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# Planning, Designing, and Implementing a Local Area Digital Library Network

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## Abstract

*The advancement in the development of Information and Communication Technology (ICT) engendered by the invention of internet and related telecommunication infrastructure is impacting virtually all spheres of human endeavour. Computers usually top the list of equipments used in various research fields such as science, engineering and humanities has also fundamentally altered the ways libraries accomplish their traditional missions of selecting, organizing, preserving, and providing access to information. This research work mainly focuses on planning, designing, implementing and management of the digital library. It covers mission and scope, time frame, evaluation, assessment and infrastructures required. The paper also discusses the need for the digital library, basic facilities to keep the technology functioning and enhancement of user awareness. A Local Area Network (LAN) setup is proposed for Department of Computer Science, Kwara State Polytechnic, Ilorin. Cost of hardware, software and other requirements have been estimated.*

***Keywords:*** digital library, local area network, hardware and software requirements, cost implications, staff

## 1. Introduction

Computing trends that began in the 1980s have enabled low-cost digital storage of information, rapid transmission of data across computer networks, and sophisticated retrieval and processing of electronic documents and information. Information and Communication Technology (ICT) has revolutionized the concept of libraries. All libraries are slowly getting digitized. A 'digital library' comprises digital collections, services and infrastructure to support lifelong learning, research, scholarly communication as well as preservation and conservation of our recorded knowledge. Increasingly, libraries are using computer facilities for searching the book collections, reading CD-ROMs, accessing the internet and researching online databases. Users have facility to access all created and acquired digital sources of information in the form of electronic text, image, map, sound, video and multimedia. The users gain on-line access to electronic versions of full text documents and their associated images.

A digital library has been defined as an electronic or virtual library where information is selected, acquired, processed, organised, stored and retrieved in digital form [1]. Reference [2] also defines digital library as the library in which collections are stored in digital formats (as opposed to print, microform, or other media) and accessible by computers. Digital library also has been described to be a collection of documents in an organized electronic form, available on the internet or on CD-ROM (compact-disk read-only memory) disks [3]. According to Reference [4], a digital library is an organization which comprehensively collects, manages and preserves for the long term rich digital content and offers to the user communities specialized functionality of that content, of measurable quality according to the codified policies.

The use of digital libraries as a sources of easily and rapidly accessing books, archives and images of various types is now widely recognized by commercial interests and public bodies alike. Benefits of their usage include freedom from physical approximation, 24/7 availability, multiple accesses, easy information retrieval, preservation and conservation, lack of space constraints, cost of value added services and downloading [5]. The setbacks are computer viruses, lack of standardization for digitized information, quick degrading properties of digitized material, different display standard of digital product and its associated problem, health hazard of the radiation from monitor etc. This makes digital libraries not so attractive. The system suffers from the violation of copyright and licensing, digital preservation, speed of access, high initial cost, bandwidth and efficiency [5].

A digital library is in the form of a large database for people working in the hypertext environment of electronic materials and services. Virtual Library is the library that only exists virtually- that is it does not exist “in real life”. Virtual library consists of materials from a variety of separate libraries which are organized in virtual space, using computers and computer networks. Hybrid library operate both in electronic or digital and print environments. Automated library incorporate machine-readable catalog, computerized acquisition; circulation and OPAC (Online Public Access Catalogue).

This research work mainly focuses on planning, designing, implementing and management of the digital library. It covers mission and scope, time frame, evaluation, assessment and infrastructures required. The paper also discusses the need for digital library, basic facilities to keep the technology functioning and enhancement of user awareness. A Local Area Network (LAN) setup is proposed for Department of Computer Science, Kwara State Polytechnic, Ilorin. Cost of hardware, software and other requirements have been estimated. Recommendations have been made based on the findings.

## 2. Objectives of the Research

This paper is aimed to

i. determine the type of information technology (IT) infrastructure required for establishing and maintaining a digital library.
ii. design a Local Area Network set up for establishment of the polytechnic digital library.
iii. determine the financial and personnel requirements involved in setting up and maintaining a digital library.
iv. allow the polytechnic management to articulate its goals and justify budget expenditures.

