ICT Investment in Rwandan Higher Education: Highlighting the Cost of Downtime and End-Users' Operations

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Based on the Total Cost of Ownership (TCO) model, this study inquired into the captured expenditure of selected Rwandan higher education institutions on the major cost components associated with owning computer networks—hardware, software, retrofitting, operations and administration, end-user operations and downtime. The findings were that overriding attention is put on hardware acquisition, retrofitting and emoluments and that the costs of downtime and end-users' operations are not captured by the institutions. Nonetheless, the study finds that, even then, the quality and quantity of ICT ware and user support are still very low and that, consequent upon downtime and end-users' operations, the institutions incur a cost equivalent to 26% of their total ICT investment. It is, therefore, concluded that even though efforts to increase the quantity and quality of ICT facilities and personnel are still relevant, they must be complemented by a focus on the functionality of these resources. Hence, it is recommended that the managers of these institutions acknowledge the cost of downtime and end-users' operations; identify the causes of downtime in their institutions; and measure the ICT proficiency of the members of their institutions to inform the elimination of downtime and the design and implementation of end-user training programmes respectively.

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Introduction

The rapid evolution of information communication technologies (ICTs) over the last 40 years has, unequivocally, been beneficial in many areas of life (Omwenga & Rodrigues, 2006; Balit et al., 2004; Kasigwa et al., 2006). Museveni (2006), for example, observes that ICTs provide people with the means to break down the walls of division and the barriers of isolation by putting information and equipment, as well as opportunities for advancement, directly into their hands. Nevertheless, this technological advancement brought with it various challenges, creating need for innovative management of these technologies. One of these challenges is that of tracking the costs, direct and indirect, involved in acquiring, utilizing and maintaining ICT equipment.

Tertiary education institutions have not been immune to this challenge. Convinced that, if wisely incorporated into their work, ICTs might improve their management and service delivery, these institutions are devoting more and more resources to their acquisition, networking, utilization and maintenance (Muzaki & Mugisa, 2006; Czerniewicz & Carr, 2005; Kistan, 2005; Damonse, 2003). According to Zhao (2003), for instance, information technology has become an important tool in the development of higher education—through providing an innovative, efficient and effective means of generating, processing, disseminating and accessing information (Bisaso,

resistance to change and inadequate skilled personnel among other barriers to the implementation of online-learning.

Consequently, while these institutions often succeed in acquiring computers, which are a central component of ICT systems, they commonly lack the resources needed for the acquisition of relevant hard and software accessories; train staff to utilize the procured ICT facilities; service and upgrade the facilities acquired and replace them when they become obsolete; and meet recurrent costs of electricity and network subscriptions. No doubt, this has been consequent upon under facilitation, which has been aggravated by lack of awareness about the total cost of owning *functional* computer networks, consequent upon which many institutional managers, as well as governments and donors, consider investment in ICTs to be a one-off expenditure on the procurement of computers and do not prioritize the meeting of the recurrent cost of owning these networks (Ddembe & Baryamureeba, 2006)—since they would rather expend their meagre resources on costs like emoluments, which they recognize as recurrent.

This is why there is reason to fear that, unless a remedy is found, investment in the acquisition and utilization of ICTs made by these institutions so far might fall short of enhancing ICT enhanced teaching, learning and research. Hence, there is need for a strategic framework within which the total cost of owning a functional computer network might be identified and articulated to pertinent higher education institutional managers and policy makers.

Gartner (2003) presents a comprehensive total cost of owning a computer network model in which seven cost components were identified. They are: hardware acquisition; software acquisition; physical site retrofitting; operations and user support; administration and professional development; end-users' operations and downtime. In another total cost of ownership model, the Consortium for School Networks (2003) identifies the opportunity cost of end-users' involvement in using ICTs as an indirect cost related to the ownership of computer networks in educational institutions. That way, they provide a framework, within which to identify *all* the costs that have to be met during the lifecycle of an ICT investment. On the basis of this framework, the researchers undertook to examine the expenditure of Rwandese higher education institutions towards these components—to highlight areas deserving attention.

Methodology

The study was conducted in Kigali Institute of Education (KIE), Kigali Institute of Science and Technology (KIST), and Kigali Independent University (Université Libre de Kigali or ULK) all in Kigali, Rwanda. Two questionnaires were used to collect the data. The first, which elicited data on expenses on information communication technologies over the years 2001 to 2005 was administered to finance officers of the selected universities while the second, which elicited data on computer networks was administered to ICT staff. To gain further insight into the effectiveness of these networks, end-user utilization of the networks was also observed and their satisfaction with the networks surveyed. For ease of comparison, the expenditures on ICTs over the five years were adjusted to be time equivalent (using the Net Present Value method) after which expenditure on each of the cost components was expressed as a percentage of the

Figure 1: Captured Expenditure on various ICT Cost Components (%)

