eastern and Southern Africa?

Is there any web networking between and among the universities in the two regions?

3. Methodology

3.1. Procedures

The study investigated Kenyan and South African institutions of higher learning that had own websites. At this stage, we targeted only universities. A total of 16 and 21 universities were selected from Kenya and South Africa respectively, based on website ownership and the availability of degree programs. The list of the studied universities in each country is provided in Table 1. Sources of data consisted of the following:

- **Catalogue of world universities**
- **Canada's University and College Information Center**
- **International Network for Higher Education in Africa** (2003)
- **Study in South Africa**

Using Link Analysis, this study crawled through and compared Kenyan and South African universities' websites based on several Web-based indicators, some of which include the number of pages, number of out-links (page out-links, directory out-links, domain out-links, and site out-links) and the number of in-links (page in-links, directory in-links, domain in-links, and site in-links). Two approaches were used for data collection. The SocSciBot computer software and the SocSciBot toolkit were respectively used to crawl through university websites and analyze collected data. SocSciBot is a website crawler that is specially designed for research purposes. The software was chosen based on its extensive use for site analysis and its user-friendliness. It also generates a number of reports, some of which were the subject of discussion of this study. Duplicate elimination in SocSciBot is done through comparison of the full HTML of the two pages. The crawled pages were limited to only those without question marks, as in some cases these pages are repeated, and thus crawling them would be an endless task. Data collection was conducted within the same month (April 2006) in order to limit errors commonly associated with frequent website updates. The findings of this study, therefore, are representative of the status of each university regarding web presence and impact as of the first two weeks of April 2006. As a way of triangulation, AltaVista and Google, two top ranked search engines, were used for comparison purposes, particularly in terms of the number of pages, in-links, and the WIF. The following uniform search strategy was used to collect data from the two search engines:

1. The total number of pages linking to the website

   Example (AltaVista): *linkdomain:anu.ac.ke/* OR linkdomain:*www.anu.ac.ke/*

   Example (Google): *link:www.anu.ac.ke/*

2. The total number of pages at the website

   Example (AltaVista): *domain:anu.ac.ke/* OR *domain:www.anu.ac.ke/*

   Example (Google): *site:anu.ac.ke/* OR *site:www.anu.ac.ke/*

External links were examined to identify the most common Top Level Domains (TLDs) targeted by Kenyan and South African universities. We employed the Citation Impact Factor analogy to calculate the universities' Web Impact Factors (WIFs) in order to compare the universities' web influences. The following formula was used to calculate the WIFs:

$$WIF = \frac{\text{The total number of pages linking to the web site}}{\text{The number of pages at the web site}}$$

Visualization networks illustrating the inter-connectivity of universities were provided using Pajek software.

3.2. Limitations of the study

As already mentioned, this study was limited to a total of 21 and 16 universities in South Africa and Kenya respectively. Presently, a study that will measure the performance of other universities in the continent is underway. A further limitation of the study relates to the search strategy that was employed, i.e.: site:(domain name). The approach meant that all links, including self-links, were analyzed, which in turn exaggerates the performance of a university with a large number of self-links, hence distorting the WIF of a given university. The citation IF has been faulted on the same premise that in its calculation, all citations (including self-citations) are used. Nevertheless, it is widely acknowledged that self-citations - just as citations from other documents - are indicators of the use made of a given document and thus they (i.e. self-citations) can be included in the calculation of IFs. After all, it has been observed that the "*self-citation rate shows only a weak correlation with the impact and subject of a journal. There is also a weak correlation between self-citation rate and the size or specificity of the category (categories) assigned to a journal*". (from **Journal self-citation in the Journal Citation Reports**). It is worth noting, however, that there are limitations associated with the use of self-citations, especially in the calculation of IFs as observed by Seglen (1997).

