

ITI as Enabler of Knowledge Management: Empirical Perspective from Research Organisations in sub-Saharan Africa

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Abstract

Information technology infrastructure (ITI) is said to play a significant role in knowledge management (KM) efforts. Yet, there is little research that focuses on how availability and use of IT infrastructure enable or constrain KM efforts. To explore this, we conducted an empirical study in six research organisations in sub-Saharan Africa. We compared the availability of IT infrastructure and its use in each of these organisations with their knowledge management efforts. Our results show that in four of the research institutes there is a clear relationship between KM efforts and ITI capabilities. However, in one organisation, a high level of IT infrastructure capability was not accompanied by high performance in KM efforts. Another organisation did well in KM at an instance of low IT infrastructure capability. In these two cases, closer inspection confirmed that IT infrastructure needs not only to be available, but also understood, accepted, and in proper use before it can play its enabling role in KM efforts.

1. Introduction

The balance between knowledge and other resources of production has shifted so far towards the former that knowledge has become perhaps the most important factor determining the standard of living, more than land, tools, or labour [16][25]. Knowledge is increasingly becoming the driving force of economic growth, social development, and job creation [22]. The growing demand for knowledge-based products and services is changing the structure of global economy; thus the role of knowledge is becoming an important management issue all over [9]. As a result, many organisations are exploring the field of *knowledge management* (KM) for new approaches to achieving and sustaining competitive advantage [11].

The American Productivity and Quality Center [1] has defined knowledge management to be “a conscious strategy of getting the right knowledge to the right people at the right time and helping people share and put information into action in ways that strive to improve

organizational performance.” Knowledge management is a complex process that is supported by a strong foundation of enablers, such as strategy and leadership, culture, measurement, and technology. Each of these should be designed and managed in alignment with the others and in support of the KM process [2]. KM has been recognised as continued interaction between technologies, techniques and people [3].

While knowledge has always been important in organisations, it is becoming more manageable because of the interaction with information and communication technologies, seen to be the primary enablers of KM [2][9]. Taken together, as an *information technology infrastructure* (IT infrastructure or ITI); they are a means for an organisation to extend their knowledge resources beyond the limitations of here and now [6]. Junnarkar and Brown [15] discussed the role of information technology in KM as a mechanism to facilitate knowledge creation and transfer. Our focus is on this KM-ITI relationship, and on how availability and use of IT infrastructure enables or constrains KM efforts.

Even though the KM-ITI relationship is our primary focus, we do not want to disregard the other enablers of KM. Technology on its own cannot make knowledge management happen [12]. We have sought a balanced view of the complexities that affect KM by using the Leavitt Diamond [18] to position technology in strong relationships to the tasks carried out, to the people participating in this, and to the organisation of the tasks and the people, i.e., the organisational structure. This having said, we nevertheless concentrated on the ITI in our study to enable us to have in-depth understanding of its role in KM in an environment with minimal technology, and with people who have had little exposure to it.

It is rather not surprising that majority of the success cases of KM implementation in organisations in the Western industrialised countries have to do with technology [2][9][15][17], although they always quickly try to add that technology alone cannot deliver KM. Dan Holthouse in his foreword to *Information technology for Knowledge management* [4] remarked on this: “*Technology is the easier piece of the problem to solve, it’s far*

more challenging to change people's behaviour and to create a learning environment that fosters the expansion of individual's personal knowledge." His assertion is based on the availability and pervasive use of IT infrastructure in organisations in the West.

Where technology is not readily available and mastered, it becomes a more important enabler and a major factor for the success of knowledge management efforts. If you don't have it, it becomes important. This is also the case of research institutions – and most of the other organisations – in sub-Saharan Africa. Nevertheless, we believe that IT infrastructure cannot replace people, but it can enable people to be more productive and efficient, as well as automate lower level activities, thereby enabling people to direct their skills at higher level value added activities [8].

Research organisations provide fruitful arenas for KM-related research due to the intensity of knowledge work that is involved. In Africa, research organisations form the bedrock of policy design and implementation, directly affecting the lives of millions of people. These organisations need effective knowledge management to be productive, responsive, competent, and innovative in order to win highly competitive grants to carry out their research. They are under growing pressure to raise quality and reduce costs, and hence the methods and technologies that could support knowledge management are increasingly gaining their interest [20][21]. IT has only recently – with the affordable personal computers – been widely exploited in them [13][14].

