

ICT And Design: Challenges And Implementations In Kaduna State University

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Abstract: Information and communication technology architectures and framework are today the driving force of transformation educational institutions. However E-learning, teaching and management information systems and implementations are face with great challenges. This research work was necessitated due to the urgent needs. The paper highlighted the current challenges facing kasu ICT center in professional cadre's placement in IT services delivery. The existing hieratical structures designs, network architectures with tree star topology and protocols were identified via wired and wireless, optic fiber cables single mode, multimode and mikrotick router and outdoor radio in the university. Theoretical concepts and technical knowledge leader stages analysis and ICT Initiatives origin in the state university were also examined. This paper proposed integrated ICT architectures framework that centralized the holistic operations and management of both IT personnel and infrastructures to overcome presents challenges for sustainable development of university through ICTs transformations strategies plains. Create awareness on guidelines on architecture designs and implementations amongst the users of ICT centers in Nigerian universities in general kasu in particular.

Keyword: ICT, ICT Structures, Bandwidth Management, Kaduna State University

I. INTRODUCTION

Information systems and information technology are two distinctive systems that exist in universities SMEs and government agencies since 1980s. Universities realized IS/IT applications and integrations processes as a result of personal computer systems birth in 1985 (Tanenbaum, et al.2002, p.1-3). Integrations of methods, processes and procedures of universities, business managers and technologist expertise to designed information systems, information technology, information management systems and computing resources are integrated together called ICT. Private sectors are the only organizations emphasis earlier to implement ICT for good services delivered and recently shifted to public institutions (Ferrer, 2009, p.1-2). The universities principles and structural designed of information systems strategy is concerned IS development to the needs of universities while information technology is all about universities guidelines, policies, standards and information management are generally

concerned the integrations and efficient management IS/IT within a universities based on new technology (Campos, 2009, p.1-3). A research study on IT and business strategy alignment (Smith, 2007) explore five factors of IT strategy and challenges which organizations should consider in developing an effective IT strategy and recommends for best practice. Technology approached and implementations it depends on universities needs and what they want to do. There are needs of clear clarifications and specifications of demand and supply for ICT skills employees' human resources workforce and infrastructures performance (Nayak, 2011). Evaluating the roles of ICTs in universities (Agbetuyi, et al. 2012) describes the importance of internet and database management as tools of quality information management and theoretical architectures framework of ICTs effective and efficient in decisions making by universities management because the needed data is available and information is at hand. With the advancement technological innovations and development ICTs architectures integrate systems, processes and functions into

one single model for best practice. ICT architectures is a blueprint of institution technologies operations and information management into four different stages (A) designing planning and process (B) development process (C) operational process (D) technical operation to the needs of organizations for best practices.

- ✓ STAGE: Describe designing planning and process which includes a general guidelines and principles of ICTs infrastructures development. Installations of ICTs various software and physical hardware equipments or components and maintenance cultures to satisfied the needs of institution for best practice and management.
- ✓ STAGE: it describes the structures, procedures and processes of implementing and executions of ICTs infrastructures based on the designs and planned. Its gives a technical solutions and update for project lifecycle plains schedules executions and development.
- ✓ STAGE: Structural policies and guidelines that monitoring the activities and operations of ICTs infrastructures maintenance and management. The operations processes determined the levels of commitments front line of university management in which provide efficient security strategies of ICTs infrastructures.
- ✓ STAGE: A technical process encompasses entirely IT processes and procedures of technical solutions to ICTs infrastructures both software and hardware for guarantee of services delivered by ICT center end to end services. Planning and techniques of technical approach of new technologies for ICTs development and management supports for best practice.

