

**ADDIS ABABA UNIVERSITY
SCHOOL OF GRADUATE STUDIES
SCHOOL OF INFORMATION STUDIES FOR AFRICA**

**THE POTENTIAL OF ELECTRONIC DOCUMENT DELIVERY
SERVICES FOR ACADEMIC LIBRARIES IN ETHIOPIA**

A THESIS SUBMITTED IN PARTIAL FULFILMENT OF THE REQUIREMENT FOR
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BY:

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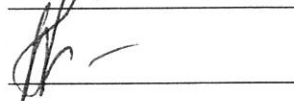
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DEDICATION

This thesis is dedicated to the late brother,
Yemane Birhan, whose living, had been a source of strength for me

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First and foremost, I would like to thank God for his merciful support to enable me recover from my illness. My special gratitude also goes to all my friends, colleagues and Sunday school brothers and sisters who were on my side when I was ill.

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ABSTRACT

One of the biggest stumbling blocks of effective resource sharing has been unavailability of delivery mechanisms in academic institutions in Ethiopia. The actual provision of information has been slow and inefficient. The academic calendar allows little or no lag time in the provision of needed documents. While technology has certainly made cooperation and document delivery more realistic, it is important to be aware of the role of IT and communication technology in the effectiveness of access and delivery of documents. Rapid and easy communication has lowered the geographic barriers that have often prevented or made impossible past attempts to develop resource-sharing programs.

In view of this, the study attempts to explore the potential of electronic document delivery services for academic libraries in Ethiopia to propose enhanced information resource sharing in this investigation. The study particularly focused on the need to share scholarly valued local and foreign journals and indigenous publications in order to optimally use these materials which already exist within academic institutions.

Findings from the literature review on technologies, standards and application protocols available for document delivery system have been discussed. Various electronic document delivery projects were also discussed in order to propose the appropriate system for Ethiopian situations.

The current status of academic libraries, their problems particularly in relation to document delivery services along with user requirements were reported. Based on the existing information and network infrastructure and user requirements identified through the survey work, attempt was made to discuss the desired features and system (hardware and software) requirements that can address the contemplated need

In attempt to use the potential use of Electronic Document Delivery Service (EDDS), specific applications were used to develop the prototype. The prototype development was based on Windows NT server software 4.0 platform, TCP/IP, Internet Information server (IIS), ColdFusion web based application development software, access ODBC driver and Microsoft Access. The prototype database for union lists of serials particularly journals were designed by Microsoft Access which is supported by coldFusion. Script codes had to be developed using coldFusion (version 4.0) application software. This prototype database and as well as the developed user interface had been discussed. As part of the final components of document delivery system Viewer paper port scanning software was used to scan a document. Using Multipurpose Internet Mail Extensions (MIME) compliant e-mail software the scanned document was sent as an e-mail attachment and sent to one of the library in Addis Ababa. The steps and its test result was documented.

Finally conclusion and recommendation were also made to synthesize the whole exercise attempted in this study and to suggest what needs to be done for deployment in academic libraries in Ethiopia as well as further research area along similar lines.

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CHAPTER ONE

INTRODUCTION

1.0 GENERAL BACKGROUND

Academic libraries in Ethiopia emerged with the commencement of higher learning, particularly, with the establishment of the University College of Addis Ababa in 1950. The number of academic libraries has increased with the expansion of higher institutions of learning. According to Ministry of Education (1999), currently, there are 18 government funded higher education institutions in the country. All of these institutions reportedly have libraries to support their training and research missions.

The primary functions of academic libraries are to fulfil their institutional training and research program requirements of the students, faculty, and other staff members. They basically meet these needs by acquiring and making the required information resources accessible and providing various information services relevant to the instruction and research programs.

However financial scarcity facing libraries, as well as the increasing availability of computer systems, led to a gradual emphasis in their mission from a focus on preservation to access to information. Providing access to information will be the principal goal and activity, and coping with technology and change will be the driving forces of the emerging "virtual libraries" (Gennaro, 1984). Virtual libraries have very small (if any) local collection but provides wide access to global information electronically from a central repository (or multiple sites) into the library or information

center that needs the information, or even directly to the client who has requested the information (Fisher, William and Leonard, B. G, 1997).

It is now widely recognized that it is no longer possible for even the largest research academic libraries to provide every item requested from their own collections. It is currently estimated that "no library can afford to acquire even half" of all published material (Graves and Wulff, 1990:53). Graves and Wulff mentioned that an average size academic library in the west may subscribe to a maximum of 10,000 journal titles representing at most only 4% of the titles available for acquisitions. This figure highly decreases when it comes to developing countries like Ethiopia. Addis Ababa University, for instance, presently subscribes to only 436 selected core scholarly journals, which is 0.17 % according to Graves and Wulff (1990). The reasons behind the falling proportion of acquired versus available materials are manifold:

- the relentless growth in the production of academic publications is compounded by the equally remorseless annual increase in serials prices;
- the drain on budgets caused by serials collections can lead to serious imbalance in collections whereby fewer and fewer books are bought.

The above factors brought the following problems for libraries.

- Inability to collect the increasing number of available sources of information; and
- Reduction in the number of serial titles subscribed to.

On the other hand, the rapid increase in the number of students and staff, and the growth of both undergraduate and postgraduate studies at higher academic institutions in the country has placed a heavy strain on library resources and has resulted in the rationing of student and staff access to library holdings.

However, the recognition of resource sharing in terms of interlibrary loan and document delivery has added a new dimension to service delivery; and many academic libraries now make use of them to overcome the above mentioned challenges. It is the emergence of these services that has led to the "just-in-time" versus "just-in-case" debate and to the development of "access versus ownership" policies.

One of the great achievements of the information age is the wide spread use of electronic technology to produce, store, manipulate, and distribute all kinds of information. Almost limitless possibilities have become realities by the arrival of digital technologies for handling text, sound and visual images. These possibilities have had impact on the whole concept of document delivery services. It has been argued that with continually improving capabilities of electronic document transfer, the time of comprehensive library collection is coming to an end. Libraries can and should concentrate on the core collection and rely on remote supply for every thing else (Cornish, 1997).

Clients are still largely dependent on libraries and expect libraries to fulfil their information needs. Librarians subsequently become obliged to address the problem and look for alternative, more effective ways of meeting these needs. Technologies such as computerized databases, including CD-ROM, enable librarians to meet some of these

needs. These technologies make it easier for users to find an access to information about the material that they may require.

Access to information has become rapid and it is possible to search a database and request directly. To this end electronic document delivery provides a streamlined method of supplying requested information to other academic institution libraries.

The growing potentials and availability of information technology has enabled the development of various forms of electronic document provisions, ranging from single article delivery to complete electronic journals.

1.1 STATEMENT OF THE PROBLEM

Like any libraries, Ethiopian academic libraries have encountered the problems discussed in the background above. From the observations and informal discussions made for the purpose of this work, and the academic libraries' status report presented at a workshop (held in Addis Ababa from 3-6 September 1998), it has been established that academic libraries in Ethiopia are characterized by the following major short comings (Addis Ababa university, 1999).

- ◆ The availability of information resources, especially of those with scholarly value have been described as extremely poor in most academic libraries in Ethiopia.
- ◆ The absence of well functioning delivery systems for local research outputs and poor bibliographic control of indigenous publications.
- ◆ Lack of mechanisms through which libraries know what is available in each of the other libraries:

- ◆ Their budgets being meager, they hardly can acquire materials that their users demand, and must instead borrow from each others collections and depend on other foreign libraries or agencies for document supply.
- ◆ High costs involved in traditional document delivery operations, such as staff time, postage, shipping costs etc.:
- ◆ Time required in requesting and supplying documents that affect provision of documents on time to their users ;
- ◆ Losses of materials.

The survey result of this study indicated that, out of 17 academic libraries in Ethiopia, 13(76.5%) offer interlibrary loan/document delivery services to their users. The majority of these document delivery practices are fairly traditional in terms of methods of request and delivery of documents. A little use of e-mail had been made for the request of documents by the Addis Ababa University Library via the American Association for the Advancement of Science (AAAS) project; however, the delivery made by DHL was costly. Otherwise, requests and deliveries of documents are mainly made by ordinary postal mail.

The manual delivery system together with the existing distance between document lenders and receiver libraries has been one of the reasons for the delay of documents requested. This also increases in the overall cost of the document, as well as the probability that it will be lost in transit.

Amidst rising costs, shortage of budgets of academic libraries, and the information explosion, the library's role remains to mediate access to recorded information required by their users, even if each library is unable individually to acquire and preserve its information sources. To continue to provide users access to as wide an array of information as possible, academic libraries have been making shift from the acquisitions of materials for local collections to cooperation with other libraries to provide access to those located at remote institutions such that larger percentages of documents could be requested and delivered from non local sources. This would imply a change in emphasis from an ownership to an access library policy.

There is a need, therefore, to utilize document delivery services as one means of resource sharing and cooperation effectively and efficiently in order to address the problems. To this end, the study attempts to explore the potential of Electronic Document Delivery Services (EDDS) using existing resources (e.g. Internet). In this regard, the use of Electronic Document Delivery Systems (EDDS) has the potential to overcome, or at least mitigate, some of these problems.

This research project is carried out with the aim of proposing EDDS, that will enhance resource sharing among academic libraries in Ethiopia.

1.2 JUSTIFICATION FOR THE STUDY

In the workshop held in Addis Ababa from 3-6 September 1998, participants and information professionals raised issues of document delivery services and discussed their major problems extensively and adopted resolutions. Amongst the major issues raised

during the workshop and considered as a base for this study are (Addis Ababa university,1999):

1. Workshop participants have recognized that the ever increasing information, escalating prices of journals, lack of skilled manpower, and meager financial resources have necessitated exploring the possibility of co-operative venture in technical services, such as, interlibrary loan, acquisition, cataloguing, etc.
2. The vision of electronic information as the solution to the library problem is realized as the trends of the future that will inevitably prevail.
3. The importance of published and unpublished locally produced scholarly publications, and hence creating a mechanism for accessing has been considered.
4. It is believed that participants have realized the importance and feasibility of electronic document delivery service among academic libraries in Ethiopia and discussed on the possibility of developing project.

A further justification for the consideration of EDDS to tackle the problem at hand emanating from the success of London and Manchester Document Access (LAMDA), Regional Electronic Document Delivery Service for Australia (REDDS) and other projects of different countries indicates the possibility of Electronic Document Delivery Services provided that technical and other capability is there. The technology that helps to scan original documents and send the message via electronic mail across a network (Internet) so that it can be read/printed, already exists in Ethiopia.

With the existing Multi-purpose Internet Mail Extensions (MIME) compliant E-mail, scanning, printing and standard technologies, EDDS could be technically feasible for academic libraries in Ethiopia provided that the existing network infrastructure in the country in general and the academic institutions in particular is reliable and is developed well.

Institutions such as Addis Ababa University, Alamaya Agricultural Univesity and Gonder College of Medical Sciences have started the project to establish a network infrastructure that enables them to connect within and between their campuses. This will make the implementation of EDDS among academic institutions much more feasible.

Electronic Document Delivery Services has a number of advantages :

- eliminate problems of long distances and delays, shipping costs, and losses of materials;
- increase in access to a broader range of primary documents from local and abroad.

Last but not least. EDD could be started as small 'pilot' projects and could be scaled upwards over time, gradually providing and facilitating the supply of an increasing breadth of information, thus, improving resource sharing among academic institutions in Ethiopia.

Hence, for the proper utilization of available limited resources and getting the optimum use of EDDS, the importance of this study cannot be over emphasized.

1.3 OBJECTIVE OF THE STUDY

3.1 GENERAL OBJECTIVE

The general objective of the study is to investigate the existing manual-based document delivery system of academic libraries in Ethiopia with a view to propose an enhanced resource sharing among the academic libraries through the application of Electronic Document Delivery Services (EDDS).

1.3.2 SPECIFIC OBJECTIVE

The specific objectives of the study are to:

1. examine the current document delivery environment within which documents are provided to end-users, outlining the problems that affect the speed and efficiency of the document delivery process;
2. describe the set of converging technologies and international standards that are available to create electronic document delivery (EDD) systems;
3. look into a number of successful electronic document delivery projects launched in other countries in order to propose the most appropriate alternative to cater for the needs of Ethiopian academic libraries;
4. discuss features and system requirements of the proposed system;
5. develop a prototype to demonstrate how electronic document delivery system works

1.4 SIGNIFICANCE OF THE STUDY

The significance of the study and the contributions it can make arise from the fact that it addresses one of the important issues related to higher education which has a national bearing. As pointed out in the background discussions (page 3), to have access and

supply of primary documents such as scholarly journals, indigenous publications within academic institutions contributes to the over all goals of higher education by finding solutions to some problems (section 1.1) of academic library services.

The study will also provide the necessary information on the current status of academic libraries with respect to document delivery services and bring into focus those major problems in a comprehensive manner for positive action by concerned authorities.

Electronic document delivery service will provide libraries and end users with primary documents, such as Journal articles, by allowing them to select, request, and obtain electronic documents directly from their local computers. It can also serve as a starting point for further study and implementation of electronic document delivery services among academic institutions.

1.5 SCOPE AND LIMITATIONS OF THE STUDY

The scope of the study is confined to academic institutions that are under the Ministry of Education. It excludes private institutions because they are few in number and most of them are not yet recognized by the Ministry of Education.

Due to time constraints it was not possible to develop full-integrated EDDS which encompasses all the functions and components. For the purpose of demonstration a prototype was developed. Since institutions are scattered throughout the country a prototype of databases and web page was developed in a comprehensive manner which could be customized by each institution.

1.6 METHODOLOGY

1.6.1 SURVEY METHOD

To understand the need and to make document delivery more efficient through electronic means, it is useful to examine current patterns in document delivery and the obstacles hindering its overall efficiency. To do this, a survey research method was used. The survey assists to find information and data about the existing patterns of information flow, exchange and resource sharing and other related issues (Leedy,1989).

To carry out the survey the following techniques or instruments were employed.

1.6.1.2 QUESTIONNAIRES

Questionnaires were distributed to all government owned academic libraries to collect data and information about the existing situations of each library. Questions were carefully set to collect the major problems libraries have faced with respect to information resource sharing via interlibrary loan/ document delivery services.

1.6.1.3 INTERVIEWS

Interviews were conducted with information professionals (Appendix two) who have interlibrary loan or document delivery services. Before conducting an interview discussion guides (appendix three) was prepared and sent to the respondents to give enough time to provide an answer for the questions.

1.6.1.4 OBSERVATIONS

On site observations in those institutions (appendix four) having ILL or document delivery services has been used to observe library operations with especial emphases on document delivery functions. This technique was applied to verify the data collected

through other means as well as to get information that was not attainable through interviews and questionnaire.

1.6.1.5 DOCUMENT ANALYSIS

Various documents such as scholarly journals, manuals, annual and technical report on the topic of the research and related aspects was reviewed.

After the data has been collected, Microsoft Word was used to keyboarding the report, and the survey result is analyzed manually. Microsoft Access was used to create databases (Serials list). ColdFusion (web application construction kit) version 4.0 was used to develop Web Accessible database and scripts.

1.7 ORGANIZATIONS OF THE THESIS

The thesis is organized into six chapters. The first chapter encompasses introduction and methodology. Chapter two provides an overview of document delivery service: its evolution, close attention was given to EDDS, its convergent technologies, international standards and application protocols, copyright issues and various EDD projects. In the third chapter survey results along with major problems of libraries and their requirements are presented. Chapter four presents features and system requirements of the proposed system. Fifth chapter is prototype of EDDS and test results has been presented and finally chapter six is conclusion and recommendation.

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CHAPTER TWO

DOCUMENT DELIVERY SERVICE: AN OVERVIEW

2.0 INTRODUCTION

This chapter provides background information about document delivery service: its evolution, overview of Electronic Document Delivery Service (EDDS), standards and application protocols available for it, copyright issues, and finally various EDDS projects have been discussed in order to propose the most appropriate system for Ethiopian situation. The proposed system is discussed in chapter four.

2.1 EVOLUTION OF DOCUMENT DELIVERY SERVICE

Document delivery services have undergone many changes in the last thirty to fifty years. Before the 1950s, libraries bought journals and delivered documents from their own stock. Libraries experienced little financial pressure on acquisition budgets and were in a position to add large numbers of new titles to their collections. They also had no practical means to deliver documents other than to buy them and allow users to read them. In terms of library policy, entire issues or bound volumes would not be lent and individual journal articles could thus not be supplied in response to an interlibrary loan (ILL) request (Kinnucan, 1993). Libraries subscribed to print-format journals just in case someone at some point needed the information contained in the articles (Dougherty, 1993). This off-the-shelf procedure of document delivery was probably satisfactory at the time, but storage space was soon to become a problem due to the increase in journal titles, especially in the field of natural science (Luijendijk, 1994).

Photocopying machines were introduced in the 1960s, which enabled copying of articles, but libraries still endeavored to keep as many relevant print journals as possible. Journals were accessed via secondary journals, such as Index Medicus and Chemical Abstracts. Relevant articles could be traced and copies requested from other libraries via the ILL service when necessary. This enhanced the ILL service but sometimes still entailed long delays in document delivery and frustration for library users. Libraries did not focus on rapid document delivery and accepted the limitations of the ILL system. It took several days for a document to be dispatched locally or from overseas via mail services (Braid, 1993).

In the 1980s, the traditional ILL was further enhanced with the use of the fax machine and electronic document delivery (Everett, 1993). The biggest drawback to interlibrary loan, however, continued to be long delays in document delivery. The processing time to execute the order often amounted to several days (Everett, 1993). At the one end, there was a delay in finding out what was available and where and at the other end a delay in tracing the journal, photocopying the article and posting or faxing the requested article. The fax procedure is a vast improvement in rapid document delivery, but it is still part of the cumbersome ILL service, which does not always meet the client's expectation of supplying the document immediately. Some documents may not transmit well via fax. These include photographs, detailed charts, maps, and graphs, text including scientific and mathematical symbols, small print, and foreign languages with diacritical, vocalization, or other small marks, and poor quality photocopies. In order to send such materials without loss of clarity an improved method in requesting and sending the

request was thus required. Hence different countries have started to implement numerous EDDS projects. Some of these projects are discussed under section 2.8.