To explore the KM-ITI relationship, we conducted an empirical study in six research organisations in sub-Saharan Africa [23]. More specifically, we wanted to explore the relationship in knowledge-intensive research organisations, in circumstances where use of technology might be more problematic than in the affluent Western industrialised countries [21]. This article presents the preliminary results of our study.

2. Research methods

The relationship between IT infrastructure and KM was studied through an exploratory multiple-case study and analysis of six different research organisations. Yin [27] observed that the triangulation of multiple sources of evidence permits convergence and corroboration of findings and building a stronger, more convincing basis for conclusions. While the conduct of a multiple-case study can require extensive resources and time, the evidence is often considered more compelling than from a single case, and the study can be regarded more robust.

We carried out our study in two countries in sub-Saharan Africa, in Nigeria and in The Gambia. Even though the whole region is characterised by low infrastructure, these countries have different levels of IT.

For example, in telecommunications, The Gambia has a significantly higher penetration [26]. We assumed there would be differences also in organisational infrastructures between the countries.

Of the six organisations, three are international: International Institute of Tropical Agriculture (IITA), Medical Research Council Laboratories (MRC), and International Trypanotolerance Center (ITC). Three are national: National Agricultural Research Institute (NARI), Nigeria Institute of Social Economic Research (NISER) and Nigerian Institute of Medical Research (NIMR). The national organisations are mainly dependent on the national government for their basic funding. Usually the international organisations have a substantial number of expatriates working in them for the duration of their project. Three of the organisations are large, with more than 500 staff. The smaller three have 100-200 members of staff. All of the organisations carry out their research within several sites. Also, all of them have in-country and international collaboration with other institutions. Thus they all work in a wide network of sponsors, customers, and cooperating institutions. More information on the organisations is given in a table in the Appendix.

The study used several methods of data gathering: the two main questionnaires were the KM diagnostic and the ITI services assessment instrument. These were complemented with semi-structured interviews and short time on-site observations. Organisational documents and presentations by senior management about their KM-related initiatives were collected and analysed. A similar approach in data gathering has been applied in a study on the relationship between IT infrastructure and Business Process Re-engineering [6].

Between January and March 2001, AO visited all the six organisations. The visits lasted for about two weeks each. Some of the research sites of each organisation were visited and as many as possible of the relevant people were interviewed, especially the heads of sections, the IT managers and the librarians, to fill out the questionnaires and to provide the documents. Individual researchers provided valuable insight into the actual work processes (see Appendix for informants). A total of 48 people participated in the research, 29 of them were interviewed and did the questionnaire, 8 did the questionnaire only and 11 were interviewed only. The interviews were recorded on audiotape and in a field diary and later transcribed. As the visits were brief and as all instruments had to be filled out with the researcher present, the time was only sufficient for observation of some KM practices.

3. Knowledge management evaluation

KM was evaluated using the knowledge management diagnostic (KMD) created by Bukowitz and Williams [7]. This diagnostic enables us to know of the KM efforts of

an organisation also when these efforts are not called 'knowledge management'. The seven processes assessed include the basic steps of daily information gathering in the organisations (GET), using knowledge to create value (USE), learning from the value created (LEARN), making the knowledge available for others to use when they encounter similar problems (CONTRIBUTE), assessment of existing knowledge assets (ASSESS), and a comparison of those assets with future needs. We either need to build and sustain the knowledge base (SUSTAIN) or get rid of unnecessary knowledge (DIVEST).

Each of the seven sections has 20 statements; in total there are 140 statements. The respondents were asked whether a given statement is strongly, moderately, or weakly descriptive of her or his organisation. The sections

are listed in Table 1 with examples of statements from each one.

A problem with this diagnostic is – not surprisingly – its orientation to U.S. working life and KM enablers. There is an assumption that all organisations have a reasonable level of IT infrastructure, which now could not be taken for granted. Some statements were not directly applicable in research and other non-profit organisations. Nevertheless, it is one of the available comprehensive instruments to assess the knowledge management process. To maintain comparability with original and to enable us have an empirical basis for future modification, we did not modify the instrument itself for this study but complemented it with on-site observations and interviews of the key people, enabling us to record also some local KM practices.