## 3. Literature Review

There are various definitions of digital libraries. Within the context of libraries, digital libraries may be viewed as technical services performed electronically with an entirely electronic application [7]. Researchers in [6] define digital libraries as a collection of services and information objects that support the users of the library in dealing with information objects and the organization and presentation of those objects which are available directly or indirectly via electronic/digital means. Since the academic community is the largest and the most important user group of digital libraries, digital library ought to contain additional resources like course calendars, university statutes, various courses being offered, course registration, thesis and dissertation guidelines, style guides, laboratory facilities, availability of software, hardware, equipment, course materials, reserve book/handout collections, local publication databases, locally produced theses and dissertations and so on [8].

Reference [9 identifies various stages along the road towards developing a digital library. Reference [10] reports that the academic staff of University of Ilorin is fully aware of the availability of electronic library resources. However, 70% of them claimed that they do not visit e-library to access e-resources. Only 36.6% indicated that they access the e-library resources from their offices. The statistics reveal that slow internet access, power outage and non-availability of e-resources relevant to their needs are obstacles in the use of e-library.

Reference [11] broadly categorizes online reference and information services into the following three groups:

(i) Those from publishers, database search services and specialized institutions.
(ii) Those provided by libraries and /or experts through the internet.
(iii) Where the users need to conduct a search and find information through the web.

Reference [11] have also suggested some other useful search engine services like Web help.com (www.about.com) which claims to offer real time

search assistance with a real live expert any time, day or night. About.com (www.about.com) is a service that shows a number of pre-defined categories related to a search topic given by the user.

According to [12], a research survey on wireless internet access reported that 100% of academic staff respondents are fully aware while 5.5% of students' respondents are aware of the polytechnic wireless internet access. Unavailability of wireless internet signal in several areas of the polytechnic and the failure to release the password to the staff and students are factors contributing to low usage.

Researchers in [13] stressed that the term electronic library (e-library) has been applied to a wide variety of domains such as collection of electronic materials and software agents that support inquiry-based education. The existing library systems serve as reservoir for several materials resulting in their non-effective in time taken to search and retrieve needed materials. The researchers presented an Internet-Based Library System (ILS) that offers greater and efficient services. The system has modules for database, web browser and services affiliated to institutions of learning.

Digital libraries are full-text databases which replicate, in digital media, many of the functions of traditional libraries. The following are the functions of a digital library in tertiary institutions [14]:

i. To preserve documents: to allow people to read older or unique documents without damage to the originals.

ii. To make documents more accessible: to serve the existing users better; e.g. to allow the users to search the full text of the documents or to serve more users than envisaged in remote locations at a time.

iii. To reuse documents: to convert documents into different formats; for example to use images in a slide show and to adopt the content for a different purpose.

The researches in digital library and development all over the world in recent years have noticeably improved the facilities for accessing and retrieving digital information resources in a timely, accurate and comprehensive form [6]. However, authors in [6] also outline the architecture, the basic components and functionalities of a Digital Work Environment (DWE) that forms the basis of a user centred digital library development at Nanyang Technological University in Singapore. Based on the experience of a continued research on design and development of DWE, a set of generic guidelines for the design of a user-centred digital library system was provided. The researchers revealed that current digital libraries or information systems do not generally organize information according to the various user tasks. As a result, users usually employ the trial and error method to move from one web page to another or from one information resource or system to another. The user-centred approach to digital library design is therefore desirable

as it aims to shift the focus from a system-oriented to a user-oriented design in an attempt to meet users' real needs and facilitates means and ways to support their information seeking and usage behavior.

It has also been observed generally that there is no standard method for designing a digital library [15]. Organizing digital libraries' information and resources can take different forms which include the use of an alphabetical listing, subject categories, broad groupings, by tasks, and so on. Right from the beginning, academic community has been the largest user group of libraries, a digital library therefore should contain additional resources like course calendars, university statutes, various course offerings, course registration, thesis and dissertation guidelines, style guides, reserve book/handout collections, local publication databases, laboratory facilities and equipment, course materials etc [16]. Finally, researchers in [17] revealed that although web accessible digital libraries (DLs) have greatly increased potential information accessibility within academia, the use of these resources varies widely across disciplines. The researchers are of the opinion that the web-accessible DLs are identified as changing the roles and working patterns of academic staff (i.e. lecturers, librarians and computer support staff).