2.2 IMPETUS FOR DOCUMENT DELIVERY SERVICE

The basic function of a library is to provide users to have access to information which they require. It is, however, not possible for any library to have all the material its users need. To alleviate these problems resource sharing became increasingly important and, as a consequence interlibrary loan and document delivery have changed from peripheral activities to essential services (Cornish, 1997). Among the forms of co-operation for resource sharing purposes, interlibrary loan and document delivery services are some of the most important services especially within academic institutions. The major factors for the accelerated growth of interlibrary loan and document delivery services are (IFLA, 1995):

- Increased user access to bibliographic information. The arrival of new technologies, such as on-line searching, CD-ROMs and locally mounted index databases, has greatly enhanced access to materials beyond the local collection.
- Improved requesting procedures. Interlibrary loan processes have become increasingly automated resulting in significant improvements over manual methods. This automation has largely improved in facilitating the location, verification, and exchange of ILL messages between lending institutions.

The ability to deliver a primary document to a user in the form of a photocopy expanded the traditional domain of interlibrary loan from simple book lending to include document delivery services.

2.3 COMPONENTS AND FUNCTIONS OF DOCUMENT DELIVERY SERVICES

Document delivery is used in its widest sense, referring to all aspects of the process of providing documents to end users. Specifically, it is defined as the provision of documents as surrogates (e.g. photocopies, microfilms, and digital images) that are retained by the user. Documents may take the form of photocopies or original, requested by telephone, e-mail or ILL subsystem, procured from libraries, document supply centers, or commercial suppliers, and sent by ground mail, courier or fax.

Currently, the most prevalent form of document is the photocopy that allows the delivery of individual journal articles and other types of documents inexpensively and efficiently.

Components that constitute document delivery environment include:

- **users** who originate the request
- **various document types** that are the focus of transaction
- **sources** from which documents are procured.

The process of document delivery can be seen to be composed of several general functions or processes, regardless of the specific types of documents, requesters, and document sources. These functions are:

- **document selection**, involving the identification of a document that meets a user's information need;
- **request management**, including verification of citation, location of a document source(s), submission of the request to the document source, request tracking, as well as establishing copyright compliance and billing.

- **document retrieval**, involving the storage of media of the original documents that affect the form of retrieval and other processes at the document sources;
- **document transfer**, involving the delivery of a document from a document source to a requester.

The variety of sources and methods of obtaining materials may be considered to constitute a document delivery environment- the setting within which information is provided to end users. Although many of the functions have been automated to some degree, problems remain that reduce the efficiency of the overall document delivery process. Such obstacles include, for example, manual procedures, redundant of clerical work, and conflicting communications channels.

2.4 ELECTRONIC DOCUMENT DELIVERY SERVICES (EDDS): AN OVERVIEW

The term Electronic Document Delivery (EDD) may have many meanings depending up on the context. For example, Cornish (1997:160) has defined it as "supplying a text in electronic form which is required by a reader but which is not in the library being used by the reader at that time". The International encyclopaedia of Information and Library Science (1997:130) defines "Electronic Document Delivery" as the transfer of information from publisher or library to user by electronic means such as e-mail, on line network or on CD-ROM. In this study, the term EDD is used to mean the automatic request and delivery of documents (Journal articles, a portion of a monographs, etc.) using communication networks such as Internet between the requesting and supplying libraries.

The delivery mechanism is via the Internet and e-mail. For the period of delivery the document must exist in electronic form; however, the original document could exist as:

- a paper document or
- an electronic document

The electronic document itself is in a variety of formats. It could be an image, a simple ASCII text file, an enhanced format document such as standard generalised mark-up language (SGML), a compound or multimedia document. The document could also be stored in a variety of media, e.g. on hard disk, optical storage and be accessed in a various ways ranging from using operating system level commands to sophisticated and user friendly access and presentation software (e.g. Netscape).

At the end of the process the document could:

- remain in electronic form and be accessed by terminal device or
- be output in hard copy form

2.4.1 ADVANTAGES OF EDDS

Electronic document delivery service has a number of advantages over the other means of document delivery system. It provides an innovative way to dramatically reduce the cost of conventional document delivery mode while providing total security. Some of the other benefits and features are:

- Cost saving it is cheaper than courier, mail and fax
- Instant request and delivery of documents than the rest
- Simultaneous delivery of document (s) to multiple recipient at a time

- Reliable and highly secured method of delivery of documents.

The following table shows a brief comparison of different delivery service mechanisms.

Table 2-1 Comparison of different Document delivery Mechanisms

Parameters	Courier	Postal Mail	Fax	EDDS
Promptness	Average	Low	Average	High
Cost	Very high	High	Very high	Less
Document quality	Very high	Very high	Average	High depending on the quality of viewers and printer
Reliability	High	Less	Average	High

2.4.2 MULTIPURPOSE INTERNET MAIL EXTENSION (MIME) BASED ELECTRONIC DOCUMENT DELIVERY

Sophisticated and user friendly access and presentation software such as Netscape are rapidly improving the delivery of electronic documents to the end user directly. However, there remains a substantial amount of information that exists only in paper format and that will not be scanned for permanent storage, for either economic or copyright imperatives. High bandwidth networks with reasonable response times are also not universally available, and even in web may not be practical or efficient.

Starting with either an electronic or paper document, the goal is to transmit the document electronically using e-mail – via a telecommunication network-either to another library, or to the clients’ desk top where the document can be printed or viewed electronically.

The technology already exists to take a paper document, scan it, send it by electronic mail across the network. the recipient can then decode it, read it and even print a copy if required. However, the user at both ends need to be computer literate and to be able to manipulate different applications to achieve the end result. What is required is a system that is easy to use as fax. Another problem of some of the technologies used today is that both the transmitting and receiving workstation have to be operational at the same time to enable transmission to occur. There is also a need to have compatible hardware and software at either end.

The solution proposed (*Blanco, 1996*) is based on the use of Multipurpose Internet Mail Extensions (MIME). It is a specification which builds on the standard Internet mail to allow the interchange by mail of more complex documents than can handled by standard mail, particularly those which contain long messages, non ASCII characters and multimedia content such as images audio video.

The web uses the multipurpose Internet mail extensions (MIME) (Borenstain and Freed 1993), set of globally recognized data types. To differentiate this wide variety of “documents” MIME defines rules for exchanging information that may have non textual parts. One key part of the MIME rule is a standard set of names for the ways that information can be coded and transmitted over networks (Yeager and McGrath, 1996). Each name refers to a specific way that information can be transferred, and MIME names are registered with an international authority.

Web browsers and servers use the MIME standard set of names for encoded pictures, text, sounds and video. The creation of a digital document specifies how the document is encoded by labelling it with the appropriate MIME type.

2.6 CONVERGENT TECHNOLOGIES OF EDD: AN OVERVIEW

There are a number of international standards and technologies that are becoming available to create such EDD software applications. The phrase, convergent technologies, refers to the fact that developments in a number of separate fields have been coming together to make such systems possible. The “building blocks” of the convergent technologies and standards that are available to create EDD software applications are electronic document conversion and generation, storage technologies, communication technologies and standards, and hard copy production (IFLA, 1995):

2.6.1 ELECTRONIC DOCUMENT CONVERSION AND GENERATION

A major problem in shifting from delivery of paper documents to electronic documents is the extensive body of print materials that libraries have collected that must be converted into electronic form. Scanning and optical character recognition (OCR) technologies that automatically put materials into electronic format can help speed the conversion process.

Although the above technologies enable to convert existing paper documents into electronic form, there is an increasing trend to generate documents in electronic format. This will be true during all stages of their development, from initial creation on word processors, through editing, to final typesetting on screen display. Computer text editors and word processors of varying degrees of sophistication have largely been used for

producing fair copies of manuscript documents; non-textual documents such as graphics, illustrations and maps, which are increasingly originated by electronic means.

After the documents has been digitized or generated electronically storage technology is important for the purpose of storage. Storage technologies could be optical storage technologies or magnetic storage technologies. Optical storage technologies have certain advantages over magnetic storage technologies. The most notable advantages of it include:

- greater storage density;
- less sensitivity to electromagnetic fields;
- less susceptibility to physical damage in the read write device;
- easy loading and removal.

For these reasons, optical disc storage merits the consideration as a mass storage medium for electronic document delivery.

The other technologies that are important in EDDS are communication technology and standards. A number of communications technologies and standards are emerging that supports the digital transmission of electronic documents. Data communication technologies that are available to transfer electronic documents range from simple facsimile, which combines image scanning technology with data communication technology, to more complicated network technologies that can support sophisticated EDD applications, including state-of-the art, high-bandwidth Fibber Distributed Data Interface (FDDI), Wide-area Network (WAN) technologies, and communications infrastructures such as research computer networks (IFLA,1995).

2.6.2 APPLICATION PROTOCOLS AVAILABLE FOR DOCUMENT DELIVERY

The two protocol suites of particular interest are Transmission Control Protocol /Internet Protocol (TCP/IP) a mature and widely implemented suite that is considered to be the de facto standard and the Open System Interconnection (OSI) a suite of protocol standards that will allow the computers of different manufactures to communicate with each other and share resources. While most institutions have endorsed *TCP/IP* the protocol suite and have stated an intention to integrate to it.

TCP/IP - is initially developed for the U.S. Defense Advanced Research Agency from the mid 1970's. It is today the most widely used set of standardized, vendor independent protocols. TCP/IP supports communications among more hosts and different data links than does any other protocol suite. It can be carried over Ethernet Optical Fibber Links, DECNET, X.25 networks, satellite links, and high-speed telephone lines. TCP/IP is also the basis of the largest world-wide network (the Internet), includes Simple Mail Transfer Protocol (SMTP) and File Transfer Protocol (FTP).

SMTP- is the TCP/IP protocol for electronic mail. This defines an envelope to be used in delivering mail messages, together with commands and conventions for performing the delivery it uses a simple mail format. The basic format uses a set of headers, containing data such as sender's name, recipient's name, subject and date, and a body that contains the text of the message.

FTP- is the TCP/IP File Transfer Protocol based on peer-to-peer interactions between a local and a remote host. It supports:

- the transfer of files

- the transfer of only complete files
- a type of file structure; binary files, ASCII text files, EBCDIC text files, and “paged” files

ILL Protocol is an Interlibrary Loan (ILL) protocol available for resource sharing mechanism in exchanging books and periodicals among institutions. The ILL protocol is a computer communications standard based upon the OSI reference Model for exchanging ILL messages such as borrow requests, indications of receipt and return of borrowed items, renewal requests, notifications of lost items, and cancellation of requests.

The fundamental benefit of the ILL protocol is that it allows ILL systems to communicate with each other regardless of the design of the ILL software, the hardware used to run the system, or the communications services selected to transmit the ILL protocol messages (Turner, 1997). A second benefit is that the standardized structure and content of the protocol established a foundation upon which to build a variety of compatible ILL systems and services. A third benefit is the improvement of transaction control and tracking. Further more, the transaction messages can be used to generate statistics on ILL message traffic service provision and other management concerns.

2.7 INTELLECTUAL PROPERTY RIGHTS

One of the major issues in electronic document delivery is that of intellectual property rights (IFLA, 1995) such as patents, trade secrets. Copyright has not kept pace with rapid advances in information technology: basic assumptions that were true in a paper based environment are no longer true in an electronic environment of particular interest of

libraries are those intellectual property laws protecting original works of authorship known as copyright laws.

The issue of copyright in the electronic environment is extremely complex and multifaceted. Historically, copyright was based on the premise that individuals should be compensated for their labor that authors, artists, scientists, and other creators of intellectual “property” should be protected from the unauthorized copying of their work (Miller and Blumenthal, 1986).

With the advent of modern information technologies, controlled copies is no longer valid. The problem of monitoring and controlling copies becomes even more acute, and the application of current copyright is more problematic because of electronic and digital technologies such as personal computers, optical storage technology, and computer networks. In electronic document delivery system millions of copies of a work may be accessed and copied by millions of users. The potential for multiple users to simultaneously access and make their own copies of documents will make the application of copyright law extremely difficult (Lynch, 1991). There are a number of most important issues regarding copyright and electronic document delivery.

Fair Use principle also extends to electronic information. This should be done in order to maintain the current role of the library “as distributor of information without charge to the public” (Duggan, 1994:24) and to maintain the free flow of information for scholarship, research, and education.

Libraries may also exercise fair use rights for their own benefit, just as individuals might, for example, to make a copy for the library collection of a work that is unattainable through normal channels. Arguably a library might even be able to build a special collection, at least partially through copies made pursuant to the fair use statute in those cases where access to original works is limited

Generally, it would be permissible to make a copy of the rare book as an exercise of the libraries right of fair use.

A number of solutions have been proposed to deal with the inadequacy of copyright law in the current electronic environment, ranging from the complete overhaul of the copyright system to charging royalties for documents on a per use basis. Some of these solutions, derived from and found in greater detail in Oakley (1991), listed below.

- Amend current copyright laws
- Overall revision of the copyright act
- Design a sui generis copyright law
- Increased reliance upon compulsory licences

2.8 ELECTRONIC DOCUMENT DELIVERY PROJECTS AND TRENDS

Some of the trends in EDDS (Blinco,1996)are:

- Delivery of electronic version of requested document to an end user desktop
- Development of an integrated EDD system that allows end user driven discovery of holdings, ordering and electronic supply. In this line there are many projects and initiatives including EDDIS (Electronic Document Delivery- the integrated solution),

the JEDDS (Joint Electronic Document Delivery Software), SEREN (Sharing of Educational Resources in an Electronic Network in Wales)

- Development of MIME based document delivery project.

There are a number of successful electronic document delivery projects launched in the world. For example, the REDD (an electronic document delivery model for Australia), LAMDA (London-Manchester Document Access) projects are the most successful ones to be mentioned. However, Some of these projects have limitations. For instance, RLG's Ariel software is designed to work on PCs connected to local area network that has in turn has a direct high speed connection to the Internet; RLG does not recommend using Ariel over low speed or dial-up connection to the Internet, because even though Ariel document files are compressed, they can take a comparatively long time to transfer over a slow network.

REDD (<http://130.102.42.183/reddlook/vala.htm>) is an electronic document delivery system which uses a World Wide Web (WWW) browser, Multipurpose Internet Mail Extension (MIME) and email to request and send documents via the Internet. It is a co-operative project of Griffith University, Queensland University of Technology and the University of Queensland libraries which was made possible through financial assistance from a Research Infrastructure (Equipment and Facilities) grant from the Commonwealth Department of Employment, Education, and Training.

The major aim of REDD was to develop and implement electronic technologies to enable rapid request, scanning (converting to digital image) and electronic delivery of materials via Australian Academic Research Network (AARNet) / Internet.

EDD uses Netscape and Common Gateway Interface (CGI) programs to request and supply scanned images to the participating interlibrary loan sections, with the potential to send scanned images to users' workstations.

The email containing the request is delivered to the email directory of the supplying library. These requests can be printed out and taken to the shelves for retrieval. Then the items are scanned and an image file is created. Once the item scanning is over, a background process takes the original message and adds it to the file name of the scanned image in HTML format. The return address is read from the message and the reply is emailed back to the requesting library.

The requesting library views the HTML-ised email message through its browser, and selects the link to the image which will launch the appropriate viewer for that image. This can then be printed out. As a housekeeping measure, a background process monitors the access log for the process and deletes image files that have been accessed.

LAMDA (<http://www.ucl.ac.uk/library/lamda/sconul.html>) was approved by FIGIT (Follett Implementation Group on Information Technology) in May 1995, as part of the Electronic Libraries (eLib). The original mission statement of the LAMDA Project was

"to set up the co-operative structure to provide a document delivery service to the users of academic libraries in London and Manchester. Each city has libraries with substantial holdings of books and journals, and requests of users from those libraries for journal articles not available in the 'home' library will be routed first to the other libraries in the city, then to libraries in the second city (London or Manchester) and if no location is found in either city, on to the British Library Document Supply Center. Whenever possible delivery will be by electronic means over the academic network, offering users a fast high-quality service."

In October 1995 the project went live between the nine supply libraries, and traffic has increased steadily. Off-the-shelf hardware and software has been used. The software is the well established Ariel for Windows, a document transmission system developed by RLG (Research Libraries Group) in the United States as a solution to fast interlending between remote libraries. The day-to-day LAMDA procedures are carried out by ILL staff in each Supply Library.

A typical LAMDA workstation comprises a scanner, a laser printer and PC. Since October 1995 LAMDA has grown from a successful project and is moving towards a commercial service with long term aims. The LAMDA service is fast, efficient and easy to use. The aim is to provide a requester with a reply within 48 hours of a request being sent to the supply library. Experience has shown that the staff involved enjoy using the service and are satisfied with the quality of the delivery.

EDDIS (<http://www.ukonl.ac.uk/serviceselib/projects/edds/>) electronic document delivery-the integrated solution (EDDIS) aims to produce an integrated, end user driven

identification, holdings discovery, ordering and electronic supply service for the non returnable items (typically journal articles) which could be used by all UK higher education institutions. The request mechanism will include facility to order returnable items (typically books) and be capable of handling the delivery of all types of item by traditional as well as electronic means. The main module will available either together or separately, to suit the particular needs of purchasing institutions.

- bibliographic search services (with the ability to select items from search results)
- holdings information for the selected items (including user-entered items bypassing bibliographic search) potentially giving the user choice of supplier, delivery method (including electronic transmission) cost
- order generation and progress checking.
- a fully network interfacing with wide range of existing databases and document supply services
- an accounts management system capable of handling all basic types of payments for documents, including copy right clearance fees if necessary, as well as internal accounting procedures.
- a report generation systems giving both financial and usage information as an aide to more effective service and collection management

RLG ARIEL is developed by research library Group (RLG). The Arial system is designed to deliver scanned, rather than faxed, images of documents over the Internet, as well as other computer networks. Also known as document transmission workstation, the system

consists of an IBM AT (or compatible) as a central processor, an HP scan jet plus scanner for the production of high quality images (300 dpi) and HP laser Jet IV Printer to produce output bound paper (Michalko, J. and Haeger, John 1994)

Ariel can be used in ILL departments and other document supply center as a rapid and convenient form of "on-the-fly" electronic document delivery the simultaneous and transmission of a document on demand. The system can handle text, photos, charts, formulae, and tables, as well as any other material that can be scanned. In operation, staff scan the requested documents which are then compressed by the system and stored for transmission over "computer network. At the receiving end, a microcomputer accepts the image and makes a laser quality printout on bound paper. Currently, Ariel runs on Ethernet and Internet, with Token Ring connectivity on the horizon.