Table 1. Sections of KMD (Bukowitz and Williams 1999)

Section	Examples of statements
GET Daily gathering of information in organisations	<i>"Communities of specialists are easy to identify, making it clear to others in the organisation where to go for specific information." "We distinguish between information that should be centrally controlled and information that anyone should be free to document and share."</i>
USE Using knowledge to create value	<i>"We give all promising ideas thorough consideration, no matter who they come from." "We frequently partner with other organisations/individuals to improve the value we deliver in our programmes."</i>
LEARN Learning from value created	<i>"When we have a big success, we talk together about what we did right." "We try to ensure that people have some overlapping responsibilities, so that it is easier to learn from one another."</i>
CONTRIBUTE Making the knowledge available to others to use	<i>"People would say that sharing knowledge does not diminish the individual's value to the organisation." "We link people across traditional organisational units and functional groups to promote knowledge sharing."</i>
ASSESS Assessment of existing knowledge asset	<i>"Senior management assesses what knowledge needs to be developed when it allocates resources." "We have mapped the process flow of knowledge management activities."</i>
SUSTAIN Building and sustaining a knowledge base	<i>"People know when it is not appropriate to share knowledge externally." "Our IT systems connect us to information sources we need to do our work." "We routinely ask ourselves how we can leverage our knowledge into other areas."</i>
DIVEST Getting rid of unnecessary knowledge	<i>"When a new opportunity arises, we first try to retool our existing skills before we hire a lot of new people." "We outsource skills and expertise that do not support our core competencies."</i>

The assessment (see Table 2) revealed that the research organisations generally performed well in their efforts in creating, finding and collecting internal knowledge and best practices (GET and LEARN). They averaged in sharing and understanding those practises (USE and CONTR) and were weak in adapting and applying the practises to new situations (ASSESS and DIVEST).

The more strongly the statements in the section are descriptive of the organisation, the higher is the score. Maximum score is 100. The highest score was received by IITA for information gathering (GET), but it was only average in assessing and divesting knowledge (ASSESS and DIVEST). The lowest score was won by NIMR in

getting rid of obsolete knowledge (DIVEST). However, NIMR fared well in getting knowledge (GET) and learning (LEARN). NARI's performance was similar to IITA, with the highest score from getting knowledge process combined with the lowest score in divesting process. MRC and NISER showed a similar pattern in most of the processes. Thus there appears to be many similarities in these organisations.

The ranking of the organisations by their average score is also in Table 2. IITA had the best overall performance in the assessment, while ITC, NISER and NARI were in the same range. NIMR and MRC were at the end of the assessment scale. If we compare countries, the average for

which is an international organisation, had fewer ITI services than, for example, NISER, a national organisation. Even though national research organisations tend to have less funds than international ones, this appears to influence their ITI in no straightforward way.

Contrary to our expectations, there were no major differences between the two countries. Even though Nigerian national infrastructures have problems (e.g., electricity failures), the Nigerian organisations IITA, NISER and NIMR show the whole range of services provided, being first, third and fifth in the ranking, respectively. One reason might be that IITA is well resourced enough to bypass the national infrastructure.

For example, they broadcast directly via their own satellite.

All the organisations, except ITC, have a computer department with two to ten persons. The expatriate heads of the IT units are generally more experienced and exposed to relevant modern technologies due to their training and access to Western market. This appears to have influence on the performance of the units and adoption of technologies. All organisations use outsourcing partners for some services, with ITC solely dependent on vendors (Table 3).

Table 3. Nature of IT management and IT Infrastructure capability

Name	IT Unit	Status of the Head	Outsourced services	Staff No.	Est. IT expenditure IT per year	ITI services ranking
MRC	Yes	Expatriate	Some	7	USD 142 000	2
NARI	Yes	Local	Some	2	Not known	5
ITC	No	N/A	All	N/A	Not known	4
IITA	Yes	Expatriate	Some	10	USD 200 000	1
NISER	Yes	Local	Some	8	USD 8 900	3
NIMR	Yes	Local	Some	4	Not known	5

5. IT infrastructure as enabler of KM

The availability of IT infrastructure and its use in each of these organisations is next compared to the knowledge management efforts, highlighting the relationships that exist between them (see Table 4). We sought to find out how the availability of the IT infrastructure has enabled or constrained managing knowledge.