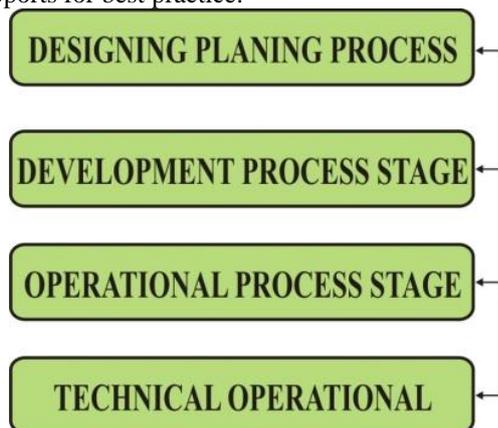


Figure 1: ICT Process Stages

II. REVIEW OF RELEVANT LITERATURE

Information and communication technology transforms the process and methodology of teaching and learning and management information systems in tertiary institutions systems. It is the responsibilities of ICTs personnel to designing, integrate and manage hardware and software infrastructures or equipments operations and interoperability to provide good quality of services (Qos) in the university (Baquero et, al. n.d.). A study research identified the basic and major challenges of ICT infrastructures designs and implementations for teaching and learning efficiency (Regina,

2012, p.3) Research study was conducted by (Hosseini, et al. 2012) implementation of ICTs framework for best practice as methods of development for productivity and industries standards for globalizations. Web develops applications and internet connectivity has rapidly increased and attracts government attentions on ICT project to improve learning and teaching efficiency for students and lectures (Wang et. al. 2007, p.1-2). This drawn the attentions of educational institutions to implement ICTs applications theoretical and technical concepts into practice to improve teaching and learning process (Ul-Amin, 2009). A proposed strategy for ICT development by international organization for standardization (ISO) applied various concepts and skills of different scientist in which includes theoretical foundations and technical for ICTs framework (Parma, 2009). Integration of ICT architectures is process whereby a holistic information systems process, information technology and ICTs (IS, IT and ICTs) problems are describes in technological manners and organization structural designs that make technology work efficient. In turn design is a creativity and knowledge that people are admired and value to pay for and problem solving consists of various processes, procedures, requirement and engineering ICT tools and services implementations for best practice (Fomin, 2008, p.2). ICT framework research paper (Vorisek, 2011) describes ICT layers functionality as services and management that integrate TOGAF, SPSPR and ITIL model architecture for computing resources to the needs of organization addressed. International organization for standardization (IOS) has seven layers architectures which serve as reference guides model for network administrator to setup network. A research study of technical architectures that serve as internal Blueprint for ICTs systems with emphasis of four network layer services integrations (Danish Defence Target Architecture, 2011, p.5-10).

ICT FRAMEWORK EXECUTIONS

Today's SMEs, government agencies and educational institutions are totally migrated 100% into ICTs applications and infrastructures which changed the modes of communications and information management processes, teaching and learning through internet connectivity in associated with additional features data communications, IP Voice and video online stream operations to reduces carbon footprint. The method of approach start with ICT concepts in general as new technologies and methodology of teaching, learning, information systems and communications followed by the relationship between architecture and framework in associate with ICTs structures models integrations to achieve target results to the needs of kasu. Information communications technology encompasses and integrates computing infrastructures or equipments layout, procedures, processes and implementations of applications and management to the needs of organizations for best practices. (Rijisenbrij, n.d.) explain core ideas of terminologies and conceptual reasoning of ICT architecture and applications as a structural designed which describes the process and procedure of each components involves in communications median both interior and exterior based on the prescribes criteria and standards of various components. A framework is a clear

planning, process and procedures of sources valuable ICTs tools which required in priorities order to fits together as starting points for best practice to achieve desired results. (Nayak, et al. 2011) explores and describes the benefits of proposed models ICTs basic skills and concepts of different categories and classifications of human resources and management of ICTs skills and knowledge based on hierarchical expertise points of view from industries levels, researcher's levels skills, professionals and end users levels practices and applications for best practice. Figure 2 shows a substantial and comprehensives leader structures of ICT knowledge and skills based on international standards and best practices in every levels of operations and management.