Advantages of the Ariel workstation include the:

- Production of images of much greater resolution than fax
- Production of output on regular bound paper
- Use of off-the-shelf hardware
- Availability of the workstation for other uses word processing desktop publishing, scanning printing when not used as a transmission workstation.
- Ability to scan documents directly without the need to first photocopy the original.
- Ability to use the Internet, a high-interconnected computer network, that currently does not incur direct charges to the user.
- Capability for fast printing enabled by the PC/printer interface.

CHAPTER THREE

FINDINGS AND DISCUSSIONS OF THE CURRENT STATUS OF ACADEMIC LIBRARIES IN ETHIOPIA

3.0 INTRODUCTION

To understand the need for efficient systems supporting document delivery through electronic means, it is important to investigate the current status of academic libraries in Ethiopia with respect to document delivery services as one of a resource sharing means and their problems.

This chapter provides the survey results, their interpretation, problems and summaries. At end the requirements of the proposed document delivery system are presented.

The survey is conducted using data gathering instruments such as questionnaire, interviews and observations. The questionnaire (appendix one) contains five major sections containing related and interdependent questions. These are general information, library resources and computer facilities, information services, interlibrary loan/document delivery services, and information resource sharing and cooperation.

3.1 PRESENTATION OF SURVEY RESULTS

All government owned institutions under the supervision of the Ministry of Education were considered as the population of the study. There are 18 academic institutions in the country of which the two are universities and others are colleges and institutes. All of them have reported to have libraries. These libraries are considered an integral parts

of the institutions and reflect the goals and objectives of their parent institutions; with major objective of supporting the teaching, learning and research activities of the parent institutions. The policies governing the development and use of each academic library are provided by the parent institutions. Libraries are organized under the supervision of assistant deans of colleges/institutions or academic vice presidents of universities (the case of Addis Ababa University and Alamaya Agricultural University).

Some institutions have more than one library and they are taken as one in this survey. The Addis Ababa University library system has seven branch libraries serving different colleges and faculties in the capital also taken as one. However, another unit of the university, the Faculty of Veterinary Medicine, with its own library which is some 45-km south east of Addis Ababa is not part of the university library system and thus it was taken independently in the survey

The questionnaire was distributed to information professionals or senior assistants working in academic libraries through out the country. Out of 19 questionnaires distributed, 17(89.5 %) were returned. Hence, the survey result is presented and discussed for the 17 libraries. The two institutions (Dilla College of Education & Health Science and Jimma College of Agriculture libraries) did not return their response and hence they were not included in the survey.

Libraries included in the survey are:

- Addis Ababa University
- Addis Ababa Commercial College

- Alemaya Agricultural University
- Ambo College of Agriculture
- Arba Minch Water Technology Institute
- Awsa College of Agriculture
- Bahir Dar Teachers College
- Bahir Dar Poly Technique Institute
- Ethiopian Civil Service College
- Gondar College of Medical Sciences
- Jimma Institute of Health Sciences
- Kotebe College of Teachers Education
- Mekelle Business College
- Mekelle University College
- Nazareth Technical college
- Wondo Gent College of Forestry
- Faculty of Veterinary Medicine

3.1.1 GENERAL INFORMATION

When asked to indicate the major academic Programs or field of studies, 17 institutions answered as shown in Table 3-1. However, respondents indicated more than one field of studies at a time hence making the total number of institutions more than 17 and consequently percentage is greater than 100 %, The programs are presented in a comprehensive manner by broad field of studies.

Table 3-1 Field of studies by Institutions

FIELD OF STUDIES	INSTITUTIONS	%
Technology (Civil, Electrical, Mechanical etc.,)	7	47.2
Agricultural Sciences (Animal, Plant, soil, forestry Sciences etc.,)	7	47.2
Social Sciences (Geography, History etc.,)	6	35.3
Natural Sciences (Biology, Physics, Chemistry, Mathematics etc.,)	6	35.3
Business and Economics (Business, banking, Management, Economics, Accounting etc.,)	5	29.4
Languages (English, Amharic, literature, linguistics etc.,)	3	17.6
Education	3	17.6
Law	2	11.8

The number of staff members working in the libraries is presented in Table 3-2. The list displays Professional (BSC/BA, MA/MSC or Ph.D. in Library/ Information Science), Technical (Diploma in Library/information Science), Non professional (12th grade complete) and Others (working in libraries such as Janitors, Secretaries Etc.,)

Table 3-2 Number of Library Staff

Library	Number of Staff Members				
	A	B	c	D	Total
Addis Ababa University	21	9	114	27	171
Addis Ababa Commercial college	3	-	13		16
Alemaya Agricultural University	2	4	22	5	33
Ambo College of Agriculture	-	1	7	-	8
Awasa College of Agriculture	1	1	12	4	18
Arba Minch Water Technology Institute	2	1	14	-	17
Bahir Dar Teachers College	2	2	16	4	24
Bahir Dar Poly Technique Institute	-	4	12	5	21
Ethiopian Civil Service College	2	3	16	-	21
Gondar College of Medical Sciences	2	-	16	-	18
Jimma Institute of Health Sciences	2	3	39	-	43
Kotebe College of Teachers Education	2	5	17	3	27
Mekelle Business College	2	1	9	1	13
Mekelle University College	1	-	18-	4	23
Nazareth Technical college	1	3	12	1	17
Wondo gent College of Forestry	-	3	12	1	17
Faculty of veterinary Medicine	1	1	10	1	13

A= Professional B= Technical C= Non professional D= Others

When asked to indicate any staff with computer skill, 17 libraries answered this question as shown in Table 3-3.

Table 3-3 Libraries' staff having computer skill

Skill	Libraries	%
Computer skill	15	88.2
No Computer skill	2	11.8
Total	17	100

3.1.2 INFORMATION RESOURCES

When asked to indicate the holdings of libraries, respondents response is summarized in Table 3-4.

Table 3-4 Library Holdings

Library	Holdings in volume				Current serial titles
	Books/monograph	Back serials	Other documents	Total	
Addis Ababa University	402,649	22,000	69,225	493,874	436
Addis Ababa Commercial College	45,000	55,000	10,050	110,050	20
Ambo College of Agriculture	15,326	2,000	1,200	18,526	6
Alemaya Agricultural University	45,759	14,287	34,000	94,046	103
Arba Minch Water Technology Institute	17,000	10,000	2,200	29,200	5
Bahir Dar Teachers College	67,000	10,088	10,500	87,138	34
Bahir Dar Poly Technique Institute	52,000	2,000	53	54,053	4
Ethiopian Civil Service College	17,000	1,000	600	18,600	100
Gondar College of Medical Sciences	30,000	7,200	5,000	42,200	28
Jimama Institute of Health Sciences	55,000	13,000	11,100	79,100	25
Kotebe College of Teachers Education	37,568	1,609	945	40,122	8
Mekelle Business College	18,000	2,000	12	20,012	16
Mekelle University College	14,000	7,500	200	21,700	34
Nazareth Technical college	29,000	724	21,085	50,809	16
Wondo gent College of Forestry	10,000	300	120	10,420	38
Faculty of veterinary Medicine	15,000	5,000	3,300	23,300	5

When asked if the institution have locally produced scholarly publication, 58.8%(10) said "yes" and 41.2% (7) said "no". When respondents who said " yes" were asked to indicate their titles, frequencies and starting date, the response is presented in table 3-5.

Table 3-5 Locally Published Scholarly journals

Title	Publisher	Date of first Issue	Frq. Per year
Journal of Language studies(JOLS)	Kotebe college of teachers Edication	--	2
Ethiopian Medical Journal	Ethiopian Medical Doctor's Association	1962	4
Journal of Ethiopian Studies	Addis Ababa University- IES	1963	2
Journal of Ethiopian Law	Addis Ababa University-Faculty of Law	1964	1
ZEDE(Journal of Ethiopian Association of Engineers and Architects)	Ethiopian Association of Engineers & Architects	1965	1
Ethiopian Journal of Education	Addis Ababa University-Dep. Of Education	1967	2
Ethiopian Journal of Development Research	Addis Ababa University-IDR	1974	2
Ethiopian Pharmaceutical Journal	Association of Ethiopian Pharmacists	1975	1
Ethiopian Journal of Agricultural Science	Institute of Agricultural Research	1978	2
SINET: An Ethiopian Journal of Science	Addis Ababa University-Faculty of Science	1978	2
Ethiopian Journal of Health development	Ethiopian Public Health Association	1984	2
East African Social Science Research Review	OSSREA-Organization for Social Science Research in Eastern Africa	1985	2
Bulletin of the Chemical society of Ethiopia	Chemical Society of Ethiopia	1987	2
Ethiopian Journal of Health Sciences	Jimma Institute of Health Sciences	1990	2
Water : Ethiopian Journal of Water Science and Technology	Arbaminch Water Technology Institute	1997	2
Research bulletin of the Gonder college of Medical Sciences	Gonder College of medical Sciences	1998	2

When asked to indicate allocation of budget for purchasing of books/ Monographs and scholarly journals, 58.8% (10) said, " they do not know their budget", 11.8% (2) said " they know their budget" and 29.4% (5) said "they know their budget partially ".

Respondents were asked to indicate the subscription rate of scholarly journals for the last five years. 29.4% (5) said "Decreased", 23.5% (4) said "increased", and 58.8% (10) did not respond.

When asked about the existence of any mechanism for obtaining or accessing locally published materials, 94.1 % (16) said "yes" and 5.9% (1) said "no". Table 3-6 summarizes document delivery facilities currently in use. Respondents were allowed to chose more than one delivery mechanisms as a result, the total number of frequency (# Institutions) is greater than 17 and percentage is also greater than 100 %.

Table 3-6 Delivery mechanisms in use for locally published Materials

Mechanism	Institutions	%
Postal service	17	100
In person	11	68.8
E-mail	2	12.5
Others	2	12.5

One thing to be noted here is the non-existence of electronic full text journals delivered by all the 17 institutions.

3.1.3 COMPUTER FACILITIES & OTHER EQUIPMENT

As table 3-7 indicates, except Ambo College of Agriculture library all them have computers. Table 3-7 shows summary of respondents.

Table 3-7 Computers and Other Equipment

Library	Item Description					
	Computer	Qty	Printer	QTY	Copier	Scanner
Addis Ababa University	IBM,HP, DELL, NCR COMPAQ, AT&T(IBM compatible), Intel based processors 8MB,16MB,32MB &above. Dos & Windows operating system	21	Desk Jet 520, Epson LQ- 1170, Epson- 2170 HP Rugged writer, Hp laser Jet IV,HP laser Jet V	12	2 Ta Trimph Adler 7 Adler , 1 Canon	IHP Scan Jet 2c, 1 HP Scan Jet 4c
Addis Ababa College of Commerce	DEL. COMPAQ 16 & 32 MB RAM	2	Epson-LQ 1170 & 2170	2	-	-
Ambo College of Agriculture	-	-	-	-	-	-
Alemaya Agricultural University	MICRON, ACCER, Mylex, 4MB RAM, 32 MB RAM Windows 3.1 & 95	3	Epson, Laser Jet 6L	2	1 Heavy duty	-
Arba Minch Water Technology Institute	IACER 32 MB RAM	1	1 EPSON		1 canon	1 Hp Scan
Awasa College of Agriculture		2	Epson , Laser Jet 6L	2	2 CANON, 1 Xerox	-
Bahir Dar Teachers College	AST, MAGNAVOX 8MB RAM,16 & 32 MB RAM Dos & Windows 3.1,95 & 98	2	Laser JET 4L	1	1Xero 5621,1Xerox , 1 REX Rotary	4C Color Scan
Bahir Dar Poly Technique Institute	Gateway 2000, Pentium, 16RAM, Dos & windows3.1,95,98,NT	2	Laser Jet 6L, Epson LQ-2170	2	-	1 Hp scan
Ethiopian Civil Service College	IBM/PS2,UNISIS,DELL 64KB,16 &32 MB RAM Windows 3.1,95	3	Epson, Laser Jet	2	Lanier	-
Gondar College of Medical Sciences	COMPAQ Pentium 16 MBRAM Windows 95	1	Epson LQ-2170	1	Canon NP 120	-
Jimama Institute of Health Sciences	COMPAQ 16 & 32 MB RAM,	3	Epson LQ-1170, Epson Lq-2170	2	1 copier	-
Kotebe College of Teachers Education	LENDING ADGE 640kb RAM Windows 3.1	1	Epson LQ-1170, IBM	2	-	-
Mekelle Business College	COMPAQ 16MB,Windows3.1, 98	1	Laser Jet	1	1	
Mekelle University College	MAGNAVOX, Pentium II 32 MB RAM Windows 95	2	Laser Jet 4 plus, Epson-LQ 2170	2	2Canon40li vetti	-
Nazareth Technical college	IBM, Pentium, 32MB RAM, Dos &Windows 95	2	Epson, Hp Laser Jet	2	-	1 Epson GT-5000
Wondo gent College of Forestry	AST 16 MB RAM	1	-		-	-
Faculty of veterinary Medicine	Pentium II 32 RAM, Dos & Windows 98	1	Hp laser Jet 6L		-	-

In an attempt to get information about the use of these computers, the researcher has asked 16 institutions who have computers, and the summary is shown in table 3-8. Since respondents were allowed to indicate more than one type of purpose at a time the number of libraries and percentage is greater than 16 and 100% respectively..

Table 3-8 Purposes of computer use

Purpose	Libraries	%
Word Processing	16	94.11
Bibliographic /Library data Bases	14	87.5
CD-ROM search	9	56.3
On line search	8	50.0
E-mail	8	50.0
Financial services	2	12.5
Others	2	12.5

With regard to Internet connection the result is summarized under table 3-9. below.

Table 3-9 Internet Connectivity

Connectivity	libraries	%
Internet	11	64.7
No Internet	6	35.3
Total	17	100.0

Those who said they have Internet connectivity were asked the purpose of use, 64.7% (11) said they are using the Internet for e-mail, literature search, sometimes for selection and ordering of materials. Those without connectivity were asked whether they have plan to subscribe to the Internet services all of them responded positively.

3.1.4 INFORMATION SERVICES

The libraries were asked to indicate the major area of services that they provide to their clients, the summary of their response is presented in table 3-10.

Table 3-10 Services provided

Services	Libraries	%
Referral	17	100
Reading and loan	17	100
CD-ROM search	10	58.8
Reprography (photocopy)	9	52.9
Inter library loan	7	41.2
Current awareness	7	41.2
Document delivery	7	41.2
E-mail	6	35.3
Literature search on the Internet	5	29.4
SDI	1	5.1
Other	2	11.8

When asked the type of bibliographic services do the libraries provide, all libraries responded as shown in table 3-11. Respondents were allowed to tick more than one alternatives if they find it applicable, as a consequence total number of respondents and percentage is greater than 17 and 100% respectively.

Table 3-11 Bibliographic Tools

Bibliographic Tools	Libraries	%
Traditional Card catalogue	17	100
CD-ROM Search	10	58.8
Manual indexes & Abstracts	3	17.6
Locally Mounted Citation	3	17.6

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To the question posed as to whether they have started automation in their libraries, 47.1% (8) of the respondents said “yes” and 52.9% (9) said “no”. Those who said “yes” were asked, to indicate the functions automated, for which 9 libraries answered as shown in table 3-12.

Table 3-12 Automation by functions

Functions	Libraries	%
Cataloging	6	66.7
Circulation Control	3	33.3
Ordering & Acquisition	1	11.1
Serial Control	1	11.1
Reports & Statistics	1	11.1

3.1.5 INTER LIBRARY LOAN/ DOCUMENT DELIVERY SERVICES

To the question forwarded as to whether they have resource sharing cooperation among themselves, the responses are shown in table 3-13-3.17. Since respondents have selected more than one type of area of cooperation, the total number of institutions and percentage becomes greater than 17 & 100 %respectively.

Table 3-13 Area of Co-operation for resource sharing

Area of Cooperation	Institutions	%
Interlibrary loan/Document Delivery	13	76.5
Staff Education & Training	8	47.1
Joint research & development	2	11.8
Exchange of Accession list	2	11.8

When asked about the libraries from which interlibrary loan or document delivery service is obtained indicating the major sources of documents for interlibrary loan or document delivery services, 13 Libraries responded. Out of which 69.2 % (9) said “libraries” and 53.8 % (7) said “ Document supply Centers such as the British Library Document Supply Center (BLDSC).

Further, the thirteen libraries practicing interlibrary loan and document delivery services were asked to indicate users of interlibrary loan or document delivery services, and all of them reported that they were academic staff. Five libraries said that they provided for undergraduate students. Addis Ababa University and Alamaya University of Agriculture have provided to postgraduate students and academic staff only.

The methods of request and supplying mechanism for document delivery or inter library loan for the 13 libraries is shown in table 3-14.

Table 3-14 Document delivery method

Method of Request	Institutions	%
Postal services	11	84.6
In Person	10	76.9
Telephone	6	46.2
E-mail	4	30.8
Fax	1	7.7

Table 3-15 is summary of responses with regard to the time it will take for a document to reach the users

Table 3-15 Duration of Receiving documents

Duration	Frequency	%
1 Month	6	46.2
More than 1 Month	5	38.5
8-15 Days	1	7.7
1-7 Days	1	7.7
Total	13	100.1

When asked whether libraries have resource sharing & cooperation with other institutions, 94.1 % (16) said “ yes” and 5.9 %(1) said “ No”.

16 libraries indicate the major areas of cooperation answered this questions as shown in the table 3-16. Since respondents were allowed to tick more than one alternative at a time the total number of respondents and percentage is greater than 17 and 100% respectively.

Table 3-16 Area of co-operation for resource sharing

Area of Cooperation	Libraries involved	%
Interlibrary loan/ document delivery	13	81.25
Staff education and training	8	50.0
Joint research and development	2	12.5
Exchange of Accession List and Table of content of Journal	2	12.5
Experience sharing	1	6.25

Among the 17 libraries, 88.2% (15) library staff have computer skill (table 3-3). Therefore, if the proposed EDD system was to be implemented, there would be no problem since a good number of the libraries have staff already with computer technology skill. Therefore, the proposed system will be implemented successfully.