Table 4. Ranking of KM and IT infrastructure capability by organisation

	MRC	NARI	ITC	IITA	NISER	NIMR
ITI capabilities	2	5	4	1	3	5
KM efforts	5	4	2	1	3	6

Four of the organisations appear to correspond to our expectations: In NARI in The Gambia and in all Nigerian organisations, the ranking in IT is similar to ranking in KM. The exceptions to this are MRC and ITC in The Gambia. In MRC, they had plenty of ITI services, yet in their KM efforts, they ranked only fifth. In ITC, the situation was the opposite. ITC had not invested much in ITI services, but they ranked second in their KM efforts. We will next discuss these findings in pairs. The first pair is IITA and NISER, the first international and national organisations. The second pair is NIMR and NARI, two national organisations, who did not fare well in either KM or ITI rankings. The third pair is the one with the

unexpected outcomes, MRC and ITC, both international organisations.

5.1. IITA and NISER

The infrastructure capability at IITA is very high, with 19 of the 23 services available. They have a well-developed computer section with highly qualified personnel. They do not have any problems in acquisition and procurement of hardware and software required in their unit.

“.....There is no difficulty at all, because IITA funds are in dollar, so we can easily get whatever we want to get from abroad in hard currency.....so we have no problems in procuring whatever IT we have.” (Library staff, IITA)

In IITA, the presence of organisation-wide local area network assisted in the process of getting required knowledge for the people and easy communication. It facilitated building of knowledge repositories and giving access to new knowledge. Every scientist has an email account and unrestricted access to the Internet. The library information system is considered adequate. The availability of infrastructure appears to reduce reinvention of the wheel and duplication of efforts. There is no organisation-wide research database management system. This and an adequate information and knowledge management strategy are being worked on currently.

NISER has a reasonable level of infrastructure, which is put into proper usage, with 12 of the 23 services available. The head of computer section estimated an average spending to be about 5 million Naira in the last five years (about USD 8900 per year). The difficulty in getting adequate funds required for IT services is echoed during the our discussion

".....No, there is little funding. ... Government does not seem to have it as a policy that IT should be provided for research. So it is from the meagre budget that the organisation tries to squeeze out some funds to buy one or two PCs each year, it is not adequate enough for growth." (Computer staff, NISER)

He also talked about the low availability of IT infrastructure and their inability to meet the needs of the researchers. This is aggravated by inadequate IT skills of the researchers.

They have a dial-up connection to the Internet through a local Internet service provider (ISP). NISER does have a web page and each staff member has access to email services at a cost. Although they recognised the importance of Internet, the restricted access puts limitation on its full capability in delivering knowledge from diverse sources.

"...You have to pay 200 Naira (~\$2) for 15 minutes of browsing, some of them use it only when it is very important and critical." (Computer staff, NISER)

In NISER, the efforts of the researchers to share their knowledge are constrained by lack of organisation-wide local area network and adequate information systems to work on it. The dissemination of explicit, factual knowledge within the organisation was not facilitated by appropriate databases.

The ranking of IITA and NISER in both KM process assessment and their IT infrastructure capability tallied and reflects the way they have been able to apply the available IT infrastructure in supporting their knowledge management efforts.

5.2. NIMR and NARI

Both NARI and NIMR had available only 7 of the 23 IT services. Similarly to IITA and NISER, there was a correspondence between KM and IT, with KM efforts also ranking low, being 4th and 6th, respectively. NARI and NIMR are both national organisations, NARI is in The Gambia and NIMR in Nigeria. With low funding, they are directly influenced by whatever problems there may be in electricity, telephone and mail in their countries.

NIMR has a computer unit which is not well staffed and developed. The little equipment they have is obsolete.

".....We have a problem, most of the computers that we have, they are very old and you find out that the capacity is quite low. ... We have a problem of trying to convince them that we need a bigger computer that we can have most of the current programmes" (Computer staff, NIMR)

The insufficient hardware and software is affecting the speed of their knowledge production and limiting what could be accomplished within given period. Also, the few IT support persons could be better trained. The few available IT services have not been fully utilised due to low IT skill level.