## 4. Methodology

The following methods are adopted in carrying out the studies.

### 4.1 Data Collection

The review of related literature for this journal paper was performed mainly with reading existing project work, journal papers, proceeding of conferences, text books, personal observation, and browsing the World Wide Web (www). The cost of hardware and software requirements was determined by taking estimates from different computer vendor within Ilorin metropolis.

### 4.2 Planning

Planning mainly involves identifying various tasks related to creating a digital library collection, developing strategies for handling these tasks, identifying required resources and formulating a timeline for accomplishing these tasks. If there is a need to have a large digital project, a feasibility study may be conducted to access the viability of the project before detailed planning. The outcome of the feasibility study could be a formal proposal for obtaining the approval or grant for the polytechnic management for the project.

The following steps are needed for the planning and creation of a digital library.

a. The first step in planning a digital library collection development project is to specify the need for creating the digital library collection, its purpose and target user community.

b. There is the need to define the source material that constitutes the digital library collections and the key attributes of this source material. There is also the need to specify the particular portion of the material to be digitized.
c. Identification of the nature of the collection e.g. static or dynamic, indicating the type of usages that would allow the users to adhere to and the kind of service delivery they should expect, e.g. CD-ROM or on-line or both.
d. Identification of the resources and money required for creating and maintaining digital collections.
e. Finally, there is the need to define how the project is going to be implemented.

### 4.3 System Implementation

Implementation is the process of getting down to the actual steps required to set up the collection. This means that there must be a need to obtain the polytechnic's management approval for the plan and the required resources before proceeding with implementation. There is also the need to identify and designate a project manager to lead the implementation of the digital project. For large digital library projects, it is essential to have a full time project manager for the project period. The Implementation of a digital library project involves the following steps [18].

i. Establish the project team.
ii. Set up the Information Technology (IT) infrastructure.
iii. Procure and install digital library software.
iv. Finalize policies and specifications.
v. Complete arrangement of workflow for digitization,
vi. Set up the digital library collection site.
vii. Obtain copyright permissions
viii. Release the digital library collection for use.

### 4.4 Infrastructure

The internet and the World Wide Web provide the impetus and technological environment for the development and operation of a digital library. The internet provides the TCP/IP and or its associated protocol for accessing the information and the web provides tools and technique for publishing the information over Internet. For the digital library to be a reality, an information technology infrastructure that ensures easy, seamless access to resources and services must be in place. For any digital library starting from ground up with completely new purchase of equipment, staff and software is unlikely [19].

### 4.5 Management and Staffing

The management and organization structures determine how the digital library will be managed, maintained, and developed over time. Organizational structure must be designed with clear delineations of responsibilities and reporting structure. The structure should be in place before the implementation of the library begins. So, managers and staff understand the responsibilities associated with their roles [20].

Staffing for the digital library is a part of the organizational structure. Library staff may work solely for the digital library or be part of a more traditional library structure with hours dedicated to staffing the services provided by the digital library. Network Administrator and Database Administrator will be required to handle the network and database maintenance respectively. Training of the library staff is also essential for the handling of IT infrastructures [21].

### 4.6 Fundings

Funding for digital library may be tapped from varied sources and is one of the most crucial factors in its planning and development. Preparation of a budget for start-up, first year operation and five-year operation and development by anticipating upgrades and expansion is essential. Each budget should include costs for equipment (hardware, software), licensing or purchase of resources, marketing and public relations, development, and other operating expenses. Funding may involve state allocation, grants from library consortia or associations, member fees and support, vendor partnerships, and private or non-profit organizations [22].

## 5. Proposed Local Area Digital Library Network

A network is a collection of computers, printers and other devices that are linked together with cables or sometimes wireless. A network usually has three layers of components, namely Application Software, Network Software and Network Hardware [23]. Application Software consists of computer programs that interact with users and permit the sharing of information, such as files, graphics, as well as resources such as printers and disks. Network Software consists of computer programs that establish protocols, or rules for computers to talk to one another. Network Hardware is made up of the physical components that connect computers. The two important components are the transmission media that carry the computer's signals (e.g., cables) and the network adapter, which access the physical media that link computers, receive packet from network software, and transmits instructions and request to other computer [23].