3.2.3 LIBRARY HOLDINGS

The survey revealed that library holdings in many of the academic libraries is very few and most of the collections are out dated. For instance, at Addis Ababa University library, we can understand from the previous study results that the percentage of books published after 1990 was only 0.4% (Addis Ababa university, 1996). The study also indicated that the number of journals regularly received in the 1990s is lower than in the 1980s. Table 3-4 indicates the numbers of current scholarly journals subscribed by each institution. These are few in number and some of them are not regularly subscribed.

With regard to indigenous publications all institutions have produced bulletins and newsletters. Addis Ababa University, Jimma institute of Health sciences, Kotebe college of teachers education, and Gonder college of medical sciences regularly produce scholarly journals. All others shown in table 3-5 are the output of professional associations and societies in the country. The survey also reveals that most of the institutions have used postal system as a delivery mechanism of locally published materials (table 3-6). Although 68.8% (11) of libraries used on site visit for requesting and supplying documents but through interviews with librarians and on site

observations it was confirmed that all institutions heavily used personal visit for indigenous publications. It is also true for ILL services.

Because of lack of mechanisms for identifying and locating documents as well as weak delivery systems it was observed that researchers and students under utilize these publications. This suggests the need for other means of services that improve the accessibility and supply of documents.

3.2.4 SERVICES PROVIDED

In all academic institution Libraries referral and reading (on the spot and on loan) services are the major functions. Similar regulations on the use of materials for spot reading and loan are exercised; reference materials and journals are not available for loan. In some cases, however, staff members may borrow bound journals and some reserve books for overnight or a day. Most of the libraries in addition to the regular working hours are open during evening and weekends.

Referral and query services are usually available, formally and informally. Current awareness services on current acquisitions and other additions are practiced in the same way in all libraries. The major tool in identifying and locating library holdings is the traditional card catalog. As has been indicated in table 3-10, 58.8% (10) libraries have also provided searching on CD-ROM databases for bibliographic information services. This service expands the accessibility of primary documents beyond the local holdings.

41.2% (7) libraries offer interlibrary loan and document delivery services. Interlibrary loan is provided for all categories of users (Staff, students both undergraduate and postgraduates). Document delivery services is allowed for Academic staff and

postgraduate students. Some institutions allow such services for undergraduate students too. Document delivery is coming from overseas, such as British Lending Library Supply Center (BLDSC) for which the Addis Ababa and Alamaya Agricultural University Libraries are notable examples.

29.4% (5) of (table 3- 10) the libraries have also carried out literature search services on the Internet for teachers and postgraduate students. These libraries also provides an e-mail services for their staff and postgraduate students.

Although not fully developed, Awassa College of Agriculture has started to provide selective dissemination of information services for researchers.

3.2.5 COMPUTER FACILITIES AND OTHER EQUIPMENT

Except Ambo College of Agriculture library, other libraries have a minimum of one IBM compatible personal computer with 16 MB RAM and above. They are using Dos and Windows operating system. The software used includes Microsoft office (Access, Word, Excel, Power point, and Outlook), Internet Explorer, and other types of database management software.

The computers are heavily used for word processing and some libraries use it for searching databases from CD-ROM. Very few libraries started to use for in-house database development and information retrieval services.

As indicted in table 3-9, 64.7% (11) libraries have been connected to the Internet. Currently, libraries use Internet for the purpose of e-mail, down loading and literature

searching. Those libraries that do not have Internet connection have plans to get the connectivity in the near future.

3.2.6 FINANCIAL RESOURCES

The major financial resources of libraries are their parent institutions. All academic institutions receive aid or donor supported project assistance for the major part of their acquisition and some specific activities from overseas.

Addis Ababa University and Alemaya University of Agriculture clearly know their budget allocated by their parent institutions. However, in general, financial resources for subscription of journals and books are inadequate. As a result of this many of the libraries are forced to cancel subscriptions of scholarly journals and maintain a constant number of books. Journals were stagnant. 58.8% (10) libraries are under the worst condition since they did not know clearly the budget allocated for the purchase of books or serials.

To supplement the needs and requirements of their users for journal articles, attempt has been made by some institutions like Addis Ababa University using document delivery services from overseas like BLDS in UK where there is still problem to cover the cost of delivery services.

3.2.7 INTERLIBRARY LOAN AND DOCUMENT DELIVER SERVICES

An ILL transaction starts when a user determines that he or she needs an item that the home library can not supply from its own resources and asks for the items to be supplied

on interlibrary loan or document delivery services. The library assists users by making citations available in bibliographies or by conducting searches for the user.

The procedure for the ILL or Document delivery services is as follows.

- The user first fills in a form that will be passed to the ILL unit or library in general. As far as the user is concerned, this is the end of the matter. After some time he or she is notified that the item has arrived.
- Before an actual request can be submitted, the requesting library acting as intermediary must verify the accuracy of the citation and take steps to ensure copyright compliance in cases of photocopy article delivery. The library that puts the requests is responsible to verify the accuracy of the references supplied by the user.
- The staff also checks a file of previous photocopy requests. In the case of Addis Ababa University this is done using the index cards which were prepared for delivered articles through its document delivery services. All these tasks have been searched in one or more paper files maintained by the library. These files are used:
 - to correlate incoming items with the request that they filled;
 - to correlate incoming invoices (In the case of document delivery services of Addis Ababa university with BLDSC) and
 - to verify that the items were received.

Items are supplied by the supplied by the owner library as a physical item or as photocopy of all or part of a requested item. In the first case the item is intended to be returned when the loan period is over; in the latter, the photocopy is not intended to be

returned. The item is normally delivered to the ILL unit or Library, where it is correlated with the users request, and from where the user is notified that the item is available.

Interlibrary loan is provided for academic staff, postgraduate and undergraduate students in all academic libraries. However document delivery is allowed for specific type of users. Addis Ababa University and Alamaya Agricultural University, for instance, allow their document delivery services for academic staff and postgraduate students.. Mekelle Business college and Mekelle University college allow the document delivery services for undergraduate students although it is not formally organized and well aware of it by their users.

As has been indicated in table 3-10, 58.8 % (10) libraries provide CD-ROM services that enables users to identify documents that meet their need. When the document is not available in their local library, users request the library to provide them either through interlibrary loan or document delivery services. Due to rules and regulations of ILL or a policy of every library user may not get primary documents through such a system because journals, rare books and books in demand are not allowed for loan. The only alternative they have in such case is that of document delivery services. The present practice of document delivery services in academic institutions except Addis Ababa University is weak and under utilized. Addis Ababa University and Alamaya Agricultural University have formal agreement with British Library Document Supply Center (BLDSC) for supplying photocopy of documents using manual methods. The practice of ILL services are not strong except for Addis Ababa University although it started long

information resource sharing through ILL and document delivery services among institutions. Although this has to be discussed with decision makers of higher management levels, such strong enthusiasm and appreciation among participants is one important ground for the successful development, implementation, and operation of electronic document delivery services within academic institutions.

3.3 SUMMARY OF SURVEY RESULTS

From of the survey results the following conclusions can be derived.

- Academic institutions have carried out various levels of programs including postgraduate degrees, undergraduate degrees, and diplomas. With these programs various fields of studies have been conducted. Institutions have common area of interest in some fields of studies.
- Libraries in all academic institutions have encountered scarcity of information professionals. Addis Ababa University is relatively in a better position in this regard. With the exceptions of two institutions namely Ambo college of agriculture and ArbaMinch water technology, all of them have a library staff familiar with computer and related technologies.
- Holdings of libraries are few in number and outdated. The number of currently subscribed scholarly journals are very few and some of them are not regularly subscribed as a result their issues are not complete. All institutions have characterized by scarcity of finance for subscriptions of journals and reference materials. Majorities of them are depending upon gifts of some donor agencies for acquisitions of books, journals and other documents from overseas. Some parent institutions did not allocate budget for the purpose of subscriptions of journals and ordering of monographs.

- Different institutions have published local scholarly valued journals. But the mechanism of their access and distributions are not efficient and well organized. Because of this they are under utilized and libraries don't know their existence.
- Many libraries have been equipped with personal computers having 16 MB RAM or above Intel based processors working with windows and DOS operating software. They are used for word processing activities. Some libraries have tried to use in developing in house bibliographic databases. More than 60% of academic libraries have been connected to the Internet via dial up connectivity. In most cases Internet is used for e-mail communication and sometimes for literature searching and downloading.
- To supplement the scarcity of materials some libraries have interlibrary loan agreement with other institutions and among themselves. But ILL was not used effectively and efficiently. One of the reasons is that except Addis Ababa University all institutions don't have formally set rules and regulations. Their cooperation is informal.
- The speedy manner in which a user may have found a reference to a document is halted before primary document is obtained, most abruptly if the document is not available locally. In order to support users in finding primary documents which are not available with in local library Addis Ababa University and Alamaya Agricultural university have formal agreement with British Library document supply center for the delivery of photocopies of journal articles. However, it has its own limitations. First, The cost of delivery is very expensive. To order ten pages of photocopy article libraries have paid Ethiopian Birr 66.75. If the requested page is between 11 to 20 the

cost will become double. Besides there is also postage expenses in submitting the request. Second, it took several days for a document to be dispatched from overseas, such as BLDSO via mail service. The processing time to execute the order often amounted several days. At the one end there was a delay in finding out in tracing the journal, photocopy the article and posting the requested article.

3.4 IDENTIFIED REQUIREMENTS

From the opinion gathered through this survey work, information professionals have expressed their support towards information resource sharing among academic institutions via electronic document delivery services. They want a system that facilitates information sharing among themselves. They have strong feelings on the use of potential of electronic document delivery system in solving the problems of the current manual based ILL or document delivery practice in their institutions.

From the survey results presented and analyzed in this chapter, It is possible to deduce the number of user requirements to be fulfilled by the proposed system. These requirements are revolving around the following needs.

- ◆ An improved method in requesting material and processing the request.
- ◆ Web based document request and submission system using Internet facilities.
- ◆ An easy to use electronic information resources
- ◆ A union serial database specifically list of locally produced publications and scholarly valued foreign journals accessible via world wide web through the Internet
- ◆ A system allowing libraries to request an item easily while searching the list of serials database

This will be used, as requirements of the proposed EDDS system with features considered most important to the users needs. The proposed system is discussed in the next chapter.

CHAPTER FOUR

FEATURES AND SYSTEM REQUIREMENTS OF THE PROPOSED ACADEMIC LIBRARIES ELECTRONIC DOCUMENT DELIVERY SERVICE (ALEDDS)

4.0 INTRODUCTION

The survey result revealed that the many challenges and opportunities end users face in obtaining research materials not available locally. Materials have to be requested from overseas when seriously needed but not available in local resources. It has also been observed that there is under utilization of both foreign and locally produced journals, which are already available in academic libraries in the country. Whenever libraries forward their request to overseas it is better to explore all possible locally available resources effectively and efficiently. To do this academic libraries should explore the potential of electronic document delivery services.

This chapter deals with the proposed system, which is expected to solve the problems stated in chapter three, specifically in relation to document delivery services. The major problems that could be solved are:

- Disparity between access and supply
- Lack of mechanisms in knowing the holdings of academic libraries with special emphasis on the holdings of scholarly journals.
- Long delays in requesting and receiving documents
- High cost of delivery
- Risk of lost or damaged materials

The proposed system enhances information resource sharing among academic institutions by providing libraries timely access to relevant citations of databases of serials (journals) and delivery of articles at the minimum cost and energy from local sources. Hereafter, information on the desired features and design of the proposed system is presented

4.1 GENERAL CONSIDERATIONS

The proposed system of ALEDDS is based on the identified needs of libraries. To this end a discussion was made with librarians of selected institutions having interlibrary loan or document delivery services. From the discussions it was observed that all libraries have interest for a strong information resource-sharing consortium via document delivery services electronically by taking in to account the following considerations.

- ❖ Use locally available personnel and other resources
- ❖ Utilize with the existing infrastructure
- ❖ Have output that is useful to users in the consortium
- ❖ Be economical and technically feasible

4.2 ALTERNATIVE APPROACHES FOR EDDS

As indicated in chapter two under section 2.8, various electronic document delivery projects have been described. These projects were developed for delivery of documents employing different approaches. The most notable ones are described as follows.

4.2.1 USE OF MIME COMPLIANT E-MAIL TO TRANSMIT SCANNED IMAGES VIA A NETWORK MAINLY THE INTERNET

This method is meant for the delivery of scanned documents using the Internet and a suite of readily available software tools for all major platforms using these standards. While the method is hardware-independent, certain hardware components are required (Printer, scanner and workstation), but no specific brands are mandatory and the user can choose to use any of Unix, Macintosh or PC platforms. Specially dedicated equipment is not needed and most of the software components can be found in the public domain.

Multipurpose Internet Mail Extension (MIME) technology has been defined and extensively deployed. It enables an extendible set of document types to be attached to an e-mail message and readily transmit between different types of computer, viewed on receipt, and printed. The mechanism used by this technology has been adopted by gopher and World Wide Web for graphics file delivered over their protocols. As a consequence, software to view such graphics file has rapidly been deployed and is now probably available at virtually all internet sites and presumably their libraries.

Barry (1994), identifies some of the major procedures and steps as follows:

- **The request phase:** - involves a user (individual or institution) initiating a message by e-mail to an appropriate institution requesting a document. Requests could be accepted from other sources, but an e-mail address would be required for transmission of the document.

- **The recording phase:** - is simply the scanning of a document (journal article, letter, diagram, etc.). This results in one or more image files and may be in any one of standard formats: Group Image Format (GIF), Joint Photographic Expert Group(JPEG) or Tag Image File Format(TIFF).
- **Transmission phase:** - is where Standard MIME-compliant e-mail software is used to transmit the scanned files back to the requester. The reply message may also be used to include accounting or other information if required.
- **Receipt phase:** - involves the requester receiving the mailed images and deciding what to do with them. The email program would automatically decode and save the attached image files to disk. Document images may then be viewed and/or printed using readily available software programs, or they may be saved for later use, or they may be forwarded to other individual (having a MIME compliant mailer).

As is described in chapter two section 2.8 REDD project is an example developed using this approach.

4.2.2 USE OF OFF-THE-SHELF EDD SOFTWARE & WORKSTATION SUCH AS RLG ARIEL WORKSTATION, DIGITAL DELIVERY WORKSTATION, ETC.

This approach is for a document delivery method using specialized specific hardware, software and other arrangements at both requestor and supplier ends. This method is hardware-dependent, and specific brands are mandatory in choosing platforms. Specially dedicated equipment is needed, and all the software components are needed to be similar

both at the supplier and requestor side. This method was restricted to delivering documents to participating institutions with identical systems.

LAMDA and RLGs projects discussed in chapter two under section 2.8 are examples developed based on this approach.

By considering the points noted under general considerations section, the first alternative (4.2.1) appears feasible for academic libraries in Ethiopia with the current dial-up Internet connectivity.

4.3 DESIRED FEATURES OF THE PROPOSED ALEDDS

From the requirements presented in chapter three together with some selected features from chapter two, we can define appropriate and important features of the proposed ALEDDS, to satisfy the needs of academic libraries' information resource sharing needs.

In the proposed system Academic libraries are both requestor and supplier of documents. They are the end user of the system.

4.3.1 FEATURES OF WEB SITE STRUCTURE

The web publishing is known for its capability not only to publish but also to easily access information. The web site structure of ALEDDS is designed to enable users to reach the information or applications they require in a minimum set of hyperlink clicks. A common approach is to use a hierarchical structure, and place as much information as possible in the form of hyperlinks near the top of the hierarchy structure.

Hierarchies are a good way to break down a large set of ideas into related categories. By nature, the upper labels of a hierarchical structure are associated with general terms, and

the lower items with depth of specialization. URLs were developed to reflect the hierarchical file structure of many of the more modern operating systems. This has made the majority of the web tend toward and hierarchical mind set.

The web site is designed to incorporate the following features

1. An ALEDDS home page to allow users read and select options.
2. Databases of list of serials and their locations (libraries)
3. Users search form
4. Online request form

4.3. 2 DATABASE FEATURES

As presented in chapter three section 3.2.3 under table 3-11, traditional card catalogue is the main source of information to know the holdings of libraries. But in modern library system the cataloguing records are typically stored on a computer in a database. The most important thing about a database, as opposed to other types of computer storage, is the ability to find information by knowing something about the information we want, without necessary knowing the details of how it is stored.

Users have faced problems in identifying and locating the holdings of libraries. Although finding bibliographic references is not generally considered to be part of the document delivery process (chapter two), it is the first stage in the over all process of obtaining information and is as such a precondition of document delivery.

Academic institutions have produced scholarly journals and they also hold foreign journals. The survey result has shown access to these documents among themselves is

very limited and so far there is no national bibliography and union catalogue or OPAC that shows holdings of libraries.

In order to mitigate such a problem the proposed ALEDDS should provide access for bibliographic information of holdings particularly serials. The bibliographic database has the following basic features.

- It is designed in such a way that it is accessible via World Wide Web.
- It enables users to search for bibliographic data of documents (Journals) by specifying what they are looking for.

4.3.2.1 DATA REQUIREMENTS

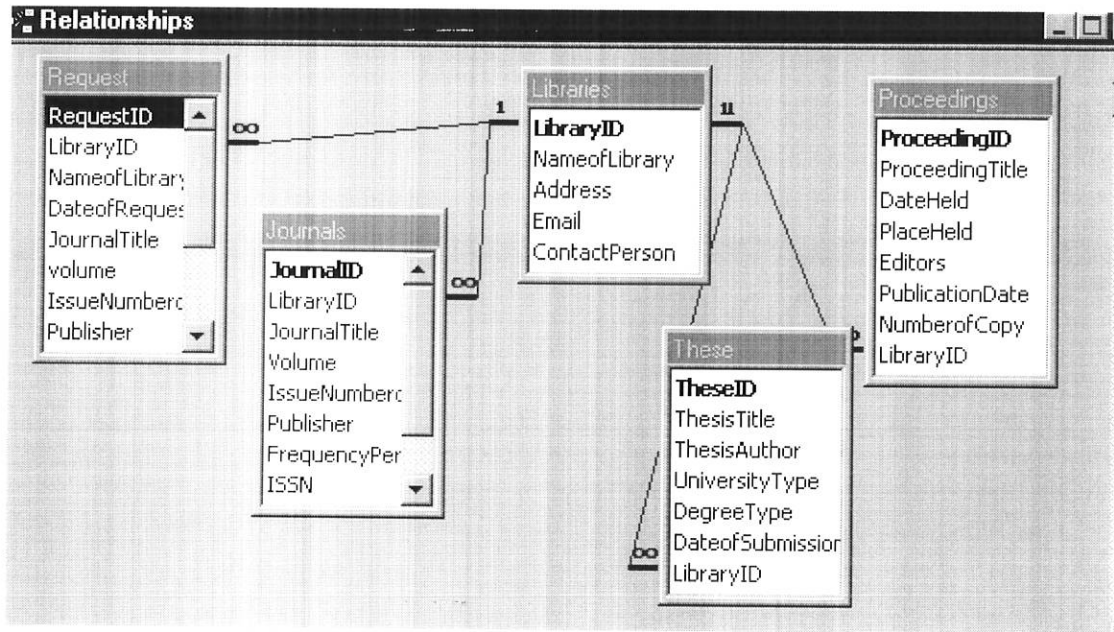
Libraries need to track bibliographic information. These data are bibliographic details of Journals, Theses, conference proceedings, and list of libraries with its full address including e-mail and details of online request form. These forms are written in HTML with the expectation that the browser will probably parse the users' response and then send that response back to the web server.