"... I want to learn computer, I have a computer but I haven't learned it." (Research scientist, NIMR)

"...You'll find out that ... just a handful of them are computer literate ..." (Computer staff, NIMR)

NIMR have a dial-up connection to the Internet through the ISP, but with persistent connection problems. There is only one telephone line available for researchers, but most of the time it is not functioning. Nevertheless, Internet access is facilitating new ways of getting grants information and various opportunities to network with their colleagues abroad. They are able to utilise their connection to MEDLINE to bridge lack of access to most printed journals.

Like in other national organisations, the major problem in NARI has to do with funding and lack of expertise to provide the required services. It is difficult to estimate the spending on IT since no proper record is kept. There is no local area network due to high initial cost, though its importance is recognised, as the initial cost associated with it is putting barrier on this.

"I would have love to, instead of buying 16 or 17 printers, one each per computer, to have two per block so that everybody can share this thing. Instead of having over 14 email accounts, we have one on the server and everyone has their own password and own account. ... Not because we don't want to do it or not see the advantage but due to cost implication." (DG, NARI)

Nevertheless, majority of the researchers have access to computers and of recent, to the Internet. Lack of awareness, training and willingness to use IT infrastructure that plagues other organisations is also a problem at NARI.

".....They are all sitting at the computer trying to do something. Some of them don't have the time to use the computer; they call the secretary to come and use the computer to write their memo for them. And also, it is age difference issue; some of the older guys want the secretary to do their typing for them. Some of the younger guys want to do it themselves. Then we have the secretarial cadre

that some of them are good and the rest are terrible.”(DG, NARI)

There is even lack of adequate information systems to support basic work processes, one executive officer at NARI expressed his view during our discussion.

“... I think they are very critical for the life of the organisation like ours, we are not in the business of making money, we get grants, we get subvention. We have to be judicious about how we spend our funds ... you cannot make a decision on the spot because you don't have that information.” (DG, NARI)

The telecommunication system at NARI is not efficient. Phone calls can only be made via the exchange, which doesn't function most of the time. No other technologies that could support knowledge management were observed at NARI.

5.3. MRC and ITC

At MRC and ITC, the KM–IT relationship is different from the other four organisations. MRC ranked high in ITI services, but low in KM. ITC ranked high in KM, but low in ITI. These unexpected outcomes are looked at in more depth next.

MRC have 16 of the 23 services assessed. In principle, they have a well-developed computer unit, managed by expatriate and other trained personnel. They have good ITI, including a full connection to the Internet, which gives all the staff an unlimited, unrestricted access to email and other services on the Internet. However, during the visit to the organisation, there were problems with their local area network and Internet access. This has greatly affected their communication and work processes. The cause for these problems was seen to be in the computer unit.

“Our communications system is not great, we have Internet, and we have email links. But that is unreliable, it has been unreliable of the recent past.....” (Management staff, MRC)

“.....The computer support services here are weak. If you have problem they either don't come or they come and don't know how to solve it. They promise and then never come back so that's very poor. I think the computer staff themselves have to have a good proper training and experience to do that.” (Head of a research programme, MRC)

Two consultants from MRC headquarters were attempting to solve these problems during our data collection period in February 2001. At their end-of-visit briefing to the management, they raised the need to use proven technologies and utilise the industry standards in building a resilient network with proper security. They suggested an easily maintainable system due to lack of local support and volume of work of the IT unit.

This period, however limited, shows the vulnerability of the organisation in the face of personnel changes, scarceness of local IT management expertise, and in general in instability of the work practices. When these are combined with the lack of sustainable support and under-utilisation due to lack of adequate training, it is understandable why IT has not been used in any consistent way to support KM. Here again [19][24] we see that while the availability of IT infrastructure is important, problems with its applications and usage can significantly lower its usefulness.

ITC has a low IT infrastructure capability with 8 of the 23 services available compared to the other international organisations in the study. This unexpected outcome is a result of their IT infrastructure being entirely managed by an outsourcing vendor. ITC is small (only 122 staff total), and they do not want to spend on internal IT personnel or on a LAN.

“... if your staff strength is not high, the cost benefit is not there... We have IT support from ITS and other ISP, that is better for us, because again of critical mass, there is no point hiring a permanent staff, if no computer breaks down in a month then he sits down idle. If there is a problem, then we call our engineers.” (Senior research scientist, ITC)

In ITC, the Internet is enabling collaboration among the staff and connecting them to external sources of knowledge that used to require travelling abroad in the past. They have extended their computing infrastructure by using the Internet to exchange files even to next door. They have dialup connection to the Internet through a local ISP with email access to all the senior staff.