For the proposed polytechnic digital library, a Local Area Network (LAN) needs to be setup and connected to the existing polytechnic wireless Internet access. To set up the LAN, the following are required.

i. Thirty three sets of personal computers.
ii. One Network Interface Card (NIC) for each computer.
iii. Four 24-port switches.
iv. Cable for the connection.
v. Network Operating System

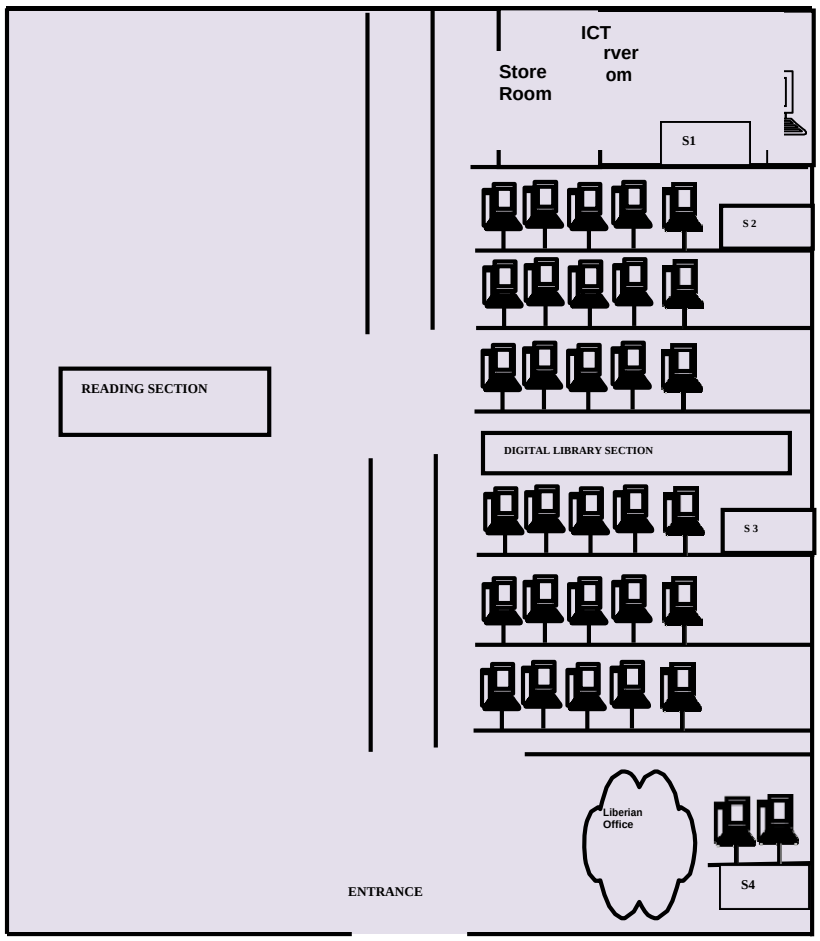


**Figure 1.** Main Library Building and the Network Designed

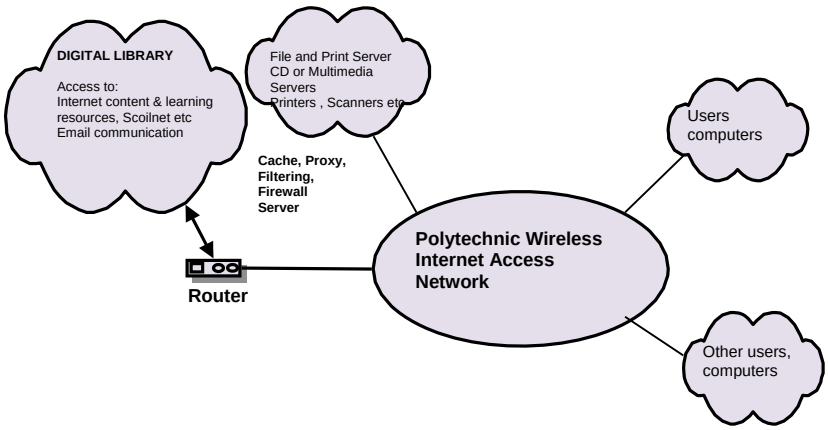


**Figure 2.** Overall Polytechnic Wireless Internet Access

As shown in Figure 1, the library main building is divided into two sections. One reading section and the other is the digital library section. In the digital library section, thirty two computer systems (workstations) and a server were connected together with the aid of four 24-port switches (i.e., S1, S2, S3 and S4) using linear bus topology. Topology is the physical arrangement of the systems in the network.

i. The server in the server room was connected to Switch 1.
ii. Fifteen workstations were connected to Switch 2.
iii. Fifteen workstations were connected to Switch 3.
iv. Two workstations at the Librarian office were connected to Switch 4.
v. The server in the server room was connected to the internet through the existing polytechnic wireless internet access.

To complete the LAN of the digital library section, some networking materials were used. The tables below represent the hardware and software configuration of the server and the other workstations as well as quantity and estimated cost.

**Table 1.** Hardware Configuration

| ***S/No*** | ***Server*** | ***Workstations*** |
|---|---|---|
| 1. | Core i3 Processor of 3.20 GHz speed | Dual Core Processor of 2.3 GHz speed |
| 2. | 6.0 GB RAM | 1 GB RAM |
| 3. | 750 GB Hard Disk or Higher | 250 GB Hard Disk |