A. ICT CREATORS TOP LAYER

The ICT creators layer specifically are those who have extensive academic skills and knowledge with professional theoretical concepts and experience in research and development of ICTs in organizations weather IT industries or non IT industries in accomplished entire ICT applications theories and empirical research in developing products and services and problems solving. Those are engineers, scientist and network administrators with advance degree qualifications are usually work in ICT industries, research institutions and educational institutions.

B. ICT ENABLERS MIDDLE LAYER

Middle layer encompasses various experts with experience and technical skills in maintain and managing ICTs infrastructures or equipments. These are technicians, software developers, systems analysis, installers and network administrators who understand technologist approached and applications in the real worlds. There are employed at different cadres based on professional experience and technical competencies in infrastructures integration and operations to make sure that there are works together for the benefits of their organizations. They always make ICT facilities available when ever is needed to users and there are ready to assist and guides in existing operations and applications to various equipments and facilities. The levels of experience and knowledge of various applications of software and hardware operations and management by technicians it varies depending on the durations and vocational knowledge and years. However some for maximum five year in university Community College and other for technical career education specifically in one single area of professions.

C. END USERS OF ICT INFRASTRUCTURES

In 21 century most people are in needs of ICTs knowledge, skills and competencies in implementations of various tools into practice by end users in respected of industry and field in modern ICT infrastructures. Community colleges and professionals IT Training institutions plays a crucial roles in the development and success of ICT usage. Consider the levels of awareness of ICT infrastructures by students in the educational institutions, SMEs and government agencies. Students and lectures conducts in research, teaching

and learning with support of ICTs facilities and internet connectivity in comply with industry principles integration standards and logical setting done by technician and network engineers.

D. ICT HELPERS AND SPREADERS

The middle layer is the life wire of ICT operations and management at every level of organizations and it has a direct relationship between ICT helpers and spreaders in the distributions and sharing professional skills and knowledge for the benefits of both users and services providers in ICT leader. The workflow and structural arrangement from the top level creators in the leader describe the roles and responsibilities of helper at the intersections between the creators and enables vividly to assist and guide users to be ICT users. Helpers are categories and known as help desk officers, IT operations in various IT industries or non IT industries. Providing specializing supports in called centers in telecommunication companies and related organizations that understand ICT systems and processes with extensive skills and experience in operations and management in order to establish customers relation management. The spreaders also has it owns rules in the development and creating awareness to introduce IT industry services or products to the general public in name of marketing, distributions, Sales and services management. The whole process and procedures adapted by spreaders to spread the innovations of creators and finished products in respected of communities, educational institutions and government agencies.

III. THE CASE STUDY IN KASU

The Kaduna state university was established on 21st May 2004 with two campuses Kaduna as main campus and kafachan to improve and boost higher education system across the state. A pre-degree program remedial was took off in main campus Kaduna and subsequently followed by the full academic program with three faculties of science, art and social and management science 460 students were matriculated into the various faculties in 2005/2006 academic session.(Kaduna state university, 2006).

Kaduna state university ICT originated through E-library and its was proposed and set-up by library unit under sponsorship of federal government educational trust fund (ETF) interventions 2005 allocations projects to the needs of university with the aims to enhances E-learning and teaching. Students and staff both academic and non-academic were uses the systems and internet connectivity to conduct research and assignment for the purpose of academic activities, communication and other administrative processes in digital form to achieve desired and predictable results. The E-library is operated and managed by the university library staff and offered services like photocopying, scanning, printing and internet services connectivity in the university. An average numbers of users systems and other ICT E-library infrastructures in the university from 2005/2007 are seven hundred and six (706) and total of systems are forty workstations (Kaduna state university, 2007, P.128).

According to the kasu news letter bullets (kasu bulletin, 2007) disclosed a progress achievement of ICT centre tweed laboratories were build and fully equips with infrastructures and total number of workstations one hundred and twelve (112) which promises and fulfilled by petroleum technology development fund as one of their social responsibilities in tertiary institutions particularly in ICT projects.