“..... We have to be aware every time of a new technology in our domain and the easier way is now the Internet, if the access is limited as the case is now, you are far behind the others, so if they can improve the computer systems and the Internet connection, I think a lot of things will be improved.” (Research fellow, ITC)

Even though ITC had a low number of infrastructure services, they performed well in their knowledge management efforts. They had a minimum IT infrastructure, which met their needs. They were able to concentrate on the particular infrastructure required for their work.

6. Summary and conclusions

In spite of the readiness of people to nurture knowledge culture in these organisations, the unavailability of the minimum technologies to support their efforts has a profound effect on the KM activities. The results from these organisations could be explained with the Leavitt Diamond [18]. Earlier, we emphasised

the balance of different organisational dimensions. Leavitt's Diamond (Figure 2) shows four of these: task, people (actors), technology, and structure. These four dimensions are highly interdependent, as indicated by the arrowheads, so that change in any one usually results in compensatory or retaliatory change in others.

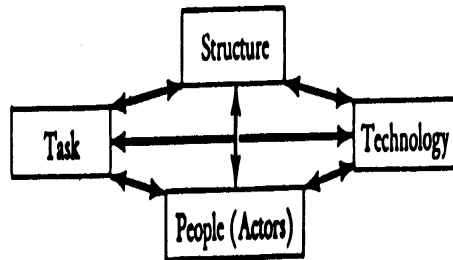


Figure 2: Leavitt's Diamond Organisation Model [18]

Of our case organisations, the *people* dimension was found to be problematic in several respects: the international, expatriate staff members tended to come and go and take their knowledge with them. This had resulted in discontinuity: knowledge could not be assessed, sustained or divested in any systematic way. The local staff members were often discouraged from ambitious projects as they were not seen able to perform beyond a certain level. They also often lacked the personal funds that the expatriates might have for supplementing the possibly meagre resources at the institutes.

The *task and structure* dimensions had to do with management – which was in some institutes better than in others – and with ability to carry out the tasks planned. Here the external circumstances had their strongest impact: if there is no electricity, no working phone, and very slow mail, work in general is slowed down. Communication between people not at the same site is greatly hampered. Visiting and sending messengers are the only possibilities, and they take time.

Technologies are considered to be tools that help organisations to get work done, and mechanisms for transforming inputs to outputs. Also in our case organisations, knowledge management was not only about managing knowledge-work processes or the people that carry out these processes; technology and organisational structure are also affected. Our findings support the views of Bhatt [3] and Duffy [10] in that only with balancing these four dimensions, it is possible to bring out the value of the knowledge management efforts in an organisation. Therefore, rather than trivialising any one of the variables, or neglecting one set (such as technology), each must be present and give equal priority for knowledge management efforts to be successful. The

performance of these organisations could be attributable to their inability to balance all these dimensions.

After this overall analysis, we now summarise our findings on the KM-ITI relationship in more detail. In the analysis of the six organisations, we found some key ITI services that appeared to be essential in knowledge management efforts. Where they are already present, they enable the efforts and they become a constraint where they are absent. The tools and technologies identified in the case institutes include: Connectivity/Network (Internet, LAN, Portals, search engines), Collaboration technology (Groupware), Data Warehousing (Research database management system), Enterprise Information System (e.g. library information system), and Enterprise Application Integration Software. It should be noted that technology that can enable KM efforts is not limited to those above, where we specifically listed those that directly emerged from the study and that are relevant in the context of sub-Saharan organisations. Application of sophisticated technologies might not be feasible as there are even problems with sufficient support for the few basic, essential ones required for the KM efforts.

The low availability and utilisation of IT infrastructure in sub-Saharan Africa with lack of expertise to support the infrastructure has been well written about (e.g., [20][21]). According to our study, while the availability of IT infrastructure has the expected significant effect on the knowledge management efforts, its under-utilisation and lack of technical expertise to support its proper application to the knowledge management processes becomes even a bigger problem.

