MANAGING ICT INFRASTRUCTURE IN HIGHER EDUCATIONAL INSTITUTIONS

Sodiya, A. S.[1], Onashoga S. A.[2], Rosanwo O. D.[3], and Lawal B. H.[4]
Department Of Computer Science, University of Agriculture, Abeokuta
Sinaronke@yahoo.co.uk[1],

Abstract
Nowadays, many Higher Educational Institutions (HEIs) have implemented Information and Communication Technology (ICT) tools for enhancing academic and management activities. A study was conducted in this work to ascertain the state of ICT infrastructure in HEIs. A random sample of 15 HEIs comprising of 5 Colleges of Education, 5 Polytechnics and 5 Universities was chosen for the study. Tested and reliable questionnaire was used to capture data on how the ICT infrastructures in HEIs are maintained or managed. Out of the sample, 15 purposive respondents were selected for each institution, making a total of 125 respondents. The result of the evaluation analysis generally shows that the mean-time- to-failure of ICT tools is high. This shows that the ICT tools are not adequately maintained or managed. An Enhanced Maintenance Model for ICT Infrastructure (EMMII) is proposed in this work for improved maintenance of ICT infrastructure in HEIs. The model integrates ICT infrastructure management, security management and service management for efficient maintenance and management of ICT tools and resources. It is believed that if this model is utilized, it will lead to enhanced maintenance of ICT infrastructure in HEIs.

Keywords:- *ICT, Higher Educational Institutions, Academic, Management, Infrastructure*

Introduction

Information and Communication Technology (ICT), which is act of creating, capturing, manipulating, processing, storing and communicating information using computer hardware and software, digital electronics and modern network technology, has revolutionarised the business world. Trends across the world show a growing demand for ICT infrastructures support for educational institutions. Many of them have been running manual systems and pushing paperwork for ages. They have had cumbersome working procedures and this has led to low productivity occasioned by highly inept manual systems. Many of the Higher Educational Institutions (HEIs) have implemented many tools running on ICT infrastructure for managing their academic and management needs. For the realization of Vision 2020 objectives, the HEIs must be able to efficiently and effectively produce high quality human resources. For HEIs to realize this, the ICT infrastructure in these institutions must be well managed.

There are four key ICT infrastructure pillars:

- ICT hardware:
  These are desktop computer, laptops and ultra-mobile laptops, thin client computers, interactive whiteboard, data projectors, digital cameras, printers, scanners, etc.
- Software:
  These provide specific functionality for teaching, learning or administration .They include :
  a) Content Management Systems
  b) Learning Systems
  c) Finance and Assets Systems
  d) Staff and Student Management Systems
  e) Assessment and Reporting Systems
  The application software products in HEI can generally be accessed through network infrastructure from many different computers.
- Connectivity :
  These are infrastructures that connect the access devices in the HEI to the required tools, services and digital resources, most of which are external to the school.
  Network infrastructures component include: telecommunication (Bandwidth, Communication infrastructure such as satellite equipment, etc.) and network equipment, environmental management equipment, and other related hardware.

- And Support services:

The resources that support ICT infrastructure are:

a) people and skills
b) processes
c) externally provided services
d) financial resources.

Why are HEIs implementing ICT?

- To enhance teaching and research activities
- To facilitate communication locally and internationally
- To facilitate collaboration and interactions among institutoins, researchers and students
- There is a general demand on institutional managers to deliver high quality service education management
- There is the increased recognition of information as an important corporate resource that is key to good decision making in a competitive and ever dynamic educational institutions.

However, the main objectives of this work are:-

i. To determine the status of ICT infrastructure in HEIs
ii. To design a model for enhanced management of ICT infrastructure in HEIs
iii. To provide recommendations for improving the status and management of ICT infrastructure

RELATED WORKS

Many previous works of Brown et al. (2002), Acosta, F R. (2004), Chacha (2004), Tusubira and Mulira (2005) and Ayoo (2006) emphasized that the need for access to advanced Information and Communications Technology (ICT) infrastructure is vital to the socio-economic well-being of cities, institutions and nations in the global Knowledge-based economy.