| 4. | DVD Writer | CD-ROM/ Writer |

Source: Authors' Finding, 2017

**Table 2.** Software Requirements (Source: Authors' Finding, 2015)

| ***S/No*** | ***Server*** | ***Workstations*** |
|---|---|---|
| 1. | Network Operating System e.g. Window 2003 Server | Operating System e.g. Window XP/Vista |
| 2. | Database Package Containing Information about various Courses | General Application Packages |
| 3. | Distributed Resources | Accesses to the Available Resources |
| 4. | Internet Connectivity | LAN Connection |
| 5. | Web Browser e.g. Mozilla Firefox | Web Browser e.g. Mozilla Firefox |
| 6. | Strong Anti Virus Program | Strong Anti Virus Program |
| 7. | Download Accelerator | Download Accelerator |

## 6. Cost Implications

**Table 3.** Estimated Cost of Software (Source: Authors' Survey, 2017)

| S/N | Material | Estimated Unit Price (₦) | Estimated Cost (₦) |
|---|---|---|---|
| 1. | Window XP professionals (Single User) | 30,000:00 | 30,000:00 |
| 2. | Novell Netware | 20,000:00 | 20,000:00 |
| 3. | Window NT | 20,000:00 | 20,000:00 |
| 4. | Internet Explorer | Pre-installed | Pre-installed |
| 5. | Mozilla Firefox | Downloaded | Downloaded |
| | E-mail Services | Pre-installed | Pre-installed |
| 6. | Library Software Package | 30,000:00 | 30,000:00 |
| 7. | Other Software Packages (Online Journal Database Subscription, Online Database Subscription and Procurement of E-Books)- Renewable Yearly. | 500,000:00 | 500,000:00 |
| | | **Total** | 600,000:00 |

**Table 4.** Estimated Cost of Hardware

**Table 5.** Overall Estimated Cost for Establishing Digital Library (Source: Authors' Survey, 2017)

| *S/N* | *Description* | *Estimated Cost (₦)* |
|---|---|---|
| 1. | Hardware | 2,786,500:00 |
| 2. | Software | 600,000:00 |
| 3. | Installation and Workmanship | 500,000:00 |
| 4. | Miscellaneous (5 years Maintenance) | 500,000:00 |
| **Total** | | **4,386,500:00** |