Table 1: List of Kenyan & S. African universities that were the focus of this study

South Africa			Kenya		
No.	**University**	**Website address**	**No.**	**University**	**Website Address**
1	Cape Peninsula Univ. Tech	www.cput.ac.za	1	Afr Nazarene University	www.anu.ac.ke
2	Central Univ. Tech	www.cut.ac.za	2	Catholic University of E. A.	www.cuea.ac.ke
3	Durban University of Tech	www.dit.ac.za	3	Daystar University	www.daystar.ac.ke
4	N. Mandela Metropolitan Univ	www.nmmu.ac.za	4	Egerton University	www.egerton.ac.za
5	Rhodes Univ.	www.ru.ac.za	5	J. K. Univ. of Arts & Tech.	www.jkuat.ac.ke
6	Stellenbosch Univ.	www.sun.ac.za	6	Kabarak Univ.	www.kabarak.ac.ke
7	Tshwane Univ. of Technology	www.tut.ac.za	7	Kenya Methodist University	www.kemu.ac.ke
8	University. Of Cape Town	www.uct.ac.za	8	Kenyatta University	www.ku.ac.ke
9	Univ. of Fort Hare	www.ufh.ac.za	9	Kiriri Women's Univ. Sci & Tech	www.kwust.ac.ke
10	Univ. of Johannesburg	www.uj.ac.za	10	Maseno University	www.maseno.ac.ke
11	Univ. of KwaZulu Natal	www.ukzn.ac.za	11	Moi University	www.mu.ac.ke
12	Univ. of South Africa	www.unisa.ac.za	12	Scott Theological Seminary	www.scott.ac.ke
13	Univ. of Venda	www.univen.ac.za	13	Strathmore University	www.strathmore.ac.ke
14	Univ. of the North	www.unorth.ac.za	14	University of E.A. Baraton	www.ueab.ac.ke
15	Univ. of the Free State	www.uovs.ac.za	15	University. of Nairobi	www.uonbi.ac.ke
16	Univ. of Pretoria	www.up.ac.za	16	United States Inter University.	www.usiu.ac.ke
17	Univ. of Western Cape	www.uwc.ac.za			
18	Univ. of Zululand	www.uzulu.ac.za			
19	Vaal Univversity of Tech	www.vut.ac.za			
20	Univ. of Witwatersrand	www.wits.ac.za			
21	Walter Sisulu Univ. Tech&Sci	www.wsu.ac.za			

4. Results

This section provides and discusses results under five sub-headings, namely:

Number of pages and out-link

- Web influence of Kenyan and South African universities
- University visualization networks
- Number of in- and out-links amongst universities in Kenya and South Africa
- Targeted external websites or links

4.1. Number of pages and out-links

Table 1 provides the total number of pages and out-links (links from the universities' web pages) as crawled by SocSciBot. From South Africa, the University of Cape Town produced 119,454 pages and 1,118,132 out-links, followed by the University of Pretoria (111,496; 1,551,541) and Rhodes University (61,418; 2,403,463). In Kenya, the United States International University (USIU) had the highest number of pages (797), as well as the largest number of out-links (11,933). Moi University came second with 352 pages and 2039 out-links, followed by Egerton University with 254 pages and 1002 out-links.

Table 1: Kenyan and South African universities: ranked by number of pages

No.	Site	Pages	Out-links	Out-links per page
1	www.uct.ac.za	119454	1180132	9.8794
2	www.up.ac.za	111496	1551541	13.9157
3	www.ru.ac.za	61418	2403463	39.1329
4	www.wits.ac.za	41408	397374	9.5966
5	www.sun.ac.za	32491	169535	5.2179
6	www.ukzn.ac.za	5691	25619	4.5017
7	www.uwc.ac.za	5272	19242	3.6498
8	www.ufh.ac.za	836	12344	14.7656
9	www.usiu.ac.ke	797	11933	14.9724
10	www.cput.ac.za	628	11058	17.6083
11	www.uovs.ac.za	436	14841	34.0390
12	www.mu.ac.ke	352	2039	5.7926
13	www.univen.ac.za	305	1725	5.6557
14	www.egerton.ac.ke	254	1002	3.9449
15	www.strathmore.edu	172	2881	16.7500
16	www.uonbi.ac.ke	165	2796	16.9455
17	www.cut.ac.za	136	1842	13.5441
18	www.kabarak.ac.ke	109	1406	12.8991
19	www.dit.ac.za	106	818	7.7170
20	www.daystar.ac.ke	102	832	8.1569
21	www.wsu.ac.za	98	1286	13.1224
22	www.anu.ac.ke	97	1680	17.3196
23	www.kemu.ac.ke	95	1298	13.6632
24	www.cuea.edu	90	420	4.6667
25	www.tut.ac.za	62	159	2.5645
26	www.unisa.ac.za	58	144	2.4828
27	www.scott.ac.ke	54	1405	26.0185
28	www.maseno.ac.ke	54	459	8.5000
29	www.ueab.ac.ke	51	399	7.8235
30	www.uzulu.ac.za	45	424	9.4222
31	www.kwust.ac.ke	37	334	9.0270
32	www.uj.ac.za	24	170	7.0833
33	www.vut.ac.za	15	115	7.6667
34	www.unorth.ac.za	15	44	2.9333
35	www.ku.ac.ke	14	41	2.9286
36	www.jkuat.ac.ke	14	14	1.0000
37	www.nmmu.ac.za	2	18	9.0000
	TOTAL	**382453**	**5820833**	**15.2197**