IT infrastructure was found to assist in the process of getting required knowledge and enabling easy communication among the researchers. It simplifies the process of building knowledge repositories and reduces the reinvention of the wheel and duplication of efforts. The availability of IT infrastructure enhances dissemination of explicit factual knowledge and sharing of best practices effectively. In the organisations with high availability of IT infrastructure, it speeds up the process of knowledge production and assists in the process of building organisational memory with the help of an organisation-wide research database management system.

Even though Gambia and Nigeria are different in terms of economy, political and social life, and infrastructures, the outcome of the KM-ITI relationship at the organisation level appear not to be affected by these differences. In spite of the better telecommunications infrastructure in The Gambia, the organisations located there still do not have any comparative advantage over those in Nigeria. The only visible difference is in the availability of personnel which seems to be better in Nigeria, although without much impact on knowledge management efforts, probably due to lack of adequate

expertise. In scope and size, the six organisations are representative of the sub-region and we can expect other research institutions there to have a similar relationship between KM and ITI. For other developing countries, a similar study is recommended.

We have discussed our findings on how IT infrastructure can enable and constrain KM efforts in research organisations in sub-Saharan Africa. Overall, organisations with reasonable level of IT infrastructure performed well in their knowledge management efforts with high potential for improvement while organisations with low IT infrastructure did not do well. Two exceptions to this consistency were found. In one of them, high level of ITI existed with low level of KM. This organisation needs to be studied further to find out their specific deterrents to efficient KM. In one organisation, high level of KM existed despite low level of ITI. This could be explained by their strong focus on organizational efficiency and on research, leaving the IT of the small organisation to be taken care of by an outside vendor. Taken together, these two organisations confirm that IT infrastructure needs not only to be available, but also understood, accepted, and in proper use before it can play its enabling role in KM efforts [19][24].

7. References

- [1] American Productivity and Quality Center (APQC), Knowledge Management: Consortium Benchmarking Study Final Report 1996 Available from <http://www.store.apqc.org/reports/Summary/know-mng.pdf> [Accessed April 3rd, 2000]
- [2] American Productivity and Quality Center (APQC), Using Information Technology to Support Knowledge Management: Consortium Benchmarking Study Final Report 1997, Available from <http://www.store.apqc.org/reports/Summary/KMIT-sum.pdf> [Accessed April 3rd, 2000]
- [3] Bhatt G., Knowledge Management in Organisations: Examining the interaction between technologies, techniques, and people. *Journal of Knowledge Management*, Vol. 5 No. 1 2001
- [4] Borghoff U. and Pareschi R (Eds.), *Information Technology for Knowledge Management* Springer 1998.
- [5] Broadbent M. and Weill P., Management by Maxim: How business and IT managers can create IT Infrastructures, *Sloan Management Review*, spring 1997
- [6] Broadbent M., Weill P., St. Clair D., The Implications of Information Technology Infrastructure for Business Process Redesign, *MIS Quarterly* 1999 Vol 23 pp159-182
- [7] Bukowitz W. R. and Williams R. L. *The Knowledge Management Fieldbook*, Pearson: London, 1999.
- [8] Daniel I., Axelsen M., Tucek G., and Sharma R., Knowledge Management: Using Computer Technology. *Australian CPA* Vol 69 Issue 7 1999. pp 24-27
- [9] Davenport T. and Prusak, L. *Working Knowledge: How organizations manage what they know*. Harvard Business School Press: Cambridge, MA, 1998.
- [10] Duffy Jan, The tools and technologies needed for knowledge management, *Information Management Journal*, Vol. 35 Issue 1 2001, pp 64-67
- [11] Dzinkowski R., The Measurement and Management of Intellectual Capital: An Introduction. *Management Accounting*, Feb 2000 Vol. 78 pp 32-36
- [12] Hibbard J., Knowing what we know. *InformationWeek*. Oct 20, 1997 pp. 46-64
- [13] Jensen M., The Status of African Information Infrastructure Economic Commission for Africa 1999 Available at www.uneca.org/adf99/codipap1.htm [Accessed August 8th 2001]
- [14] Jensen M., The African Internet – A Status Report 2001 Available from www3.sn.apc.org/africa/afstat.htm [Accessed July 29th 2001]
- [15] Junnarkar B., Brown C., Re-assessing the enabling role of information technology in KM. *Journal of Knowledge Management* Dec 1997 Vol 1 Number 2 pp 142-148
- [16] KPMG Management Consulting, Knowledge Management Research Report, 1998. Available from <http://www.kpmg.co.uk/uk/services/manage/research/knowmgm/index.html> [Accessed August 10th, 1999]
- [17] Lai H. and Chu T., Knowledge Management: A Theoretical Frameworks and Industrial Cases, HICSS-33, 2000
- [18] Leavitt H.J., Applied organisational change in industry: Structural, technological, and humanistic approaches, in March J. (ed), *Handbook of Organisations*, Rand McNally & Co. Chicago 1965, pp.1144-1170, 1965
- [19] McDermott R., Why information technology inspired but cannot deliver knowledge management. *California Management Review* Vol 41 summer 1999 pp 103-114
- [20] Moyo, L. M., Information technology strategies for Africa's survival in the twenty-first century: IT all pervasive. *Information Technology for Development*; Mar 1996 Vol 7 pp17-
- [21] Odedra M., Lawrie M., Bennett M., and Goodman S., International Perspectives: Sub-Saharan Africa: A Technological Desert, *Communications of the ACM*, Feb. 1993
- [22] OECD World, Knowledge Economy January 2001, Available from <http://www.oecdworld.org/news/sectionfront.php/section/31> [Accessed May 19th, 2001]
- [23] Okunoye, A., Karsten, H. Information Technology Infrastructure and Knowledge Management in sub-Saharan Africa: Research in Progress. *GITM Conference*, June 10-12, 2001 in Dallas, TX, USA. 2001
- [24] Robey D. and Sahay S., Transforming Work Through Information Technology: A Comparative Case Study of Geographic Information Systems in County Government, *Information Systems Research*, Vol. 7, No 1 1996
- [25] The World Bank Group, World Bank Report 1998/99: Knowledge for Development 1999a Available from http://www.worldbank.org/ks/html/pubs_pres.html [Accessed April 3rd 2000]
- [26] The World Bank Group, Data and Map, Available from <http://www.worldbank.org/data/databytopic/databytopic.html#INFRASTRUCTURE>, 1999b [Accessed April 3rd 2000]
- [27] Yin R. K., *Case Study Research: Design and Methods*, 2nd ed. Sage Publications: Newbury Park, CA. 1994.