American Public Power Association mentioned that academic institutions, municipalities and communities across North America are planning and deploying their networks, using a range of technologies including fibre, broadband-over-power-lines, and wireless, to provide citizens with internet connectivity CRACIN (2005). A recent review of telecommunications policy in Canada by Telecommunications Policy Review Panel recommended the development of "affordable and reliable" broadband connectivity to all citizens by 2010.

Sodiya et al. (2006) cited that 67% of respondents in HEIs use PC for academic research, which shows that many institutions are yet to provide computer for academic staff, 86% of respondent experience security breaches on academic data or information which signifies a major security problem for academia

Wycliff and Muwanga-Zake (2008) proposed a professional development model and suggested that IT Specialists and Administrative Assistants should be involved in ICT management .

Methodology

Survey

There has not been a previous attempt to undertake a comprehensive survey on the status of ICT infrastructures in HEIs. Increasing importance of ICT in the HEIs also justifies a need for comprehensive survey of this sector. In this study, a survey was conducted to determine the status of ICT infrastructures in some HEIs.

Method of Data Collection

The instrument for data collection was a carefully designed questionnaire that captures the needed information for determining the status of ICT infrastructures in HEIs. This was administered on the categories of respondents and was validated using test-retest method.

Scope Of the Study

A purposive sample of 15 institutions in the South-western Nigeria was chosen. The sample consisted of 5 Colleges of Education, 5 Polytechnics and 5 Universities. The respondents were 5 students, 5 administrators and 5 academic staff in each of these institutions, making a total of 125 respondents.

Data Presentation
The data was summarized using simple frequency counts.

Summary of findings
Major findings of the study are given below:
a Hardware Infrastructure:
- Office PC-Employee ratio 1.5:5
- PC-student ratio 1.3:5

b. Connectivity Infrastructure:
- 75% of HEIs are currently connected to the Internet
- 40% have LAN
- Average of 7hrs daily down time of network connectivity

c. Uses of ICT in HEIs
- Student management - 95%
- Office management - 90%
- E-portal - 55%
- Telecommunication services - 35%
- Finance and Assets Management - 65%
- Learning management - 25%
- Staff management – 30%
- Internet Access - 35%
- Strategic decision making - 15%
- Others - 5%