4.2. Web Influence of Kenyan and South African universities

Table 2 ranks the universities according to the number of web pages, links to the websites, and WIFs in both AltaVista and Google search engines. The top ranked universities are, in descending order, the University of Witwatersrand, the University of Cape Town, the University of South Africa and the University

of Pretoria. The bottom half of Table 2 and Appendix A consists largely of Kenyan universities. None of the universities appeared to rank constantly throughout the variables, i.e. number of web pages, links to the websites and WIFs. For instance, the University of Witwatersrand ranked fifth in the number of web pages in both search engines and in Google's links to the website, and twentieth in Google's WIF, whilst ranking second and twelfth in AltaVista's links to the website and WIF respectively. Table 2 also shows that most of the universities recorded high impact factors: - a situation that may be attributed to the inclusion of self-links. High impact factors were particularly recorded by universities with fewer web pages and a high pattern of in-links.

Table 2: Rank distribution of Kenyan and South African Universities by number of web pages, links to websites and WIF in AltaVista and Google search engines

			AltaVista			Google		
No.	*Rank*	*University*	*Web Pages*	*Links to Website (Total)*	*WIF*	*Web Pages*	*Links to Website (Total)*	*WIF*
1	1	www.wits.ac.za	5	2	12	5	5	20
2	2	www.uct.ac.za	3	1	27	9	2	16
3	3	www.unisa.ac.za	7	7	23	2	1	20
4	4	www.up.ac.za	1	3	34	3	3	20
5	4	www.uovs.ac.za	9	9	16	1	8	21
6	5	www.ru.ac.za	4	4	29	4	4	20
7	6	www.ukzn.ac.za	8	8	20	11	9	18
8	7	www.sun.ac.za	2	5	35	7	6	20
9	7	www.ufh.ac.za	20	14	8	13	12	8
10	8	www.uwc.ac.za	6	6	32	8	7	20
11	8	www.uj.ac.za	11	11	30	14	11	2
12	9	www.nmmu.ac.za	15	12	17	6	21	21
13	10	www.usiu.ac.ke	18	17	19	17	16	8
14	11	www.univen.ac.za	25	22	7	19	17	6
15	12	www.cut.ac.za	19	19	21	15	14	9
16	13	www.ku.ac.ke	23	21	9	18	18	9
17	14	www.unorth.ac.za	13	10	25	23	26	5
18	15	www.mu.ac.ke	16	16	24	16	20	11
19	15	www.tut.ac.za	17	18	28	11	10	19
20	16	www.uonbi.ac.ke	12	13	36	10	13	20
21	16	www.cput.ac.za	21	23	22	22	15	1
22	17	www.dit.ac.za	14	15	33	24	22	3
23	18	www.uzulu.ac.za	10	13	37	20	23	9
24	18	www.vut.ac.za	31	27	3	12	19	20
25	19	www.egerton.ac.ke	22	20	18	21	24	9
26	20	www.jkuat.ac.ke	24	25	15	26	25	4
27	21	www.wsu.ac.za	29	26	4	27	28	9
28	22	www.cuea.edu	31	28	5	31	29	7
29	23	www.anu.ac.ke	28	30	11	30	30	8
30	24	www.strathmore.ac.ke	26	24	6	34	35	14
31	25	www.kabarak.ac.ke	27	29	10	25	35	17
32	26	www.daystar.ac.ke	35	34	2	29	31	13
33	27	www.maseno.ac.ke	36	36	1	32	33	15
34	28	www.scott.ac.ke	33	31	13	36	33	9
35	29	www.kemu.ac.ke	30	32	31	28	27	8
36	30	www.kwust.ac.ke	34	33	14	35	34	12
37	31	www.ueab.ac.ke	32	35	26	33	32	10

4.3. Universities' networks

Figures 1 and 2 are visual maps demonstrating links (only site links were mapped) between the universities within South Africa and Kenya respectively. Figure 3 combines the two maps in order to check for inter-connectivity between South African and Kenyan Universities. Whereas Universities in South Africa do have a fairly well developed network, Kenyan Universities' web inter-connections are few. Unlike South African universities, it was noted that the main linking universities (i.e. Moi University and the United States International University) provided links to universities in their categories (i.e. private or public).