Data sets required to design serials, their locations and online request form are shown in table 4-1. The database contains five tables. The Complete schema and their relationship of these tables are shown in table 4-1 and figure 4-1 respectively.

Table 4-1 Serial.mdb schema.

Table	Fields	Data Type	Field size
Journals	JournalID	AutoNumber (primary key)	
	JournalTitle	Text	50
	Volume	Number	Integer
	IssueNumber/Date	Text	10
	Publisher	Text	20
	Frequency	Text	10
	ISSN	Number	Integer
	PublicationDate	Number	Integer
Proceedings	Pages	Text	8
	LibraryID	Number	Integer
	ProceedingID	AutoNumber(Primary key)	
	ProceedingAuthor	Text	30
	ProceedingTitle	Text	50
	DateHeld	Text	20
	PlaceHeld	Text	20
	Editors	Text	30
	PublicationDate	Text	10
	NumberOfCopy	Number	Integer
Theses	LibraryID	Number	Integer
	TheseID	AutoNumber (primary key)	
	ThesisTitle	Text	100
	ThesisAuthor	Text	20
	UniversityType	Text	30
	DegreeType	Text	20
	DateofSubmission	Text	10
LibraryId	Number	Integer	
Request	RequestID	AutoNumber(Primary Key)	
	DateofRequest	Text	20
	NameofLibrary	Text	30
	LibraryID	Number	Integer
	Authorof Article	Text	30
	Titleofarticle	Text	100
	JournalTitle	Text	50
	Volume	Number	Integer
	IssueNumber/Date	Text	10
	Publisher	Text	20
PublicationDate	Number	Integer	
Libraries	LibraryID	Number (Primary Key)	
	NameofLibrary	Text	30
	Address	Text	50
	E-mail	Text	15
	ContactPerson	Text	20

Fig 4-1 Relationships of serial.mdb tables



4.3.3 SEARCHING FORM FEATURES

Web forms are a special kind of HTML document defined by the rules of HTML (Berness-Lee, Fielding, and Frystyk, 1995). Actually, they are regular web documents that have places for the user to respond. Web browsers must know how to interpret forms. A form may use any HTML format commands, such as headers, paragraphs, and lists. An HTML form also contains some unique items:

1. The **Method** by which the user input is to be sent (required)
2. The **Action** , which specifies a URL to which the user input is being sent- presumably, a script that will act upon the request appropriately (required)
3. A **submit** button, to send the completed form (required)

The form may have as many input items as needed, and in whatever combination is desired. Forms can be used to collect many types of information such as the title, volume, issue number and date of publication or words to search from serial database.

The form acts as an intermediary between the user and the query language program. The gateway acts as a client of the database service and as a server for the web service.

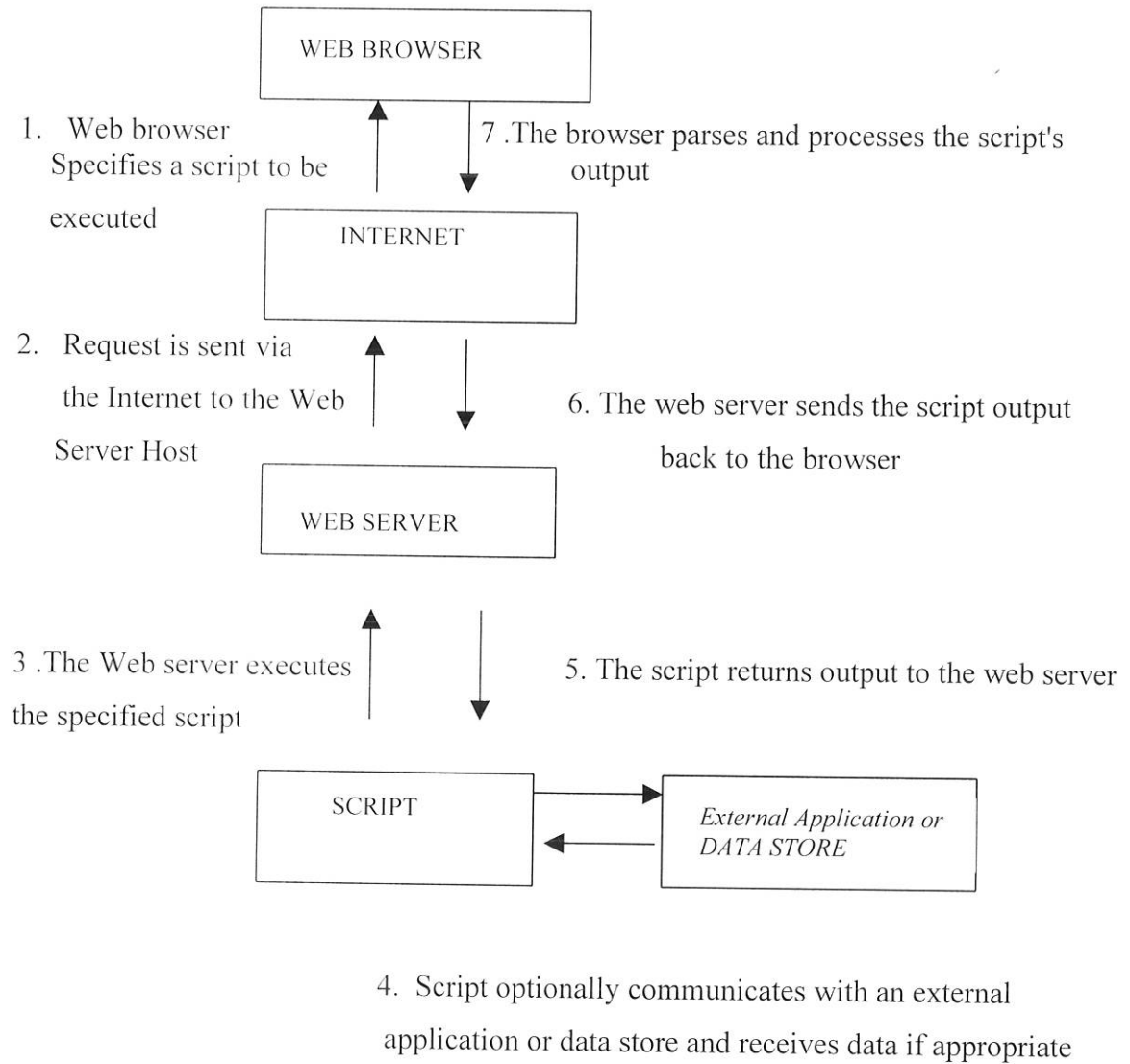
Scripts collect information through a special type of HTML document that is a fill-in-form. The form document is sent to the client and the browser displays the form to the user and collects input from the user. Then the filled in form is returned to the server. There are two models for retrieving documents from a forms-based search service.

- An index of the original resource may be stored in the database, but not the document itself.
- Alternatively, the original resource may be stored in a database, in which case the retrieval is tribal. In this case, a form-based service maybe used to retrieve the document via HTTP, FTP, Gopher, or some other network protocol.

The form is designed for ALEDDS is to retrieve bibliographic descriptions of a document, which is stored in the serial holding database.

The over all processes done by web servers and web browser is shown in fig 4-2.

Fig 4-2 Web Server process requests made by browser with scripts



4.4. PROCESS RELATED FEATURES

The required process related features of the proposed ALEDDS are described as follows.

Libraries receive items of interest from the end users identified by themselves or through the assistance of library staff for delivery of documents.

As indicated in chapter three under section 3.2.4, end users have used different bibliographic tools such as traditional card catalogue, CD-ROM databases, bibliographies, indexes and abstracts in identifying items of their interest.

The items identified at the first stage of identification are the input for location of items within the academic libraries. For the purpose of location of items the system will provide holdings of journals of a library accessible via the Internet. If an item is available on a web server then the system will simply provide a request form that will be filled-in and submit the request.

If a document is available from supplier library the system will be able to generate document request form and send the request as an e-mail attachment. At the supplier end, this should be read by library staff whose task is to locate and scan the document or article. The resulting image file will then be emailed to the requesting library e-mail directory.

4.5 SYSTEM REQUIREMENTS OF ALEDDS

In the proposed ALEDDS system:

- A document delivery request could be transmitted to a document supplier library via a network (The Internet)
- A document has to be digitized before it is transmitted to the requestor, if it does not exist in digital format.
- A document supplier library has to supply the requested document to the requestor via a network (the Internet),and
- The received document has to be either printed or viewed electronically by the requestor

In general, ALEDDS has the following requirements.

- ❖ Hardware
- ❖ Software
- ❖ Communication Network
- ❖ Standards & Protocols
- ❖ Copyright Issues

4.5.1 HARDWARE AND SOFTWARE REQUIREMENTS

- **WorkStation:** The minimum recommended hardware is Pentium class machine running at 100 Mhz. It should have to run 32 bits. For Windows 95 or windows 98 users, the minimum recommended memory is not less than 32 MB of RAM. The computer also should have 50 MB of disk space after the Web Server is installed and configured.

- **Scanner:** It is to be used for digitization or scanning of the original document if it is not already exists in electronic/digital format. It crates one or more image files in any one of standard format GIF, JPEG or TIFF. It should have reasonable resolution as fast as possible. 200dpi is often considered to be the minimum acceptable for consistently legible digitization of word-processed documents. In its basic form, all that can be done with a scanned image is to store it or display it again; either on a computer monitor, or by printing it on to paper. Subsequent to scanning additional process should be required. The principal additional processing that may be required is data compression, format conversion, and possibly some form of optical character recognition (OCR).
- **Printer:** To be used in hard copy production of the transmitted digitized image. Needs to be able to support reasonable high resolution for graphics. Laser Jet family printer are more appropriate
- **Operating system** such as Windows 95/98, Windows NT. The operating system must have the TCP/IP protocol installed in order to run Web Services.
- **Database Management Software** such as Microsoft SQL server, Oracle, Microsoft Access, Visual FoxPro, Borland dBase
- **Communication software** (mainly E-mail software) compatible with MIME such as Eudora, Internet Mail, etc.
- **Scanning software** such as HP DeskScan II, Visioneer Paperport etc.
- **Web Server:** In order to run the web services various web servers are supported. As mentioned in chapter three section 3.2.5 academic libraries employ windows 95 or 98 operating system. and some of web servers supported coldFusion are Microsoft

Internet Information Server (IIS), Netscape Enterprise Server and O'Reilly Website Pro.

- **Web Browser:** It is client programs used to access web sites and pages. The web browser has the job of processing received web pages, parsing the HTML code, and displaying the page to the user. The most popular web browsers required for the proposed system are Netscape Navigator and Microsoft Internet explorer.

4.5.2 NETWORK REQUIREMENT

To access serial holdings of each library and to transmit both document delivery request and digitized documents electronically, a network connection between a requestor and a supplier is needed.

Ethiopia is connected to the Internet. Academic institutions get this service through dial-up connection to the Internet service provider (Ethiopian Telecommunication Corporation). As mentioned in chapter three section 3.2.5 most academic libraries have Internet connection. To have Internet connectivity the following minimum equipment are needed.

- Modem
- Direct Telephone Line
- Communication software and
- Personal computer

4.5.3 STANDARD AND APPLICATION PROTOCOL REQUIREMENT

The Internet and WWW are becoming the defecato standard interface for users in academic arena and outside it. The Internet offers seamless access to the world so it is

possible to not only request documents from the participants but also from anywhere in the world as long as they have e-mail I.D.

In a networked environment in which documents are exchanged electronically, the user must be aware that the recipient of the document is likely to use a different system, with a different hardware platform, and different software. This heterogeneity of equipment requires ways of requesting documents for exchange that are independent of the configuration of the system on which the document was created. In this regard there are two broad forms in which a document can be exchanged:

1. A revisable form, in which the recipient can alter the content and or structure of using his/her local system; and
2. A final form, which the recipient is not intended to alter but only to print or display.

There are international document standards available to facilitate computer based authoring and type setting and to ensure that such documents can be readily interchanged. These standards include Standard Page Description Language (SPDL), Standard Generalized Markup Language (SGML). The proposed system adopts the second type of forms (final form) to exchange documents using Standard Page description Language (SPDL), such as Adobe's PostScript, define the layout of an electronic document but not the content; they specify the exact manner in which a page appear when printed.

4.5.4 COPYRIGHT ISSUES

Ethiopia has already signed the World Intellectual Property Organization (WIPO) conventions that will encourage the faire use policy of copyright protected items. In

addition, the legal protection of literary and artistic works in Ethiopia had been developed under the Civil Code of Ethiopian Law of title 11,1959. Article 1660 (2) of this code stated that copies and reproductions of the work made in a single copy shall be permitted where they are intended for private use only. However, the description of works of the mind on article 1648 is far from covering all the current sources of information. Hence, revision is necessary to incorporated journal articles, electronic form of scholarly publications, and so on. Therefore, the electronic document delivery project planned among academic libraries in Ethiopia should be in conformity with these local and international copyright laws. Also, if libraries in Ethiopia prefer to create an image database by scanning for any future delivery, they will first have to determine the copyright status of the works in question, and then secure permission of the copyright holder before creating a database.

CHAPTER FIVE

PROTOTYPE OF THE PROPOSED ALEDDS

5.0 INTRODUCTION

As discussed in chapter two under section 2-8 the experiences of other countries' EDDS projects shows us EDDS could be developed phase by phase and grow up to fully integrated system. Due to shortage of time and cost the proposed ALEDDS is developed and tested only for the processes of identification of location of serials (manly of journals) within academic libraries, submitting online request to the supplying libraries and transfer of requested scanned documents to the requestor Library. At the supplier end, librarians entertain the request by scanning the hard copy in to digital format and send it using MIME coding e-mail attachment.

According to the requirements and desired features of the proposed system a prototype serial database, searching and online request forms were developed.

5.1 APPLICATION EMPLOYED

The prototype is developed using ColdFusion application kit. ColdFusion is a rapid application development tool that enables the rapid creation of interactive dynamic and information-rich web sites. It does not require coding in traditional programming languages (although programming constructs and techniques are supported). Instead we create applications by extending HTML files with high level formatting functions, conditional operations, and database commands (Forta, 1998).

All ColdFusion interactions is via templates. Templates can contain HTML, ColdFusion tags and functions, or both. ColdFusion templates are plain text files, just like HTML files are. Unlike HTML files, which are sent to the users browser, templates are first processed by ColdFusion.

ColdFusion accesses applications via a database interface called Open Database Connectivity, or ODBC. ODBC is a standard Application Programming Interface (API) for accessing information from different database systems and storage formats. ColdFusion is an ODBC client.

ColdFusion supports different Database Management System (DBMS) and the database language called Structured Query Language (SQL). The prototype database is designed using Microsoft Access. Windows NT server 4.0 was used as an operating system platform. In order to run ColdFusion application server web server should be required. This prototype uses Microsoft Internet Information Server (IIS) which comes along with Windows NT 4.0.

5.2 THE PROTOTYPE DEVELOPMENT

For the purpose of the prototype, the ALEDDS web page is developed by HTML and ColdFusion. tags The web page presents general background information about ALEDDS and links of available services and list of academic libraries. This page is published on the publishing directory of the Internet Information Server (IIS), (InetPub\wwwroot). The list of HTML files and ColdFusion application pages' script code files published on the prototype development appear in appendix 5.

5.2.1 THE WEB PUBLISHING PROCESS

Basic features of the web publishing include:

- ColdFusion Studio editor is used to develop ColdFusion application pages and HTML files.
- A client server model is adopted where for this particular prototype, server includes Windows NT operating system , IIS web server and Coldfusion application Server.
- The network configuration on the server side is integrated into TCP/IP network.
- The client is configured for ColdFusion Studio over TCP/IP and uses Remote Development Services (RDS) to connect with the coldfusion and web servers to get an access to the server's file systems and all system ODBC data sources. The client is also equipped with Microsoft Internet Explorer.
- The client and the server communicate with each other using HTTP protocol.

5.2.2 PROTOTYPE DATABASE DEVELOPMENT

For the purpose of demonstrating database access through the web, list of journals and libraries database was developed. The database tables are created using Microsoft Access. This is made because ODBC supports the Microsoft Access driver. ColdFusion application server communicates with the database through ODBC. Sample records of journals and lists of institutions are created.

5.2.3 USER INTERFACES

The first screen is a home page of academic libraries electronic document delivery services. As is mentioned in chapter four sections 4.3.1 the web site is designed to have hierarchical structure that enables users to call any service from any page. The page provides short introduction of electronic document delivery services. It has links to all

academic libraries and various services such as add journal, complete listing of journals, journal search, on line request forms. The first user interface of this page is shown in Fig 5.1.