IV. METHODOLOGY

The objective of this research paper was to achieve ICT architectures blueprint which coordinates competent man power, knowledge, skills and experience to provide excellent, effective and efficient ICT services to the needs of kasu. In order to achieve these three methods includes face to face interview, observation and survey in data gathering were employ in which the researcher believed is enough to obtain a substantial amount data. A face to face interview was applied on IT personnel who has an experience in IT operations and also as the pioneer staff of the university. A reconnaissance survey was carried out which enable the researcher to identify ICT framework, laboratories, network topologies, equipments and existing new and old buildings and finally observation method were made to identify network topology in associate with size of campus distance cover from university central backbone points to points in data gathering.

E. RESULTS

Research results were obtained during a field exercises in the kasu and series of personal interview conducted with senior principles technical personnel, technical operators and management of ICTs infrastructure within the kasu. The exiting ICTs architecture frameworks and workflow of IT personnel hieratical structure in the university. Three units answerable directly to office of ICT directorate were identified while a special assistance to Vice Chancellor on ICT matters reporting to the Vice Chancellor directly on issues and decisions related to ICT in the university. Three fundamentals layers architectures of computer networks and communications which include core, distributions and Access layers functionality, bandwidth utilization and management in associated with network security and systems maintenances. Five VSAT internet connectivity infrastructures were identified one radio links from central backbone in new E-library with additional outdoor radios and sectorial antenna. Single mode optic fiber cables were lying and terminated from kasu backbone Old E-library. One of the affected architectures hieratical structure and chain of commands IT personnel were identified in the study area.

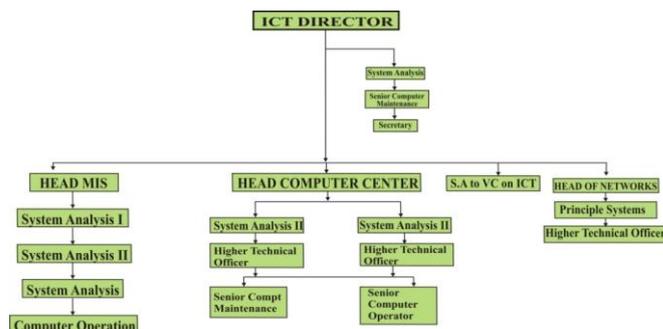


Figure 2: ICT Hieratical Structure

A. CHALLENGES

There are various challenges in ICTs architectures framework associated with operations, implementations and management for best practice in the kasu. Challenges it encompasses the entire technical and non-technical operations which has a relationship of ICTs strategies plain in the University towards the achievement of specific goals. Globally information and communication technology knowledge, skills and awareness has changed information disseminations, management, information security and network infrastructures security dynamically depends on the organizations ICT strategies policies and capabilities to coup with the presents challenges to utilized the opportunities as competitive advantage.

B. NETWORK TOPOLOGY

Network topology has two approach and categories towards the executions and management within and outside kasu. The first approach is logical design of system operations and procedures in which required both hardware and software a systems or nodes configurations and setting to enables network administrator to implements core and basic applications and network security to prevents any damages that may occurs from internal users and outsider (hackers) and gives user access authentication to available resources within campus interconnected nodes to shared information while the seconds approach consist of physical map descriptions of nodes within university campus systems from centre nodes (server) to various destinations access workstations (Santra, et al. 2013). The university network topology were identified in main campus is tree or extended star topology which included all four faculties with sectorial antenna wireless connectivity, mikrotick router outdoors radios which cover all four faculties and fiber cables single mode interconnections from old e-library to center nodes for each faculties. Whoever some computer laboratories and administrative blocks were identified the Ethernet LANs uncompleted and some are yet to implement. A research study was conduct on fiber optic and network topology communications data rate speeds comparisons over LANs implementation with cost effective and distance covers (Bhatia, et al. 2012). A proposed methods and calculations of actual value range and frequencies range and IP routing information table reconfigurable virtual network topology (VNT) on high traffic control on wavelength (Shiomoto, et al. 2003). A descriptive analysis pros and coins of four types of P2P network topology from the

logical topology points of view implementations which provides a reasonable network architecture structure designs for easy configuration and subnetting of routing information table (RIT) and IP maintenance and management (Yong, et al. 2012).