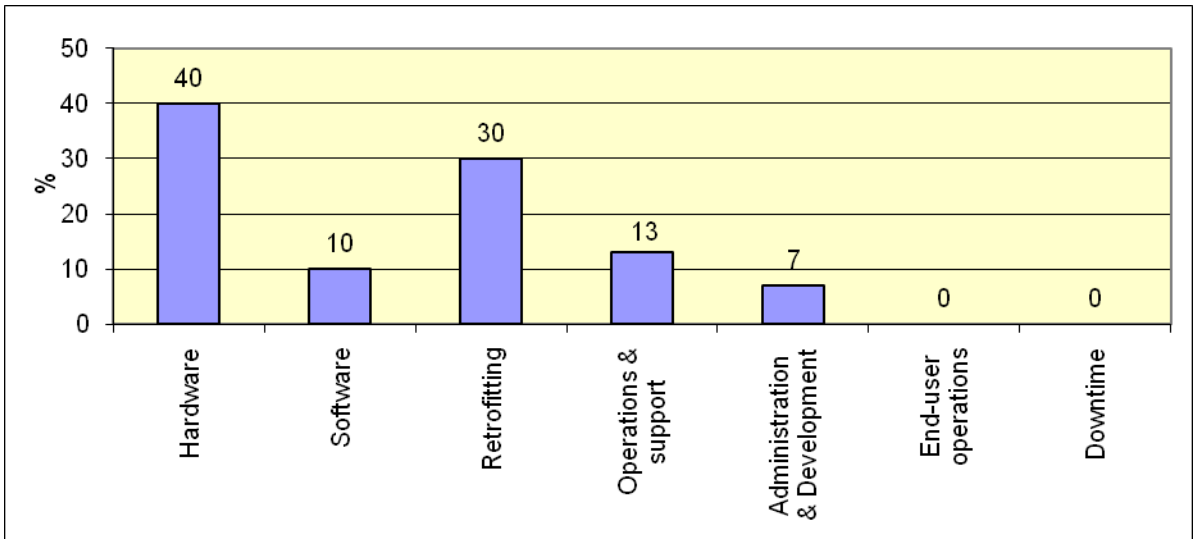

Figure 1 indicates that hardware acquisition accounted for the largest proportion of the institutions' expenditure (40%) followed by retrofitting, which involved physical structure refurbishment, (transmission and electrical) system installations and air conditioning. These were followed by operations and support—expenses on personnel, planning, and service desks. Accounting for 13% of the total cost of ownership, however, support was established at an average of one technical person per 600 users. Expenditure on software—operating systems, applications, database utilities and messaging—was also conspicuously low (10% of the total cost of ownership). Specifically, it was found that, by and large, software procurement is one-off. Lastly, administration and development, which included end-user training, accounted for 7% of the ICT budget while the opportunity cost of end-users' operations—involvement in peer support, self instruction, formal training, application development and data management; and the cost of system downtime—unavailability of the computer network resulting from outage of networks, electricity, printers and applications—on the other hand, was not captured by the institutions.

It was established that the institutions neither possessed instruments for measuring end-users' IT proficiency and trainability nor had regular end-user training programs. Subsequently, end-user survey and observation of staff productivity proxies revealed that the institutions incur a cost equivalent to 26% percent of their ICT investment in man-hours lost to information system related tasks (opportunity cost of end-users' operations) and downtime, albeit implicitly. This

suggests that IT staff do not provide sufficient support to end-users so the latter expend much of their would-be work time on information system related tasks including self training and peer thr long.r

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Nevertheless, the findings that software costs, which included expenditure on operating systems, applications, customization, database utilities and messaging; and administration and development, which included expenditure on computer network maintenance and development of end-users' capacity to utilize the network effectively, respectively accounted for 10% and 7% of the total cost of ownership are striking anomalies. This is particularly on the understanding that, the necessity of its acquisition (and, subsequent, retrofitting of structures) notwithstanding, expenditure on hardware must be accompanied with expenditure on up-to-date and, where necessary, customized software and end-users' training for a computer network to work effectively. The Education Week (1998), for instance, recommends that expenditure on software, administration and development should account for 20 to 30% of the total ICT budget. Moreover, across four years after the base year (year of initial investment), expenditure on updating software and end-user training was expected to be increasingly more significant since software and opportunities for its customization are emerging faster than hardware products.

In accounting for these anomalies, the findings of the study hint on some explanations. It was established that, even though ICT investment expenditure is tilted in favour of hardware acquisition, there isn't enough, let alone satisfactorily qualitative, hardware in these institutions yet. The average cost of a networked computer, for example, was established at USD 1500, which is five times less than that incurred in the business sector (IDC, 1997). Several factors—including considerations that these institutions procure subsidized equipment, receive donations, (sometimes) assemble rather than procure branded equipment and utilize equipment for longer periods of time—could be cited for this gap. Reservations here, however, are that donated equipment is often weeded from the donors' institutions and longer utilization is often at the cost of obsolescence, which explains why institutional managers place overriding attention on hardware procurement. Moreover, being valued at 0% (Figure 1), it is possible that the cost of end-users' operations and downtime is indiscernible to these managers yet hardware inadequacies are conspicuous, being manifested in scrambling for access and congestion.

Similarly, even though expenditure on operations and support was relatively high, the finding that the ratio of users to technical personnel stood at a gigantic 600:1—which is several fold higher than that of 50:1 in the commercial sector where ICT utilization is more effective (Consortium of School Networks, 2001)—appears to explain why the managers of these

Recommendations

Institutional managers should address themselves to the need to eliminate computer system downtime and develop end-users' capacity to effectively utilize their computer networks. This is because downtime is synonymous with system unavailability while end-user inability to utilize ICTs results into system under- or non-utilisation let alone productivity loses, which mitigate returns to investment in ICT ware. Addressing this need will be three-dimensional: acknowledging, understanding and eliminating the cost of downtime and end-users operations. Establishing it at 26% of the total cost of owning a computer network, this study brings to the attention of higher education managers, especially those that are content with the availability of computer ware per se, the cost of downtime and end-users' operations. Subsequently, they should identify the causes of downtime and measure end-users' IT proficiency—to inform the elimination of the former and the design and implementation of pertinent end-user training.

Moreover, downtime minimization and end-users' proficiency development would maximize the system time utilisation rate whilst minimizing breakdown—arising out of system misuse—which would, in turn, diminish the need to procure hardware, spend on end-user support staff and the cost of system repair. The savings arising out of this cost-minimization strategy could be invested in system functionality enhancement, notably software procurement, upgrading and customization; and further end-user capacity development, which would minimize the opportunity cost of end-users' operations further.

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