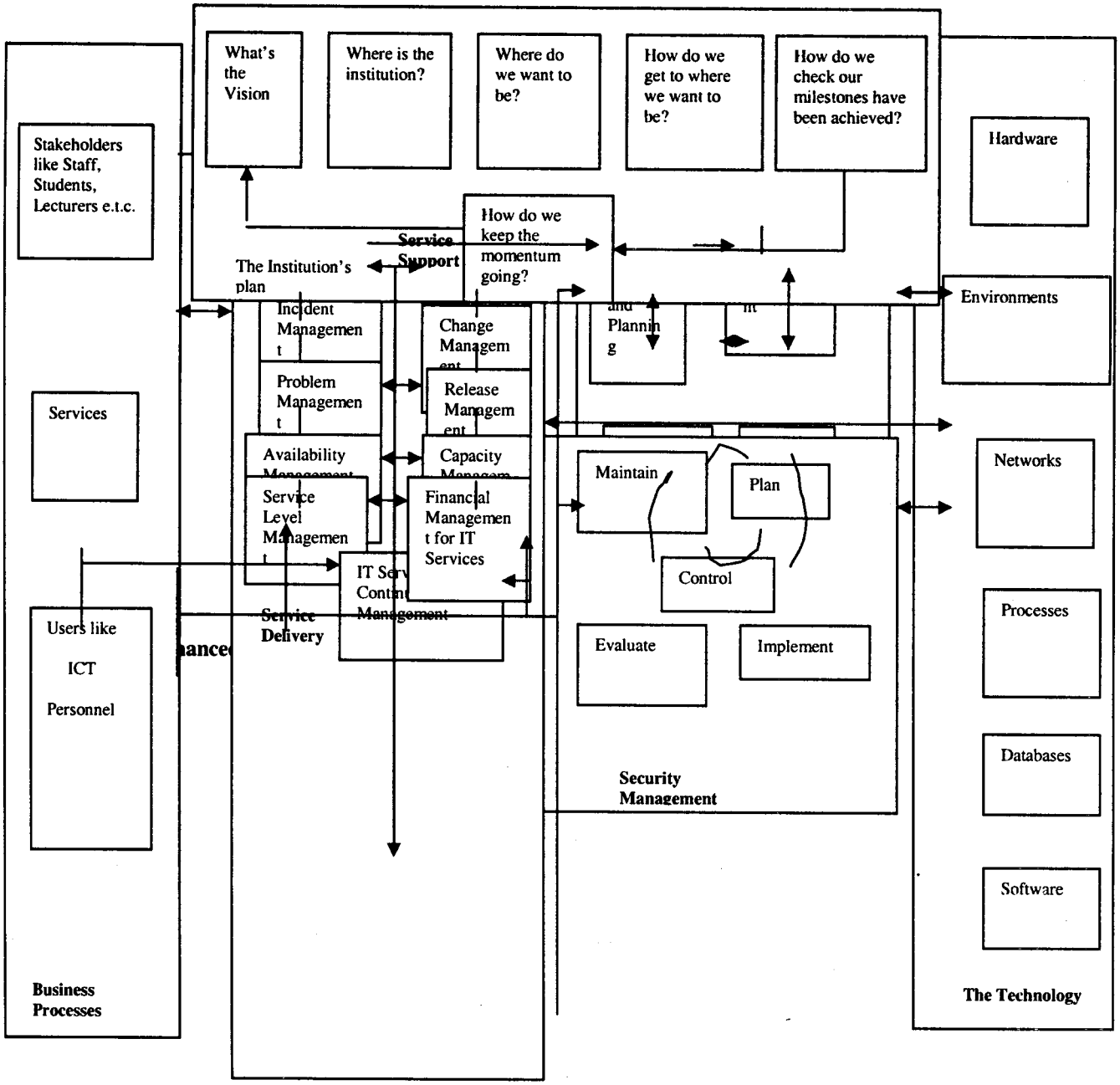
d. Access to ICT tools
- Rare - 55%
- Frequent - 30%
- Not all - 15%

e. Maintenance of ICT infrastructures
- Rare - 55%
- Frequent - 30%
- Not all - 15%

f. Training of ICT support staff
- Rare - 55%
- Frequent - 10%
- Not all - 35%

Enhanced Model for Managing ICT Infrastructure (EMMII)

EMMII provides an efficient technique for managing ICT infrastructure in HEIs. The model integrates the three components viz ICT infrastructure management, security management and service management as shown in figure 1. The model extends the models presented in Tusubira and Mulira (2005) and Wycliff and Muwanga-Zake (2008).



a. ICT Infrastructure Management

This handles the specification, procurement, setup, testing, support, operations and administration of ICT infrastructure such as server and association system, software, operating system, network operations, telecommunication, and so on. It also involves identifying the various challenges associated with other areas of ICT infrastructure management.
There are four ICT management processes:

- ICT DESIGN AND PLANNING: This is the process of developing and maintaining strategies and processes for the deployment and implementation of appropriate ICT infrastructure in an organization.
- ICT DEPLOYMENT: Entails the actual implementation and roll out of appropriate ICT infrastructure or solution as designed and planned such that there is minimum disruption to institutional processes or activities.
- ICT OPERATIONS: This is the day-to-day technical supervision of the ICT infrastructure. This process involve activities like task management, backup and restoration, network monitoring, system monitoring, database monitoring and storage monitoring.
- ICT TECHNICAL SUPPORT: This is the development of standards for the evaluation, support and proofing of all current and future ICT infrastructure.