C. WIRELESS AND WIRED CONNECTIVITY

Accessing internet connectivity via radio wireless access end to end Wimax and wired within the campus through the exiting access network topology. (Lehr, et al. n.d.) A research study was conducted on wireless architectures for full data packet transmission and comparisons analysis of the two methods which concludes that wired is the reliable due to the inherent scarcity of spectrum allocation and management in associate with problems between primary user and secondary white space spectrum licenses. (Bassil, 2012) transmission control protocol and internet protocol (TCP) is well known as defector standards and reliable compared with user data protocol in packet transmissions. TCP was design in the presences of congestion and to overcome packet losses for both wireless and wired connectivity to reduced packet burst. OPNET IT guru software is one of the simulation packets for wired connectivity which helps to analysis a load balance, delay and speeds of data transmit from host machine to others workstations. (Malhotra, et al. 2011) describes based on the simulated results obtained a wired connectivity has a highest liked of 1000 Base and also a wireless is an extension of wired as alternatives in communications.

D. BANDWIDTH UTILIZATION AND MANAGEMENT

(John, et al. 2011) explored and describes the necessity of monitoring bandwidth load and delay transmits over WAN connectivity and performance of good quality of services (Qos) between TCP and UDP. Bandwidths are priorities in other of accessing controls and guarantee of full bandwidth connections (Wang, et al. n.d.). Ever internet service provides has a bandwidth policy management towards the delivered services to his esteem clients (Saththa, 2010) based on their research paper a case study of telecom company organization in Thailand analyze and found out the problems and challenges of bandwidth management and Qos is liked of framework.

In the field exercise survey observed five different ISPs with VSAT connectivity were identified in the main campus and VSAT in kafachan campus in e-library. Still students and staff both academic and non-academic were complains about the efficiency and full bandwidth via wired and wireless within campus. However among the five VSAT identified in main campus four is fully functions. In old e-library that is university central backbone has 4Mb/4Mb upload and download radio link and new E-library 1024 upload and download 512 and PTDF centre with 1024/512 finally faculty of medicine with 1Mb/1Mb with total twenty (20) workstations in the laboratory. One single access server with sectorial antenna with network hot spot management was identified that managed users logging access to internet connectivity in the campus. Norton anti-virus software was installed in all workstation for security reasons and no any

additional network security infrastructures in kasu apart from antivirus package trial versions.

E. IMPLEMENTATIONS

Other best way of reducing amount of paper in information records and management, teaching, learning and information dissemination in educational institutions SMEs and government agencies through digital form electronically to coup with presents global ICTs applications and challenges. Proper coordination and strategist plains of financial, human resources, staffing and placement of personal with an intensive skills, experiences and knowledge in the field to advice management accordly towards the achievement of specified ICT goals and objectives. ICT its has become a driving for forces that change the methods, processes and procedure of teaching, learning, communications and business transactions processes entirely any organizations who do not applied and comply with standards and guidelines of newer ICTs cycles is left be hide ICT wised it's easy to fetch out in business group. (Idowu, et al. 2003) analyses the levels of increased of population rates of ICT inventions and implementations facilities users globally and particularly in Nigerian health sectors and other agencies experiences since from 1950s.