Figure 1: University inter-linkages: South Africa

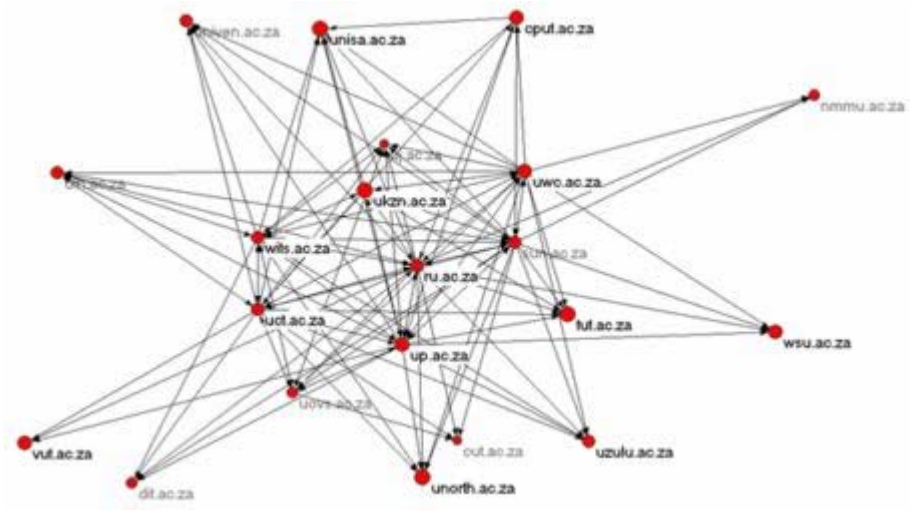

Figure 3 indicates that Kenyan universities, particularly the Jomo Kenyatta University of Agriculture and Technology, Africa Nazarene University, Moi University, University of Nairobi, Kenyatta University, United States international University, and Kiriri Women's University of Science and Technology, do have links with South Africa's Rhodes University, University of Pretoria, University of Witwatersrand, and the University of Cape Town. Furthermore, it was observed that all the links between Kenyan and South African universities emanated from the latter. The nature of these connections could not, however, be established.