b. ICT Service Management

Management of service provided by the ICT infrastructure can be categorized into:

- Service support
- Service Delivery

a. Service support operations include:

- SERVICE DESK: This provides a central point of contact for services of an ICT center.
- CONFIGURATION MANAGEMENT: This is the identification of all significant components within the ICT infrastructure and taking records of these in the configuration management database.
- INCIDENT MANAGEMENT: This involves setting up of mechanism for restoring normal service after the occurrence of fault or failure.
- PROBLEM MANAGEMENT: This involves setting up mechanism for improving service availability and minimizing the effect of future incidents by using lessons or experiences from past incidents.
- RELEASE MANAGEMENT: This is the process of managing the planning, development, design, building and testing of new process, system or software and the release into service.
- CHANGE MANAGEMENT: This process involves the production of approval for any proposed changes. The process goes from request to change, to scheduling, implementation and final review.
- SERVICE CATALOGUE: This is the process that list and describe the IT services provided to users

b. Service Delivery

Service Delivery is one of two disciplines that comprise ICT Service Management. It is concerned with management of long term processes. Service Delivery defines the business of IT. Through Service Delivery processes, IT can:

- Clearly define the content of services
- Clearly define the roles and responsibilities of customers (those who pay for the services), users (those who use the services) and Service Providers
- Set expectations of service quality, availability and timeliness

The components of Service Delivery are:

Service Level Management:- Service Level Management (SLM) processes provide a framework by which services are defined, levels of service required to support business processes agreed upon, Service Level Agreements (SLAs) and Operational Level Agreements (OLAs) developed to satisfy the agreements, and costs for the service developed.

Financial Management for IT Services:- Financial Management determines the costs of those services and provides financial accounting support to ensure expenditures fall within approved plans and that funds are well-spent.

Capacity Management:- This is responsible for ensuring that IT infrastructure resources are in place to satisfy planned institutional needs and that those infrastructure assets are effectively used. CM is responsible for building the annual infrastructure growth plan.

Availability Management :- Availability Management is responsible for ensuring application systems are up and available for use in accordance with the conditions of the respective Service Level Agreements (SLAs).

c. ICT SECURITY MANAGEMENT (ISM)

ICT Security Management is the process of managing a defined level of security for ICT resources and services within institutions. It includes physical security and automated access control. Physical security involves physical prevention of unauthorized access to ICT resources and automated access control involves the use of anti-virus, authentication and identification, firewalls, Intrusion Detection System (IDS), and so on.

ICT Security Management should provide a blue print or framework for information security management. Content of a good framework for security management should include:

- Security Policy: HEIs should have security policy for ensuring adequate security for ICT resources.
- Security awareness: This requires that HEIs should embark on periodic security awareness programme in order to sensitize students, lecturers and administrators on current security breaches and tools to prevent these breaches. This is necessary because of the changing nature of attackers' goals and tools.
- Assets Classification and Control: There should be assets classification and control so as to maintain appropriate protection of corporate assets and to ensure that information assets receive an appropriate level of protection.
- Personal security: This includes mechanisms for reducing risks of human errors, theft, fraud or misuse of resources and facilities.
- Physical and Environmental Security: This provides measures to prevent unauthorized access, damage and interference to premises and information, e. t. c.
- Communications and Operation Management: This includes measures to ensure correct and secure operation of information processing facilities, minimize the risk of system failure and protect integrity of systems and information.
- Access control: These are measures to control access to information, prevent unauthorized access to any information systems, ensure of network services e. t. c must be in place.

3.3 Benefits of EMMII

EMMII

- Provides a stable and secure ICT infrastructure.
- Provides a log of all operational events.
- Ensures proper maintenance of operations monitoring and management tool.
- Considers what we are doing now and how to improve.
- Views ICT as need to operate at a professional level, not just a nice to have.
- Make the institution realize the worth of all ICT assets and how they interrelate.
- Empower or motivate teams to work together and deliver better services.
- Lowers stress levels associated with management of ICT infrastructures in HEIs.