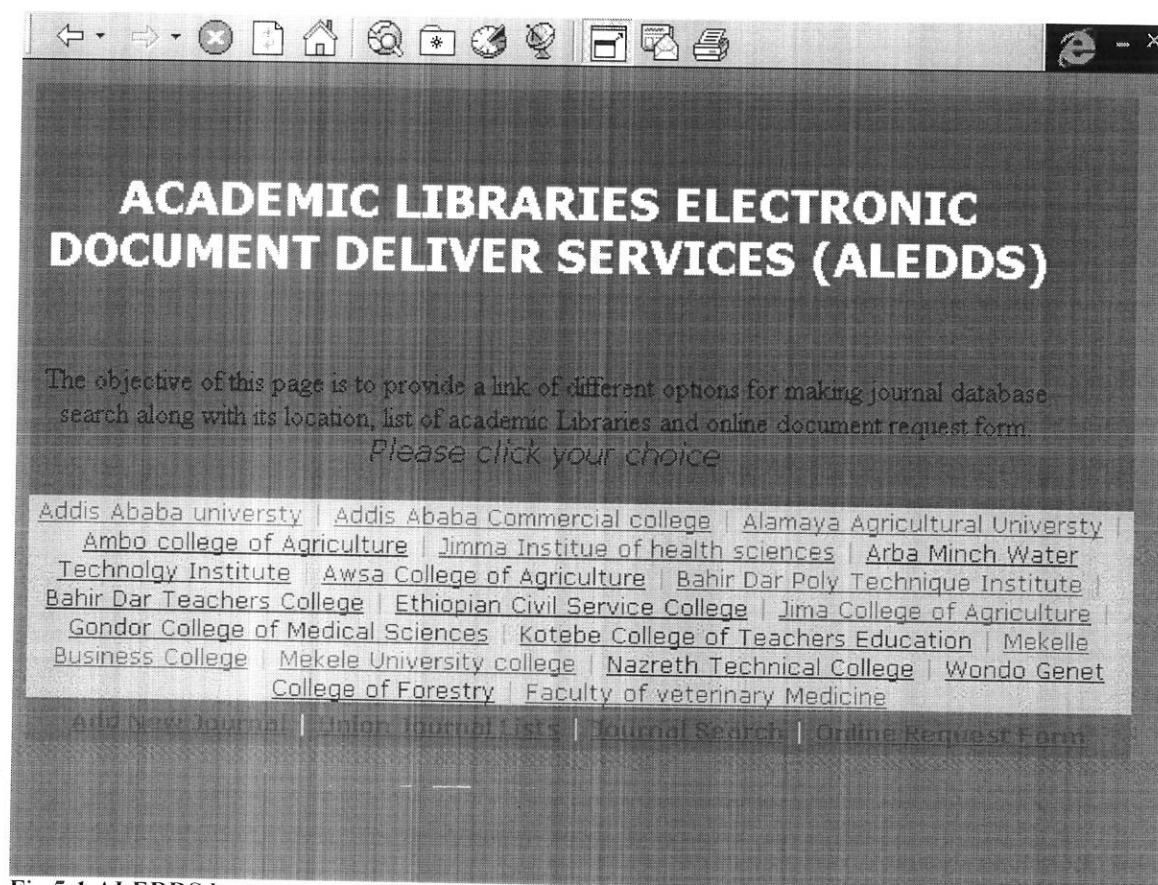


Fig 5-1 ALEDDS homepage

COMPLETE LISTING PAGE

This page lists all journal holdings by libraries. A particular library may have many journals and this page provides name of library, title, publication year, volume and issue number of each journal. For detail description of a journal it is linked with details page. When a user want to see details of a journal, the link leads to details page .This page is shown in Fig 5-2

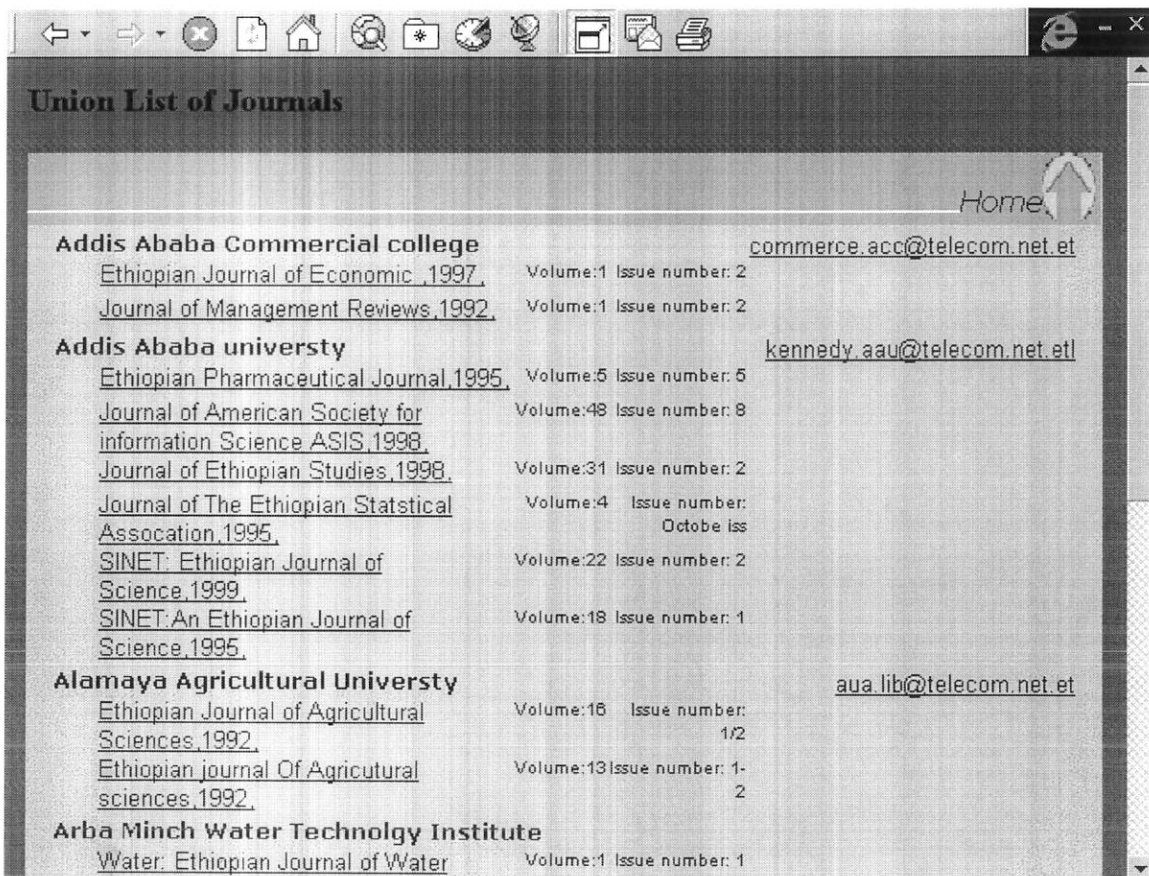


Fig 5-2 complete listing of Journals by Libraries

To see list of journals by individual library click on one of the list of libraries on home page. It is shown in fig 5-3.

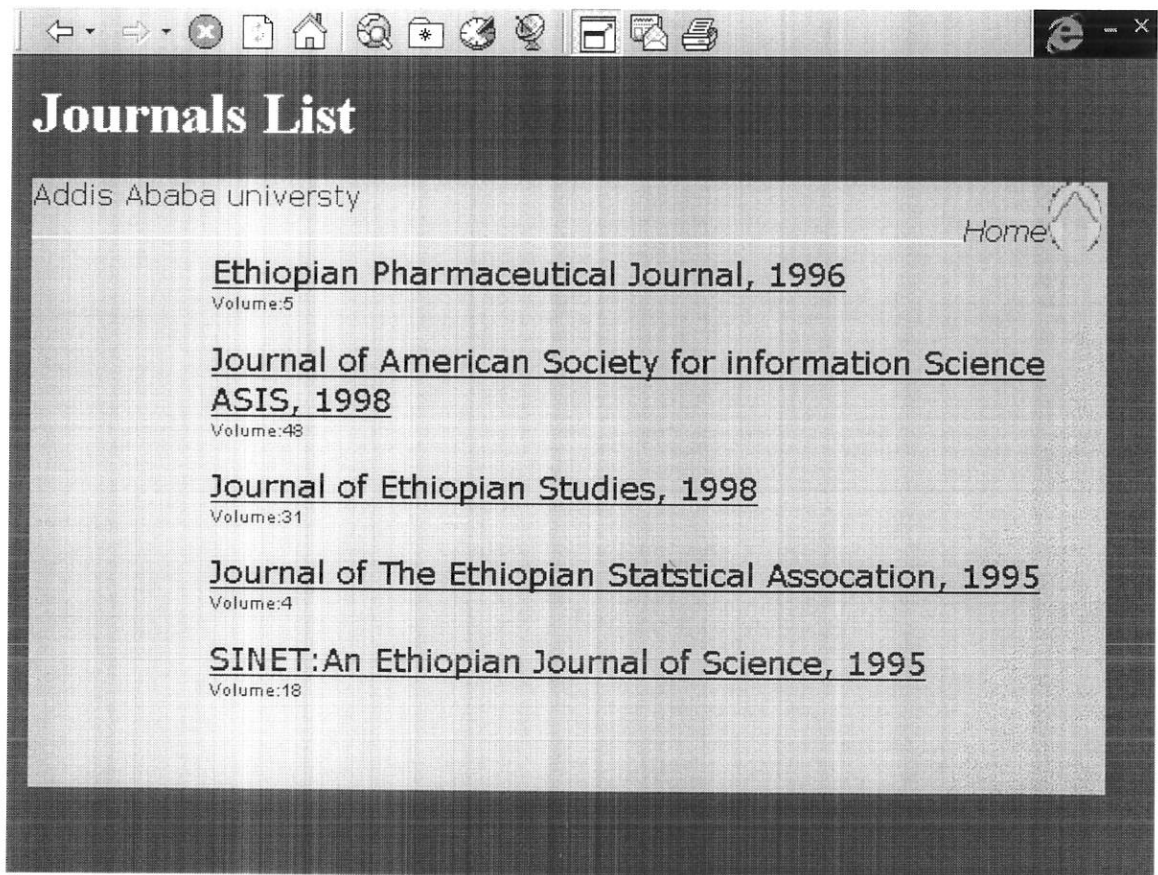


Fig 5-3 List of journals by specific library

DETAILS PAGE

In this page bibliographic details of a particular journal will be displayed. It has a link with update and online request screens. Fig 5-4 shows this page.

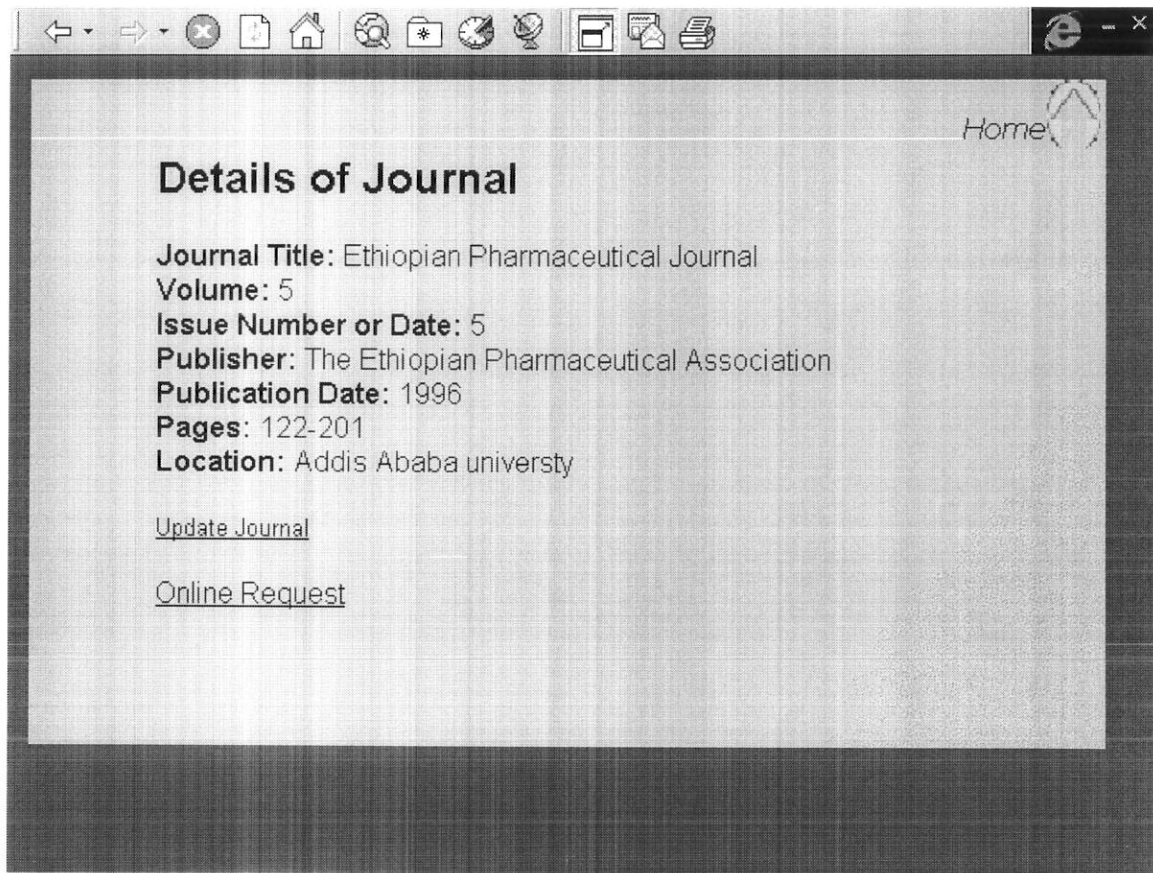


Fig 5-4 Details screen

SEARCH SCREEN

The search screen enables users to search for a journal by title, issue number, volume or through combination of all. It also allows searching using a word available from the journal title. There is no need to remember full description of journal title. If a user searches by a single word he will get a journal containing that word. The search is done either by individual libraries or from all libraries. This page is shown in fig 5-5

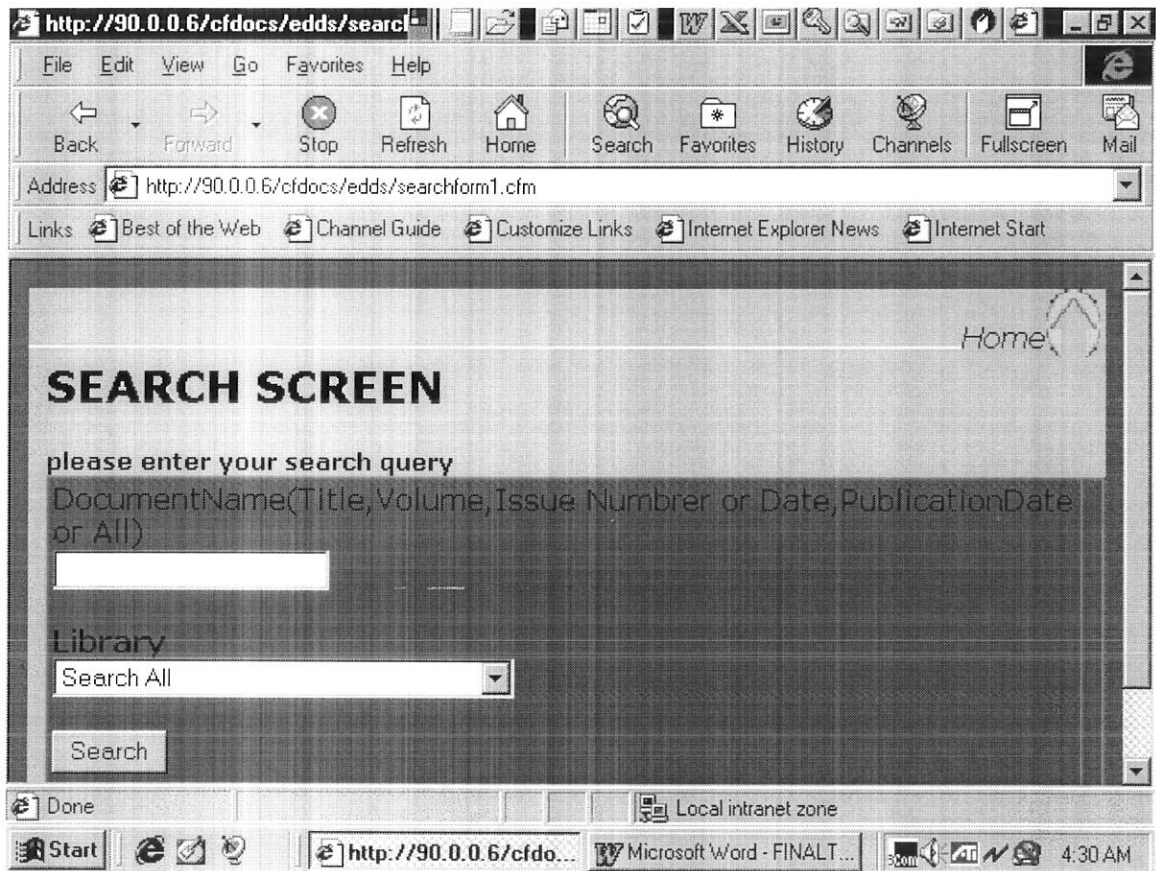


Fig 5-5 Search screen

SEARCH RESULTS

After the search queries has been formulated, click the search button. The search result page will provide its result. When there is no journal matched with search queries it displays message that 0 journal is found. When journal is found it provides tile, year of publication, volume and Issue number. For further details of a journal has a link with details journal list screen. This page is shown in fig 5-6.