Figure 2: University inter-linkages: Kenya

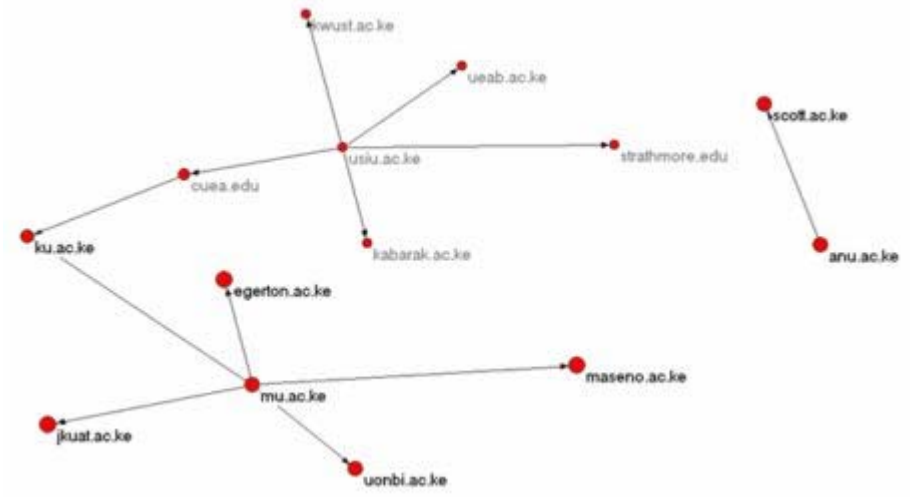

Figure 3: University Inter-linkages: South Africa and Kenya

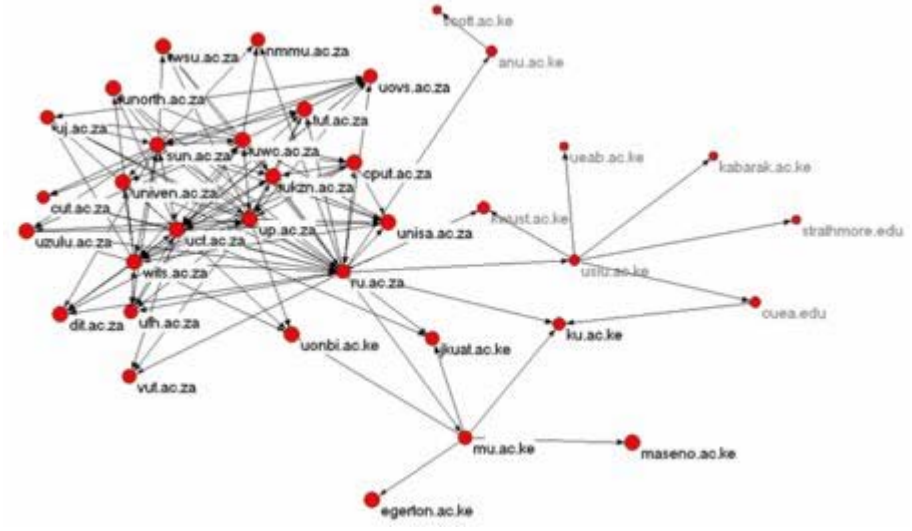

Table 3: Number of in- and out-links amongst Kenyan Universities: ranked by number of page in-links

	Page inlinks	Directory inlinks	Domain inlinks	Site inlinks	Page outlinks	Directory outlinks	Domain outlinks	Site outlinks
www.ku.ac.ke	2	2	2	2	0	0	0	0
www.cuea.edu	1	1	1	1	1	1	1	1
www.egerton.ac.ke	1	1	1	1	0	0	0	0
www.jkuat.ac.ke	1	1	1	1	0	0	0	0
www.kabarak.ac.ke	1	1	1	1	0	0	0	0
www.kwust.ac.ke	1	1	1	1	0	0	0	0
www.maseno.ac.ke	1	1	1	1	0	0	0	0
www.scott.ac.ke	1	1	1	1	0	0	0	0
www.strathmore.edu	1	1	1	1	0	0	0	0
www.ueab.ac.ke	1	1	1	1	0	0	0	0
www.uonbi.ac.ke	1	1	1	1	0	0	0	0
www.anu.ac.ke	0	0	0	0	1	1	1	1
www.daystar.ac.ke	0	0	0	0	0	0	0	0
www.kemu.ac.ke	0	0	0	0	0	0	0	0
www.mu.ac.ke	0	0	0	0	5	5	5	5
www.usiu.ac.ke	0	0	0	0	5	5	5	5

4.4. In- and out-links amongst universities in Kenya and S. Africa

Tables 3 and 4 provide the number of in- and out-links among and between universities in Kenya and South Africa respectively. In Kenya, most out-links were produced by the USIU and MU, which recorded five out-links each for pages, directories, domains and sites, while KU received the highest number of in-links (2 in-links each for pages, directories, domains and sites). In South Africa, the UCT received the highest number of page in-links (357), directory in-links (245), and domain in-links (101), whilst receiving 8 site in-links from other South African universities. Overall, South African universities have performed better in providing links to each other than their Kenyan counterparts, as shown in Figures 1, 2 and 3 and Tables 3 and 4.

Table 4: In- and out-links amongst South African Universities: ranked by number of page in-links

	Page Inlinks	Directory Inlinks	Domain Inlinks	Site inlinks	Page outlinks	Directory Outlinks	Domain Outlinks	Site Outlinks
www.uct.ac.za	357	245	101	8	218	193	88	14
www.sun.ac.za	247	206	68	7	179	150	77	15
www.ru.ac.za	228	130	64	9	97	74	45	15
www.unisa.ac.za	147	107	35	8	0	0	0	0
www.uovs.ac.za	114	91	33	7	6	5	5	5
www.up.ac.za	109	53	17	2	273	232	68	15
www.ukzn.ac.za	43	30	15	7	16	14	12	5
www.unorth.ac.za	33	27	17	6	0	0	0	0
www.uzulu.ac.za	30	29	17	6	0	0	0	0
www.ufh.ac.za	25	24	14	6	49	13	12	2
www.uj.ac.za	19	14	14	7	2	2	2	2
www.cput.ac.za	18	12	7	4	48	4	4	3
www.tut.ac.za	17	11	7	6	0	0	0	0
www.uwc.ac.za	15	14	7	1	106	54	28	16
www.dit.ac.za	12	10	9	5	0	0	0	0
www.univen.ac.za	12	12	6	3	0	0	0	0
www.cut.ac.za	11	10	5	4	0	0	0	0
www.wsu.ac.za	11	5	4	4	0	0	0	0
www.nmmu.ac.za	9	4	4	3	0	0	0	0
www.vut.ac.za	6	4	3	3	0	0	0	0
www.wits.ac.za	0	0	0	0	469	297	106	14