Through: ICT Security Management

- It enables and ensures that security controls are implemented and maintained to address changing circumstances like changed business and IT services requirements, IT architecture elements, threats e.t.c.
- It ensures that security incidents are managed.
- It ensures that audit results show the adequacy of security controls and measures taken.
- It enables reports to be produced to show the status of information security.

Overall, this model ensure

- Best practices are adopted for maintenance of ICT infrastructure.
- Security of operations and activities.
- The institutions have a competitive advantage with its ICT infrastructure i.e. the state of its ICT infrastructure gives her competitive advantage.
- Compliance to existing legislations.

Discussions

Recommendation

The following are the suggested recommendations:-

- The type and quality of ICT infrastructure acquired must be in line with the vision, mission and objectives of the University.
- Management of HEIs should ensure that ICT tools must be online at all time
- ICT infrastructure should be constantly and adequately maintained
- Training of ICT support staff of institutions
- Institutions should invest more in ICT infrastructure because of its importance or benefits in the educational sector and research
- Institutions should constantly update itself with current ICT techniques that are required for using and managing ICT infrastructure
- Institutions should also constantly upgrade the ICT infrastructure in order to meet changing challenges

Conclusion

An evaluation of the management of ICT infrastructure in HEIs conducted on some colleges of education, polytechnics and universities using questionnaire reveal that the down-time to failure of ICT tools is high, skilled or trained ICT support personnel are inadequate, investment in ICT infrastructure for HEIs is low, these and other reasons shows that the ICT tools are not adequately managed in HEIs.

Management of ICT infrastructure involves the tasks of design, provision, implementation, proactive maintenance, reactive services, and support and training of staff. An effective model for ICT infrastructure management in HEIs is the EMMII which integrate the various tasks enumerated above within security management, infrastructure management and service management. As a result management of HEIs should ensure that ICT tools must be online at all time, training of ICT support staff of institutions should be promoted and staff should be encouraged to upgrade their ICT skills ,and so on (recommendations of the EMMII model) in order achieve an efficient management of the ICT infrastructures, consequently aiding the nation in the attainment of the vision 20/2020 since an enhanced ICT infrastructure in organizations especially HEIs, is an important co-operate resources for economic advancement in this dynamic and ever changing world.

REFERENCES

Acosta, F R. (2004).Information Technology Strategic Plan of Olivarez College. Unpublished doctoral dissertation, University of Baguio, Philippines.

Ayoo, P. (2006). The East African VarsityNet Project: Development of an Inter-university Information-Based on OpenSource Software, IUCEA, 2006

Chacha, N. C. (2001). Higher Education in Africa: The Emerging Issues,IUCEA, 2001

Chacha, N C. (2004). Reforming Higher Education in Kenya: Challenges, Lessons and Opportunities, *IUCEA, 2004*

CRACIN (2005). Written Submission to Telecommunications Policy Review Panel, Toronto, Canadian Research Alliance for Community Innovation & Networking. *Telecommunications Policy*. (In press)

Brown, R. H., Irving, L., Prabhakar, A., & Katzen, S. (1995). The Global InformationInfrastructure: Agenda for Cooperation. Information Infrastructure Task Force.

Makerere University ICT policy, (2002)

Sodiya, A. S., Ibrahim, S. A. and Ajayi, O. B. (2006). The state of information security in south-western Nigerian educational institutions'', *Proceeding of the first international conference on science and national development*, University of Agriculture, Abeokuta, Ogun-State.

Tusubira, F. F and Mulira, N. (2005). Integration of ICT in Higher education Institutions: Challenges and best practice recommendations based on the experience of Makerere University and other organizations. Directorate for ICT Support, Makerere University

Wycliff, F. and Muwanga–Zake, F. (2008). Information And Communication Technologies: University Perspectives. *Journal Of Information Technology Education*, USA Volume 7, 2008