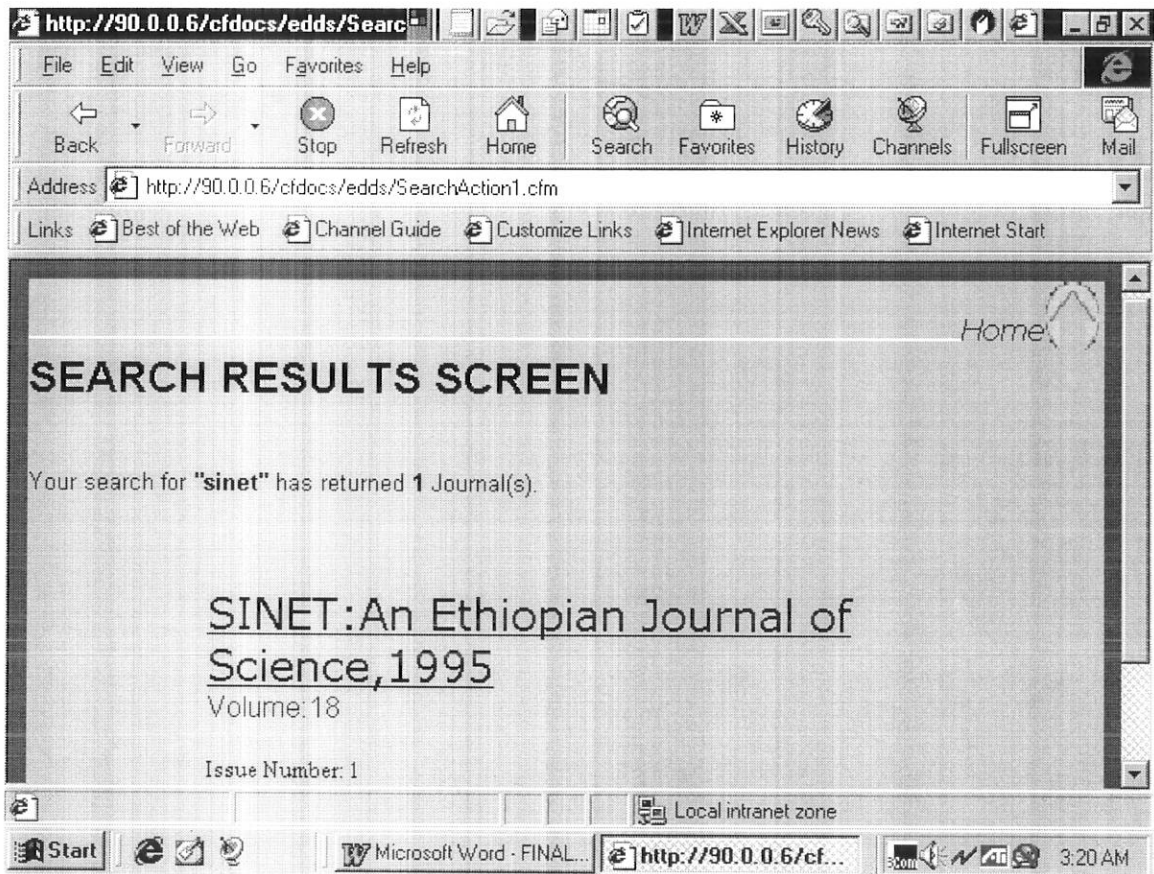


Fig 5-6 Search result screen

ON LINE REQUEST FORM

Online request form is used for data entry, as front-end for filling out requests .It has all details of a journal including the author of the article, title of the article and the number of pages requested article with in a journal. For the successful document delivery services users should fill the forms properly. The online request form is designed to build form validation on client side using Java script.. On line request is submitted by clicking the submit button. Successful request automatically gets a confirmation letter from the web server. Online request form and confirmation letter screens are shown in fig 5-7 & 5-8 respectively.

Please enter journal information:

Date of Request :	Name of Requestor Library:
<input type="text"/>	<input type="text"/>
Author of article :	Title of article :
<input type="text"/>	<input type="text"/>
Pages of article:	Title of Journal :
<input type="text"/>	<input type="text"/>
Volume:	Issue Number or Date :
<input type="text"/>	<input type="text"/>
Publisher:	Publication Date :
<input type="text"/>	<input type="text"/>
Supplier Library Addis Ababa Commercial college	Submit Request
	Clear

Fig 5-7 Online request form

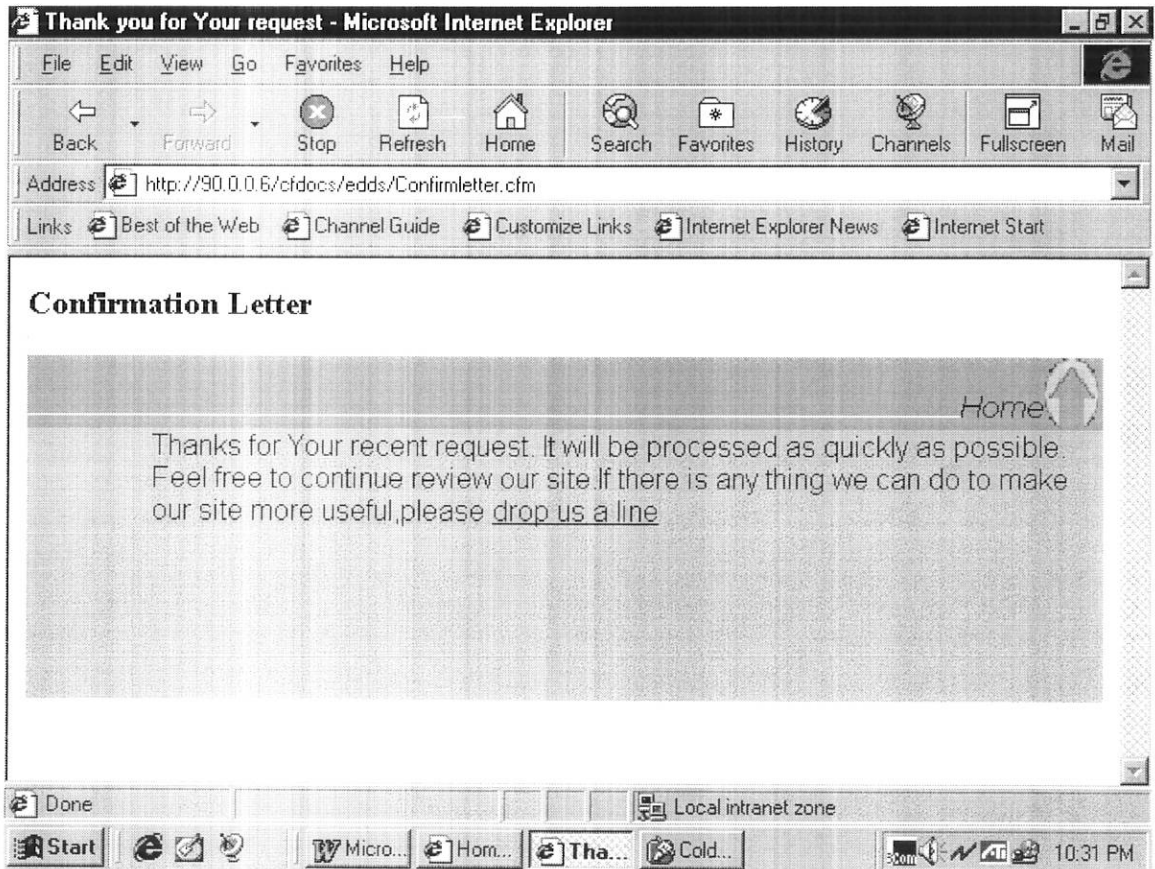


Fig 5-8 confirmation letter

The other user interfaces such as add journal, update journal pages are shown in Fig 5-9 and 5-10 respectively

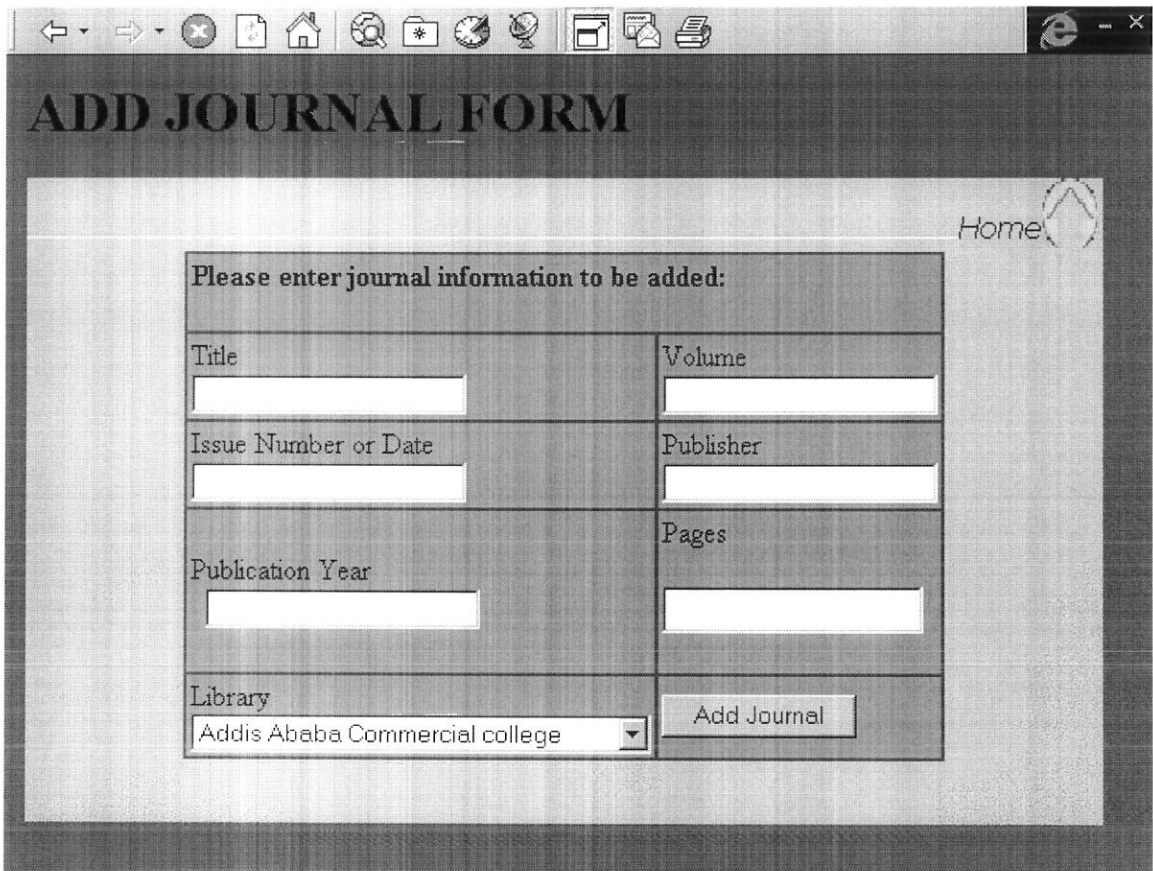


Fig 5-9 Add journal screen

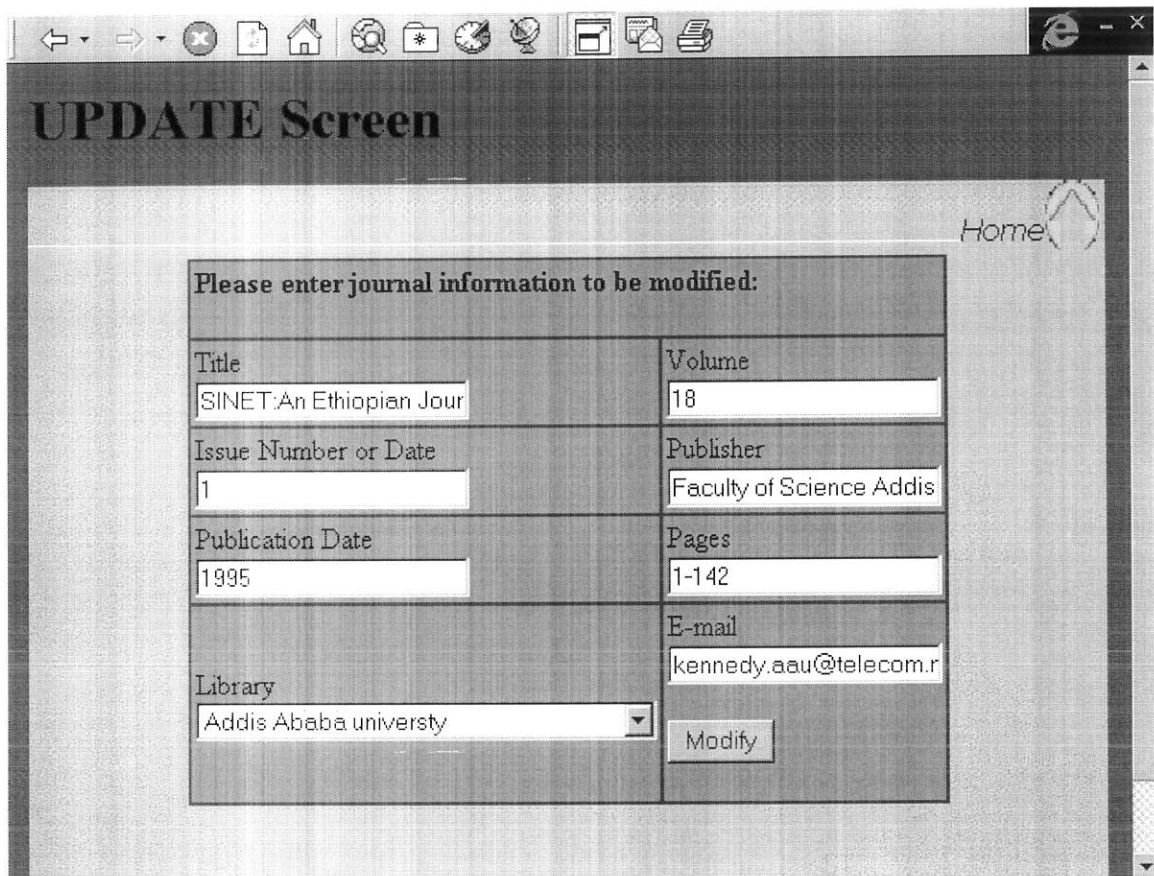


Fig 5-10 Update Journal screen

DELIVERY OF DOCUMENT

The delivery of requested article is the job of a supplier library. The supplier library in most cases scan the document and whenever necessary compressed the file and sent to an e-mail attachment via the Internet to requestor email directory. Brief notice should be sent along with scanned document which contains its file size., in which format it is saved, and what type of viewer software required to display a document.

RECEIVING DOCUMENT

The requestor library receives the document when it has connected to the Internet and finds in its e-mail directory as an attachment and it could be read and print and provide to the end users either as soft copy or printout.

5.3 TESTING

Test Case: 11 pages of article entitled " LITHOLOGIC AND STRUCTURAL MAPPING OF THE NORTH EAST LAKE ZIWAY AREA, ETHIOPIAN RIFT, WITH THE HELP OF LANDSAT TM DATA" written by Tesfaye Korme from the SINET: Ethiopian Journal of Science was selected as a case. The article consists of texts, maps, tables, graphs, figures and formulas.

TOOLS AND METHODS

1. Scanning or Digitizing

- HP Scan-Jet II set to 200-300 DPI depending upon the type of image to be scanned.
- Desk-ScanJet software for windows
- Visioneer PaperPort

The scanning of the article has been done manually as an automatic document feeder (ADF) is not available with the scanner. Using Visioneer Paper-Port continuous scanning of pages to the desktop for later stacking and previewing before saving has found to be an advantage. Drawings and maps are scanned as picture image set to 100 by 200 DPI. The rest of pages are scanned as text pages using OCR/Text features of Paperport.

The user-interface of Visioneer PaperPort Viewer is easy with rich export, import, built-in compression, stack and unstack features. Paperport has different options in saving the document, such as paperport files (.MAX) ,GIF, JPG, TIFF, PDF etc.,. It also offers links to printer, e-mail, fax, word processing and image editing applications (H.P., 1995).

2. Sending and Receiving

- ETA-based Dial-up Internet network

- Netscape Mail which is a MIME compliant mailer software
3. Viewer and Printer
 - Visioneer PaperPort Viewer software
 - HP LaserJet IV printer

STEPS FOLLOWED

1. The 11 pages were scanned manually onto the desktop. The time elapsed to scan these pages was about 20 minutes, i.e., less than 2 minutes per page 511 KB before saving into paperport file.
2. The 11 images were stacked and exported as a paper-port document (.MAX) format and had a size of 496 KB.
3. The file created in step 2 at SISA was sent to the Medical library, which is one of the branch libraries of Addis Ababa University library system as an attachment using Netscape mail. It took from 3-4 minutes in each case;
4. The Internet mail with the attachment was received at the destination. Nearly three minutes were used to receive the mail;
5. The attachment was viewed and printed.

To view the attachment file, point and double click the icon assigned to the attachment. The system automatically loads the PaperPort viewer program, which should be installed in the receiver workstation, and retrieves the document. One can view page by page, export, etc., but cannot edit. Printing was done within the viewer software using its standard windows printing interface. It is possible to print all or specific page(s) on paper or to a file as well.

TEST RESULTS

The quality of the received documents was as good as the original and the overall process was successful. Therefore, this pre-test demonstrates the feasibility of the exercise. Sample pages of electronically delivered articles are indicated in Appendix 6.

USER COMMENTS

The prototype was demonstrated to users, mainly to Addis Ababa University library. They have provided comments on the interface which shows complete journals listing of all libraries in one page. Their comment is basically to have an interface for holdings by each library. Hence, list of journals by specific library was developed (see fig 5-3). The other comment they made was on the appearance of forms on the screen. Based on their comments add journal, update journal, and online request forms were redesigned and attempt was made to display each form on one screen. Previously each of these forms were not incorporated in a single screen.

CHAPTER SIX

CONCLUSION AND RECOMMENDATION

6.0 CONCLUSION

The lack of automation in the area of document delivery has created a large disparity between bibliographic access and document supply—the speed with which citations are found is not matched by the provision of the primary document. Although certain aspects of the document delivery process have been automated, such as the electronic exchange of requests, other aspects, such as the final transfer of documents, remain largely dependent on traditional manual methods. This disparity, furthermore, threatens to become even more acute as a result of the quantum leap in bibliographic access provided by recent developments of end-user searching of locally mounted citation databases, CD-ROMs, and network-accessible library catalogues.. The next step will be to make the documents themselves available through the networks The answer to this is EDD system. The imbalance between access and supply can potentially be over come through electronic document delivery. The use of electronic forms of documents and transmission media to automate the entire document delivery process, from the initial selection of relevant citation to the final delivery of document.

In view of this, taking academic libraries in Ethiopia as a case the whole exercise of this thesis was to explore the potential of electronic document delivery service for the purpose of information resource sharing. To propose an enhanced document delivery system as electronic means analysis of the current status of academic libraries with respect to document delivery services as a means of resource sharing was done.

The survey result revealed that academic institutions have carried out various levels of programs including postgraduate and undergraduate degrees, and diplomas and various research activities. With these programs different fields of studies have been conducted and institutions have common area of interest in some fields of studies for the purpose of information resource sharing.

In regard to holdings of libraries, the availability of information resources for the academic and research community in Ethiopia is very limited. The holdings of serials particularly scholarly journals are very few and some of them are not regularly subscribed as a result their issues are not complete. This is due to the escalating cost of scholarly publications and the limited financial capacity of libraries.