4.5. Targeted external websites and/or links

Table 5 provides a list of the top 15 most targeted TLD links by the Kenyan and South African universities. In South Africa, the highest ranking TLD domains include: informationweek.com (magazine published in the U.S. that offers news, features and events for technology professionals); java.sun.com (website that offers information on Java programming); boingboing.net (a blog whose main themes include technology, futurism, science fiction, gadgets, intellectual property, and political issues); and forbes.com (American business and financial magazine founded in 1917 by B.C. Forbes). The sites

that recorded the highest number of links from Kenyan universities, in descending order, are: usiualumni.com (website for the United States International University's alumni); adobe.com (a company popular for the development of acrobat reader used for desktop publishing); search.freefind.com (website search engine); daystarus.org (Daystar University's parent organization); and fordfound.org (The Ford Foundation – an independent nonprofit grant-making organization). Notable appearances, in Kenya's case, include eastandard.net and nationaudio.com (local newspapers); nbnet.com (an Internet Service Provider [ISP]); google.com (global search engine); search.epnet.com (EBSCO database – offers a variety of information resources/databases) and emeraldinsight.com (Emerald company – publisher of the world's widest range of management and library information science journals, as well as a strong specialist range of engineering, applied science and technology journals); to name a few. It appears that preference has been given to sites that offer daily news.

Table 5: Most commonly targeted TLD domains by Kenyan and South African Universities

South Africa			Kenya		
No.	External TLD	No. of links	No.	External TLD	No. of links
1	informationweek.com/	38495	1	.usiualumni.com	338
2	java.sun.com/cgi-bin/	21113	2	.adobe.com/	68
3	.boingboing.net/	17707	3	search.freefind.com/	63
4	.forbes.com/bow	17707	4	.daystarus.org/	62
5	.heavens-above.com/	17706	5	.fordfound.org	34
6	.hypermail.org/	11405	6	.useit.com/	27
7	root.cern.ch/	7232	7	.TUDelft.NL	13
8	gallery.sourceforge.net	2111	8	.eastandard.net/	10
9	.digitaldutch.com/	1491	9	.nbnet.co.ke	9
10	validator.w3.org/	1330	10	.kodibarth.com	9
11	jigsaw.w3.org/	1148	11	.nationmedia.com/	8
12	plone.org	842	12	.kemuda.org	8
13	.section508.gov	842	13	search.epnet.com/	7
14	.w3.org/WAI/	841	14	.google.com/	7
15	Plone.org/	840	15	.emeraldinsight.com/	7

5. Discussions, Conclusions and recommendations

A significant observation that has already been made is that Web-based tools are rarely used within South African universities (Blewett & Singh, 2002), perhaps because in general, African universities have embraced the Internet and its features fairly recently. Consequently, their websites are still relatively new. This late launch into cyberspace could be attributed to the African governments' lack of support or active involvement in web development (Chisenga, 2004). Nevertheless, it was noted in this study that all the universities in the two countries have their own websites, although some of them were under construction at the time we crawled the Web (e.g. Maseno University – which had one page then - has since updated its website).

The total number of pages produced by SocSciBot and the two search engines differed significantly, as shown in Table 1 and Appendix A. Even within Appendix A, AltaVista yielded different results to those of Google. In the first instance, the approach that was used to download data presented in Table 1 was different from that used to extract data presented in Appendix A. Appendix A contains all web pages as indexed in AltaVista and Google, while Table 1 consists of only the web pages whose links did not contain question marks. The differences between AltaVista's and Google's coverage may be attributed to differences in indexing. Previous studies have shown that search engine overlaps of web coverage are small (Lawrence & Giles, 1999 and Bar-Ilan, in Thelwall, 2004), therefore meaning that whatever is indexed in one search engine may not necessarily be covered in another. In addition, Thelwall (n.d.) observes that Google only reports a fraction of the links that Google is aware of (approx. 10%), which may explain why Google produced less links to African universities than AltaVista.