V. AWARENESS OF ICT FRAMEWORK AND IMPLEMENTATIONS AMONGST THE USERS

(Onyekachi, et al. 2013) describes the levels of awareness and efficient of Nigerian university Nsukka multimedia ICT virtual library applications and utilizations by students and lectures for teaching and learning and few universities that are enjoyed in Nigeria. Different workshops and seminars were organized by professional bodies local and international on ICT framework and awareness applications in Nigerian educational institutions in comply with internal and external regulatory bodies standardizations. (Adebowale, et al. 2012) explore the levels of awareness and experiences of secondary schools teachers on ICTs applications in teaching and federal government agencies regulatory ICT policies in Nigeria. The national ICT policies is become a necessity for ever individual and organization to be aware of it existent in execution of various ICT facilities in teaching and learning and information management systems. (Adedoying, et al. n.d.). A Propose ICT framework and policies implementations in educational institutions in Nigeria by reviewed national information technology development agency NITDA and other national IT agencies 2011 committee national policies and strategist plains on ICT. An empirical research study was conducted (Olatokun, et al. 2008) on E-readiness assessment of ICT infrastructures availability, framework, regulation policies and IT personal professional cadre structure university of Ibadan to achieve the ICT goals based on the Nigerian university regulatory commission (NCC) guidelines and policies for standardizations. Four federal universities were identified with effective and efficient ICT hieratical structures which defined the responsibilities of each units of IT services implementations towards the achievement of university ICT goals (ABU, UNILAG, FUTA and FUTMINNA).

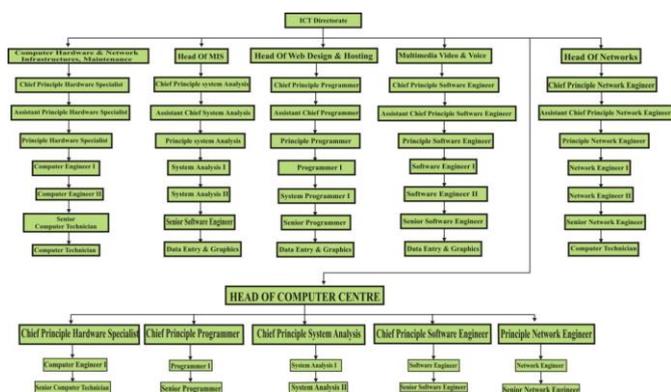


Figure 3: Shows a propose standards hieratical ICT Structure

VI. CONCLUSIONS

Kasu ICT architectures framework needs to be given special attentions and proper coordination to re-arranged operations of machineries and implementations of ICT strategies plains for technical solutions to overcome presents challenges and provide excellences ICT infrastructures services and development of the university in general. Centralizations and re-structuring IT personnel positions and information flow based on hieratical structure of professional experience cadres of ICT directorate functional chart with effective chain of commands in figure 4 is the solution based on identified ICT architectures framework in figure 2 results in kasu. However by implementing figure 3 ICTs processes in the kasu, management will have a full guides and ideas on how to monitor and controls the performance rates of each units to identified their straights and weaknesses of entire units provided that all the required necessary equipments or infrastructures are provided as recommended by ICT directorate based on the units demands to satisfied the needs of kasu ICTs services delivery. Fully implementations of three fundamentals layers architectures and management with regular updates of software and hardware maintenance and repairs of networks devices and other ICT services for security and safeguard within kasu by designated unit that are responsible for best practices.

VII. RECOMMENDATIONS

- ✓ Circuits switches and LANs trunk unshielded twisted pair cables cat 6 lying and termination with fiber optic single mode and multimode for old and new departments buildings structures in kasu with tree extended stars topology.
- ✓ Full implementations of the standards ICT structure for best practices in figure 3.
- ✓ Kasu bandwidth connectivity to be integrates by using devices like peplink products for VPN and gives priority order users accesses and status to enables manages and utilized the bandwidths effectively.
- ✓ Services level agreement between kasu with various ISPs for downtime compensations.
- ✓ Computer center as proposed in figure 4 to be managed by center manager reporting to ICT directorate to run

various ICT academic professional courses ranging from certificates to Higher National Diploma and other professional training to generate more revenue with the available ICTs facilities and competent experience personnel.

- ✓ The university management should give more attentions of ICT strategies policies training and developments of IT personnel both academics and professional qualifications in chosen are of specializations for the benefits of university.

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