Tables 1 and 2 above describe the hardware and software requirements for both the server and the other workstations. It is obvious that the server requires higher configurations and software requirements than the workstations because it will store the information that will be shared among the workstations. Table 3 reveals that the estimated cost of software is ₦600, 000:00 and table 4 shows that the estimated cost of hardware is ₦2, 786,500:00 which is reasonable considering the number of computer to be acquired. Table 5 depicts that installation and workmanship will cost ₦500, 00:00. Table 5 also shows that 5 years maintenance

| S/N | Material | Qty | Estimated Unit Price (₦) | Estimated Cost (₦) |
|---|---|---|---|---|
| 1. | 24-port Ethernet Switch | 4 | 35,000:00 | 140,000;00 |
| 2. | Pentium M Computer | 1 | 80,000:00 | 80,000:00 |
| 3. | Pentium IV Computer | 32 | 60,000:00 | 1,920,000:00 |
| 4. | RJ-45 Connector | 50 | 50:00 | 2,500:00 |
| 5. | Unshielded Twisted Pair (UTP)-Cat6e cable | 4 Rolls | 15,000:00 | 60,000:00 |
| 6. | External Modem | 1 | 150,000:00 | 150,000:00 |
| 7. | Screw | 8 Packs | 500:00 | 4,000:00 |
| 8. | Desk jet Printer | 1 | 30,000:00 | 30,000:00 |
| 9. | Laser jet Printer | 1 | 50,000:00 | 50,000:00 |
| 10. | Scanner | 1 | 15,000:00 | 15,000:00 |
| 11. | UPS | 35 | 3,000:00 | 105,000:00 |
| 12. | Router | 1 | 40,000:00 | 40,000:00 |
| 13. | LAN Tester | 1 | 10,000:00 | 10,000:00 |
| 14. | Crimping Tools | 2 | 5,000:00 | 10,000:00 |
| 15. | Air Conditioner (Split) | 4 | 40,000:00 | 160,000:00 |
| 16. | CD-RW/DVD-RW | 10 Packs | 1,000:00 | 10,000:00 |
| **Total** | | | | 2**, 786,500:00** |

will gulp ₦ 500, 00:00. The overall cost for the establishment and maintenance of the polytechnic digital library will cost ₦ 4,386,500:00, as shown in table 5, at the time of findings (2017). Finally, it is worth mentioning that the above estimate did not include construction of building. Only the cost of hardware, software and maintenance were estimated.

## 7. Conclusion

It is obvious that information technology has affected the skills and responsibilities of the librarians and academicians as well. Technology has changed not only the face of information but also the information seeking behavior of the users. Technology demands a high level of technical skill set from library professionals in order to make maximum use of new technological tools for providing effective and better services to the users. The initial cost of digitization is high but experience shows that once digitization is introduced then the cost to manage will be cheaper than that of any traditional library. Day by day the cost of digitization is decreasing, the online publication is increasing, and the needs of users are shifting towards a different environment. Once a digital library has been created, it is important to have procedures in place to ensure that the library is adequately maintained. This includes piloting of the library to ensure it meets the users' needs; ensuring that the underlying system running the library remains in good working condition and

conducting routine reviews of the system; and conducting routine reviews of the library holdings.

This study therefore concludes that due to the changing scenario of the dissemination of information, the librarians working in developing countries are facing common problems such as inadequate technical skills, lack of advance searching skills, inadequately trained and low skilled manpower, misuse of digital sources of information, different library soft-wares, poor fiscal condition of libraries, inadequate infrastructure, inadequate trainings, low rate of information literacy and professional status. It is needless to say that after one or two years many libraries will be digitized. Although the digital environment is built as a system, which can be used by its ultimate end user directly from their desktop pc, the role of librarian cannot be overlooked. Finally, in digital environment the librarian and information scientist is needed for packaging and repackaging of information, for electronic publishing, for reference purpose, to advise the user about the strategy to identify relevant electronic sources etc. Thus, the librarian is more or less a hypertext engineer.

## 8. Recommendations

The following are recommended for the polytechnic.

i. Considering the benefits of digital library, it is recommended that the polytechnic should have one.
ii. A steering committee could be set up with the view of digitalizing the polytechnic library.
iii. The wireless internet facilities of the polytechnic should also be improved to facilitate easy access for the creation of the polytechnic digital library.
iv. The polytechnic librarians should orientate the academic staff of the polytechnic about accessing the electronic resources/databases that will be subscribed to by the polytechnic.

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