There were a total of 382453 university pages for the two countries, while the number of out-links, according to SocSciBot data, totaled 5820833, thus creating an average number of 15.2 links per page. Kenyan universities recorded an average of 11.8 links per page from a total of 2457 pages and 28939 out-links, while South African universities had a total of 379996 pages and 5791894 out-links, producing an average score of 15.2 links per page.

Comparatively, therefore, South African universities were the most prolific, although the mean number of links per page among them does not differ significantly as might have been expected. An analysis of each university's mean number of pages, using AltaVista and Google, showed that Kenyan Universities produced only 382 pages per university, while South Africa recorded 55,090 pages per university. As a result, South African universities seem to have made remarkable progress in developing their websites, which are at an advanced stage and can be compared to those of their counterparts in developed countries, e.g. Spain, Australia, the UK, Taiwan and New Zealand, which recorded 33187, 71749, 49000, 46754 and 39393 pages respectively per university between 2001 and 2002 (Thelwall, 2004).

Impact-wise, Kenya (0.79) had a higher impact factor than South Africa (0.61), a situation that may have been caused by the few pages and several in-links (including self-links) that Kenyan universities yielded. This perhaps explains why using the impact factor as a means of ranking, evaluating or assessing individuals, institutions and countries is problematic. WIF usage with other measures such as the number of pages, number of links, website size, etc.; may yield better rank results as illustrated in this study. Overall, universities from the two countries produced an impact factor of 0.61 (AltaVista) and 0.01 (Google).

It was observed that the most commonly targeted external links were largely news sites (especially magazines and newspapers on computers/computing and technology), downloadable freeware, and electronic databases. The former two's high ranking could be attributed to the persons responsible for creating links on the universities' websites. Usually, these people are computer scientists or information technologists. Links to electronic databases such as EBSCO and EMERALD may have originated from the university libraries' websites.

A 'content divide' was noted, not only between South African and Kenyan universities' websites, but also between South African universities' websites. The minimal web page content in Kenyan universities is manifested in the universities' few web pages. In South Africa, it was noted that historically advantaged universities' (HAUs) web performance in terms of the number of web pages, content, out-links and in-links, was better than historically disadvantaged universities (HDUs), perhaps due to privileges the former category enjoyed during the apartheid era (Jacobs, 2000) and their subsequent growth following the 'Matthew's' principle. Nevertheless, links between South African universities were manifest. Unlike Kenyan universities, which had poor networks, South African universities exhibited fairly strong linkages/patterns. Seemingly, the broad social gap between the HAUs and the HDUs that existed in the apartheid era is slowly being narrowed. Meanwhile, Kenya's situation may be attributed to the engagement of external/internal poorly skilled webmasters, or unwillingness for collaboration, partnership or sharing among the universities. (For example, one computer science lecturer, whom we casually asked why Kenyan universities have such poor connectivity, noted that these universities are competitors and thus cannot warrant advertising each others' services, products, curricula, etc., on their websites).

In conclusion, given that webometric studies are usually based on web-based indicators, which in turn largely depend on how well the website of an institution is developed and visible, it is our view that some universities in Africa may not qualify for comparative webometric studies, especially for ranking purposes, due to underdeveloped or non-existent [yet-to-be constructed] websites. Similarly, universities operate under different economic, political and social conditions, and unless these aspects are taken into consideration, comparative webometric studies meant to rank universities on the basis of quality may be subject to unprecedented criticism. Worth noting as well is that the size of an institution may also influence the quantity of web pages. Nevertheless, African institutions of higher learning have developed web sites which, in our view, should be periodically evaluated. Although weblinks have been used for ranking universities, studies have emphasized that given the constraints of web-link methods, caution should be taken when applying these indicators to rankings. Emphasis on the benefits of web-link studies, such as enabling visibility, should be viewed as strong reasons demonstrating why such webometric studies are vital. However, it should be appreciated that there is no method that is absolutely perfect and reasonably objective.