Appendix:

The six organisations studied

Name of the Institute/Homepage	Areas of Research	Location/ Country	Staff/ Expatriate	Sites	National/ International	Sponsors (Some)	Informants
Medical Research Council (MRC) www.mrc.gm	Medical	Banjul/ The Gambia	600/ 30	Fajara, Basses, Farafenni, Keneba, Bansang, Walikunda	International	MRC/DFID, IARC, EU, WHO, IARC, Glaxo - Welcome SKB, and others donors	Researchers (2) Programme leaders (2) Library personnel (1) IT personnel (2) Management staff (3)
National Agricultural Research Institute (NARI) www.narigambia.org	Agri-cultural	Brikama/ The Gambia	211/0	Brikama, Sapu and Yundum	National	Government of The Gambia and international donors	Researchers (5) Programme leaders (3) Library personnel (2) IT personnel (1) Management staff (2)
International Trypanotolerance Center (ITC) www.itc.gm	Agri-cultural	Banjul/ The Gambia	122 / 22	Banjul, Bansang Keneba	International	The Gambia, EU, ADB, IDB, IDRC, USAID, FAO, World Bank, IAEA, IFS, foreign governments	Researchers (3) Programme leaders (1)
International Institute of Tropical Agriculture (IITA) www.iita.org	Agri-cultural	Ibadan/ Nigeria	1400 / 100	Ibadan, Onne, Kano, Cotonou, Kampala, Cameroun	International	World Bank, FAO, UNDP, national and private donors	Researchers (1) Library personnel (1) IT personnel (1) Management staff (1)
Nigeria Institute of Social Economic Research (NISER) www.niser.org	Social Economic	Ibadan/ Nigeria	500/0	Ojo Road, UI Campus	National	Federal government of Nigeria and other donors	Researchers (4) Programme leader (2) Library personnel (1) IT personnel (1)
Nigeria Institute of Medical Research (NIMR) http://www.homestead.com/nimr_ng/	Medical	Lagos/ Nigeria	130/0	Yaba, Lagos	National	Federal government of Nigeria and other donors	Researchers (5) Programme leaders (2) Library personnel (1) IT personnel (1)