For African universities to compete favorably with the rest of the world and perform better than they are currently performing on the Web there is an urgent need to invest in information technology and to popularize the Web within institutions whilst engaging the services of qualified webmasters in the design and construction of their websites. Other specific measures to be taken include: formulating minimum web development standards; revisiting link development and codification policies so as to increase links for visibility; and placing/locating institutions' products on the web through tools such as Open Access and institutional repositories. Similarly, ICT policies with adequate web development guidelines are critical. We believe that these factors would, among others, assist in improving web development, bridging both the digital and content divide between African universities' websites and those of universities elsewhere, and provide the universities with better visibility.

There are a number of unresolved issues that could be on an agenda for future research. Among them are:

1. Finding out the types and nature of the links
2. Using other online indexing services in order to compare the coverage and visibility of African universities
3. Comparing findings from webometric studies with those generated from other performance indicators (e.g. publication count and citation analysis)
4. Broadening the area of study, i.e. to include all African universities/countries
5. Employing other web performance measurements (e.g. relevance, link relationships, rankings, visibility, etc.)
6. Establishing reasons for sitations (links)
7. Exploring both institutional and national ICT policies in the region, aiming to uncover their formulation/creation and implementation and the bearing they may be having on web development

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Appendix A: University web pages, links to websites and WIFs

			AltaVista			Google		
No.	*Rank*	*University*	*Web Pages*	*Links to Website*	*WIF*	*Web Pages*	*Links to Website*	*WIF*

				(Total)			(Total)	
1	1	www.wits.ac.za	93200	134000	1.44	75500	701	0.01
2	2	www.uct.ac.za	209000	148000	0.71	29400	1640	0.06
3	3	www.unisa.ac.za	30800	24000	0.78	180000	2130	0.01
4	4	www.up.ac.za	288000	122000	0.42	120000	830	0.01
5	4	www.uovs.ac.za	11400	14000	1.23	195000	334	0.00
6	5	www.ru.ac.za	157000	104000	0.66	77200	811	0.01
7	6	www.ukzn.ac.za	14600	14300	0.98	13500	302	0.02
8	7	www.sun.ac.za	242000	89000	0.37	35200	483	0.01
9	7	www.ufh.ac.za	641	1200	1.87	800	132	0.17
10	8	www.uwc.ac.za	90800	46400	0.51	34300	343	0.01
11	8	www.uj.ac.za	3720	2310	0.62	688	239	0.35
12	9	www.nmmu.ac.za	1570	1910	1.22	47700	61	0.00
13	10	www.usiu.ac.ke	901	922	1.02	460	78	0.17
14	11	www.univen.ac.za	283	552	1.95	334	72	0.22
15	12	www.cut.ac.za	783	735	0.94	553	85	0.15
16	13	www.ku.ac.ke	408	647	1.59	441	71	0.16
17	14	www.unorth.ac.za	3140	2400	0.76	176	46	0.26
18	15	www.mu.ac.ke	1350	1050	0.78	532	63	0.12
19	15	www.tut.ac.za	1270	857	0.67	13500	284	0.02
20	16	www.uonbi.ac.ke	3620	1300	0.36	13900	125	0.01
21	16	www.cput.ac.za	640	531	0.83	202	80	0.40
22	17	www.dit.ac.za	2130	1070	0.50	163	56	0.34
23	18	www.uzulu.ac.za	5700	1300	0.23	334	53	0.16
24	18	www.vut.ac.za	97	267	2.75	9530	66	0.01
25	19	www.egerton.ac.ke	609	659	1.08	329	49	0.15
26	20	www.jkuat.ac.ke	316	392	1.24	150	48	0.32
27	21	www.wsu.ac.za	112	305	2.72	126	19	0.15
28	22	www.cuea.edu	97	261	2.69	94	18	0.19
29	23	www.anu.ac.ke	118	180	1.53	99	17	0.17
30	24	www.strathmore.ac.ke	220	447	2.03	54	4	0.07
31	25	www.kabarak.ac.ke	120	186	1.55	155	4	0.03
32	26	www.daystar.ac.ke	14	47	3.36	109	11	0.10
33	27	www.maseno.ac.ke	1	12	12.00	91	6	0.07
34	28	www.scott.ac.ke	51	69	1.35	40	6	0.15
35	29	www.kemu.ac.ke	98	56	0.57	118	20	0.17
36	30	www.kwust.ac.ke	36	48	1.33	44	5	0.11
37	31	www.ueab.ac.ke	61	46	0.75	56	8	0.14
TOTAL			**1164906**	**715459**	**0.61**	**850878**	**9300**	**0.01**

Notes

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