With regard to indigenous publications, some institutions have published locally produced scholarly valued journals and various research outputs in the form conference proceedings, seminar reports, theses etc. But due to lack of mechanisms for locating and identifying these documents within institutions, such as union list of serials or absence of national bibliographies or union catalogs and weak delivery system (postal system) these materials are not properly distributed among libraries and as a result they are under utilized. This is also true for foreign journals.

Although many libraries are using CD-ROM databases to have an access for bibliographic information of primary documents, the speedy manner in which a user may have found a reference to a document is halted before primary document is obtained,

most abruptly if the document is not available in the library. To solve this problem, some libraries such as Addis Ababa University, Alamaya Agricultural University and Jimma Institute of Health Sciences provide document delivery services to their users from overseas. They have formal agreement with document delivery suppliers like British Library Document Supply Center (BLDSC) for the delivery of photocopies of documents. However, it has its own limitations.

- The cost of delivery is very expensive
- It takes several days for requesting and receiving documents.

Academic libraries have exercised little cooperation through interlibrary loan (ILL). But is poorly organized and are not well functional. In most cases the form of cooperation is informal. Except Addis Ababa University other libraries have no rules and regulations of ILL. The absence of well functional cooperative mechanisms developed to share available information resources among libraries in Ethiopia, there is a high chance of duplication of resources and requesting of documents from abroad, which may exist locally. This is a big financial loss considering the foreign currency constraint that most libraries in.

In regard to infrastructure many academic libraries have been equipped with personal computers with their printers. Even some of them have scanners and color printers. They are used for largely for word processing activities. Some libraries have tried to use in developing in house bibliographic databases. Many academic libraries have been connected to the Internet and they are used for E-mail communication and sometimes for literature searching and downloading. From this it is ascertained that these are

opportunities of libraries for exploring the benefits of Internet services of which exchanging documents and accessibility of their holdings become easier.

Electronic document delivery systems have already formed an essential part of the electronic libraries that are emerged as the principal source of information in this era. These systems have helped to increase the efficiency with which primary documents can be provided to end-users allowing them to select, request, and obtain documents directly from their local computers. Such systems are necessary for academic and research communities of Ethiopia to increase access to both locally available information resources and to other exponentially expanding body of information. However, this will not appear rapidly in an evolutionary manner, but will most likely develop slowly in an incremental fashion out of the existing library system. Since most of the requirements for implementing an EDD either exists or can be realized relatively easily, the cost effectiveness of an EDD is also apparent. With the existing MIME compliant e-mail, scanning, printing & standard technologies, EDD is technically feasible for the academic libraries in Ethiopia provided that the existing network infrastructure in the country in general and in the academic institutions in particular is developed well.

6.1 RECOMMENDATION

According to the academic libraries resolutions adopted during the first and second work shops held in Addis Ababa during 3-6 September 1998 and 15-19 November 1999 they have outlined the importance of electronic document delivery services for information resource sharing activities among themselves. This thesis has investigated a similar line

of intent in depth and has shown how to. Academic libraries might, therefore, use the results reported, alternative options suggested, and desired features and system requirements recommended by this study as an input to the execution of their resolutions.

To be more specific, this study recommends the following points for consideration during the course of the implementation of electronic document delivery services.

- Initiative has to be taken by one institution probably the Addis Ababa University, to prepare the necessary ground and initiate the cooperation in this line.
- Formation of a coordinating body (a project team) elected by participants with the major goal of coordination of activities, device and implement an interim plan of action which should include:
 1. Formal sensitization of parent organizations' decision making bodies on the problem and on the need for cooperation through document delivery services; about the benefit to be gained provided that full support from them is granted, in such areas of financial support, provision of meeting places, arranging workshops and discussion forums etc.
 2. Creating awareness and motivation of the staff of academic libraries, mainly of professionals, to coordinate their willing and conscious participation to realize the objectives of EDDS.
 3. The coordinating body should also start operation by working out an action plan involving all aspects of procurement, installation, testing, user training and evaluation.

- After estimating the costs and final decision has been reached funds should be solicited from each institution in the consortium. If funds from their budget are not adequate, the coordinating body should approach donor agencies who may be willing to finance the project. If the later option is taken the grant application or proposal should be prepared clearly stating the needs and objectives of the proposed system.
- It is not advisable to make document request in obtaining material from overseas before local resources have been explored thoroughly through cooperative agreement of information resource sharing.
- Libraries should rethink their approach to collection development and may devote a part of the budget to request documents that can be supplied by document delivery services, instead of buying documents that might never be used.
- The shared database should be located centrally and institutions can have access at their site. Addis Ababa University library could be a central node. This has a number of advantages. First, relatively this institution is equipped with more IT infrastructure and it will have its network in the future. Second many numbers of information professionals are in this institution. Third its holdings are better than other institutions.
- EDDS is a scaleable project where it can be started small and fully developed latter. Therefore, libraries can start to implement the service with the existing infrastructure in a small scale.
- In order to see other options of EDDS Ethiopian Telecommunication Corporation (ETC) should provide leased line and reliable band width channel for academic institutions in order to have their own Web server.

- The prototype database only holds journals. The prototype searching and requesting interface supports only to journals. Similarly other type of serials should also incorporate before implementation. Some application services of the prototype like update and adding journal interfaces should be secured before implementation.
- Technology changes every time. What is regarded, as the best today might be multifold by developments and changes happening any time in the future. Therefore, academic libraries should always keep track of technology changes and evaluate against the already existing system.
- Further study should be conducted to enable users locate, request and receive documents including databases of articles of journals in a simple, unmediated process from a place of work where one has network access.
- The other area of study that should be considered is to develop fully integrated automated EDDS that could support delivery of electronic journals using FTP protocol.

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APPENDICES

APPENDIX 1 Survey Questionnaire

ADDIS ABABA UNIVERSITY SCHOOL OF INFORMATION STUDIES FOR AFRICA (SISA)

Dear Librarian,

I am a student of SISA. Currently, I am working my thesis entitled " Electronic Document Delivery services: the case of academic libraries in Ethiopia". To do my research I need data / information on your institution particularly on the library. This could be done through questionnaire or observation if need arises.

Therefore, I have prepared a questionnaire to be filled by you. The quality of the study is depending on your appropriate answer. Most of the questions are objective and few of them are subjective. For objective questions there are different choices given.. For subjective questions if you need additional space you can use a sheet of paper.

Attached, please find a five-page questionnaire. I am expecting your answer within 15 days.

The response is sent directly to me on the address of:

Petros Demilew
Addis Ababa University
School of information studies for Africa/ University Library
P.O. Box 1176
Addis Ababa

Or
Petros Demilew
P.O BOX 14028
Addis Ababa

Or
E-mail Kennedy.aau@telcom.et.net

I am looking forward to hearing from you at earliest possible time.

Yours sincerely,

Petros Demilew
Addis Ababa University
SISA

This questionnaire is designed to survey "the Present Status of Academic Libraries in Ethiopia with Respect to Document Delivery Service Environment". It will be responded by Information professionals.

Purpose: To assess the prevailing status of academic libraries in Ethiopia with the aim of proposing enhanced resource sharing through electronic document delivery services.

Mark "X" against your choice when appropriate. You can tick more than one choice if applicable.

I General information

1. Name of the institution _____
2. Major academic programs/departments in your institution (e.g. Social Science (History, Geography), Science(Biology, Chemistry, Physics) Technology (Civil, Electrical, Chemical engineering), Medicine (Human, Veterinary), Agriculture (Plant, Animal sciences) etc.,
 - 1.
 - 2.
 - 3.
 - 4.
 - 5.
 - 6.
3. Name of your library _____
4. Name of contact person _____
5. Total number of Library staff _____

Technical _____	Professional _____
Non professional _____	Others _____
6. Does the library have staff with skill in computer?

Yes No

I Library resources & Computer Facilities

Information Resources available

Types of Collection	Total Vol.	Percentage
Books/monographs		
Back volumes of serials		
Current serial title		
Technical report		
Government publications		
Others (please specify):-		

7. Do you have any publication in your institution?

Yes No

If your answer is yes list titles indicating their frequency (if serials), when started, number of copies distributed.

Serial No.	Title	Frequency	Starting Date	No. of copies for distribution

8. Indicate the amount of budget allocated for the purchasing of Monographs and Periodicals for last five years.

Item	Amount in Ethiopian Birr				
	1997	1996	1995	1994	1993
Books (Monographs)					
Periodicals (scholarly journals)					
Computers					
Software					
Other equipment (specify)					

9. The subscription of scholarly journals in the last five years:

Increased by _____ %

Decreased by _____ %

10. Do you have any mechanism for acquiring or accessing locally published materials?

Yes

No

If yes through what delivery mechanisms do you acquire?

Postal service

In person

E-mail

World Wide Web

Fax

Others (please specify) _____

11. Does your library have full text electronic journal?

Yes

No

12. Please list Computer, software, Printer, Scanner, and photocopier... and Software resources that are available in your library.

A. Computers

Make/Model	Main Memory (RAM)	Operating system	Hard disk capacity	Quantity

- Reference service Current awareness
- SDI (Selective Dissemination of Information)
- CD-ROM database search E-mail
- Literature search on the Internet Interlibrary loan***
- Document delivery Reprography (photocopy)
- Reading and loan Others(specify _____)

15. What kind of bibliographical services does your library provide to users?
- Traditional card catalogue On-line public catalogue (OPAC)
 - CD-ROM databases Locally mounted citation databases
 - Indexes and Abstracts Network accessible databases/catalogues
 - Others (please specify).....

16. Have you started automation in your Library?

- Yes No
- If "Yes" which parts of library function (s) is/are automated?
- Cataloging Ordering & Acquisition Serials control
- Circulation Control Reports & Statistics Interlibrary Loan
- Others (please specify) _____

III Interlibrary loan¹/Document Delivery services²

17. The major sources of documents that your institution / library exchange through interlibrary /document delivery services arrangement are:

- Document supply centers (Non profit sources of documents like British Library's Document supplies center)
- Commercial document supply services (Supply documents for profit purposes like Chemical Abstracts Document delivery Service (CASDDS)
- Publishers Authors Libraries Others (please specify) _____

18. The method of document request is/are

- Postal services Fax Net-work E-mail Telephone call
- In person Letter Others (please specify) _____

19. How long does it takes to get requested document?

- 1 - 7 days 8 - 15 days 1 month

¹ Interlibrary loan is traditionally about transferring a document (rather than a copy of a document) from one Library to another

² Document delivery is the provision of documents as surrogates (e.g. photocopies, microforms, digital images) that are retained by the user.

APPENDIX 2 DISCUSSION GUIDE

1. What are the major functions involved in document delivery or interlibrary loan services at your library?
2. How do the selection of relevant citation, location of a source, submission of request and/or originator of the request, retrieval and transfer of a document is carried out?
3. How does the library cover the cost incurred for document delivery or interlibrary loan services?
4. What is your opinion on resources sharing via document delivery services among academic institutions in Ethiopia?
5. What are the major problems you have faced with respect to document delivery or interlibrary loan services?
6. What do you think are the solutions in alleviating these problems?
7. How do you see the opportunities of Electronic Document delivery services for your library?
8. What is your plan for information resource sharing particularly document delivery or interlibrary loan services?

APPENDIX 3 NAME OF INTERVIEWEES

Name	Position
Nistuh Ferede	A/Head of Addis Ababa Commercial College Library
Ato Enchalew Yiffiru	Head of computer center of Jimma Health Sciences institute
Gebremeskel Grima	Head of Kotebe College of Teachers Education Library
Yeshimebet Mersha	Head of Bahir Dar teachers College Library
Habtamu Alemayehu	A/ head of Bahir Dar Polytechnic Institute
Ato Newaynek Ketsela	Head of Gondar College of Medical Sciences
Ato Mulugata Asgedom	Assistant Librarian of Mekelle Business College
Ato Yared Mammo	Assistant Librarian Alamaya Agricultural Univesity
Ato Higemedhin Hadara	Head of Mekelle Univesity College Library
Ato Tamirat Mota	Chief librarian, Civil Service College
Ato Girma Mekonnen	Head of Acquisition department of Addis Ababa university Library
Ato Zewdie Gudeta	Head of Reference department of Addis Ababa university Library
Ato Gutema Balcha	Head of Periodical department of Addis Ababa university Library
Ato Habtemariam Nigussie	Senior Library assistant of Department of reference, Addis Ababa University Library

APPENDIX 4 LIST OF VISITED LIBRARIES

Addis Ababa Commercial College

Addis Ababa university

Alamaya Agricultural University

Bahir Dar Polytechnic Institute

Bahir Dar teachers College

Civil Service College

Jimma Health Sciences Institute

Kotebe College of Teachers Education Library

Mekelle Business College

Mekelle University College

```

<!--APPENDIX 5 ColdFusion scripts and HTML files>
<!--Name: Index1.CFM
Author: Petros Demilew
Date: May, 2000
Nothing exciting really going on here... just a Welcome page. --->
<HTML>
<HEAD>
  <TITLE>ACADEMIC LIBRARIES ELECTRONIC DOCUMENT DELIVERY SERVICES</TITLE>
</HEAD>

<BODY BGCOLOR="Olive" TEXT="Navy" LINK="Blue" alink="White" vlink="Red">

<!--- Pretty formatting... --->
<table width="615" border="0" cellspacing="0" cellpadding="0" align="CENTER"
bgcolor="#008040" bordercolor="Lime" bordercolorlight="Teal" bordercolordark="Navy"
teal="YES">
<TR><TD COLSPAN="">&nbsp;</TD>
<TR>
  <TD WIDTH="0">&nbsp;</TD>
  <TD>

  </TD>
  <TD ALIGN="CENTER">

    <font face="Myriad Web, Verdana, Helvetica" size="+2" style="color:
White"><BR><h2><strong>ACADEMIC LIBRARIES ELECTRONIC DOCUMENT DELIVER SERVICES
(ALEDDS)</h2></strong><BR></FONT>
    <p> The objective of this page is to provide a link of different options for
making journal database search along with its location, list of academic Libraries
and online document request form.
    <font face="Verdana" color="Black"><I>Please click your choice</I> </FONT>
    </TD>

  <TD WIDTH="45">&nbsp;</TD>
</TR>
<TR><td height="0" colspan="4">&nbsp;</td>
</TABLE>
<!--- This provides all of the (dyamically generated) links at the bottom. --->
<CFINCLUDE TEMPLATE="_footer1.cfm">

</BODY>
</HTML>

```

```

<!--
Name: _footer1.CFM
Author: Petros Demilew
Date: May, 2000
The footer will contain a link to all the libraries.
First we do a query to fetch the libraries. --->

<CFQUERY NAME="GetFooterLinks" DATASOURCE="Serial">
SELECT NameofLibrary, LibraryID
FROM Libraries
</CFQUERY>

<!-- Then we set up some formatting... --->
<TR>
  <TD COLSPAN="3">

    <table width="615" border="0" cellspacing="0" cellpadding="0" align="CENTER"
style="color: Navy;" bgcolor="Olive">
      <TR>
        <td height="25" colspan="4" align="CENTER" bgcolor="Silver"
bordercolor="Teal" style="color: Aqua;">
          <font face="Myriad Web, Verdana, Helvetica" size="-1" color="Lime">

<!-- Now we CFOUTPUT over the query we just executed. --->
<CFOUTPUT QUERY="GetFooterLinks">
<!-- Notice we're passing the LibraryID in the URL... --->
<A
HREF="department1.cfm?LibraryID=#LibraryID#">#NameofLibrary#</A>
      <!-- The following line inserts a | if the current record does Not
Equal the last record. --->
<CFIF CurrentRow NEQ RecordCount>|</CFIF>
</CFOUTPUT>
</FONT>
</TD>
  </TR>

  <TR>
    <td height="25" colspan="4" align="CENTER" bgcolor="#666666" style="color: Red;">
      <font face="Myriad Web, Verdana, Helvetica" size="-1" color="Silver">
        <A HREF="insertform1.cfm"><b>Add New Journal</b></A> |
        <A HREF="list1.cfm"><b>Union Journal Lists</b></A> |
        <A HREF="searchform1.cfm"><b>Journal Search</b></A> |
        <A HREF="RequestForm1.cfm"><b>Online Request Form</b></A>
      </FONT>
    </TD>
  </TR>
</TABLE>
</TD>
</TR>

```

```

<!--
Name: Department1.CFM
Author: Petros Demilew
Date: May, 2000
If there is no variable GetLibraryName.LibraryName,
    CFPARAM creates it and assigns the value "List of libraries" --->

<CFPARAM NAME="GetLibraryName.NameofLibrary" DEFAULT="">

<!DOCTYPE HTML PUBLIC "-//W3C//DTD HTML 3.2 Final//EN">

<HTML>
<HEAD>
    <TITLE><CFOUTPUT>#GetLibraryName.NameofLibrary#</CFOUTPUT></TITLE>
</HEAD>

<BODY BGCOLOR="Teal" LINK="Black" VLINK="Black"
background="http://0/CFIDE/main/ide.cfm?CFSRV=IDE&ACTION=READ&File=/C:/InetPub/wwwroot/imag
es//InetPub/wwwroot/images/smpress.gif">

<table width="600" border="0" cellspacing="0" cellpadding="0" align="CENTER" style="color:
Black;" bgcolor="Silver" bordercolor="Fuchsia" bordercolorlight="Aqua"
bordercolorordark="Blue">
    <!--      <TD WIDTH="25" NOWRAP ROWSPAN="99">&nbsp;</TD>
    <TD COLSPAN="3">&nbsp;</TD>
    <!--      <TD WIDTH="25" NOWRAP ROWSPAN="99">&nbsp;</TD>--->
    <TR>
        <td height="15" colspan="3" valign="TOP" bgcolor="#FF8080" bordercolor="Lime"
bordercolorlight="Aqua">
            <font face="Myriad Web, Verdana, Helvetica, Size=+2" color="Blue">
                <A HREF="index1.cfm"><IMG SRC="up.gif" WIDTH=30 HEIGHT=40 BORDER=0
ALIGN="right" ALT="HOME"> </A>
<!-- Displays library name --->
                <CFOUTPUT>#GetLibraryName.NameofLibrary#</CFOUTPUT>
                <BR><IMG SRC="white.gif" HEIGHT=1 WIDTH=520 border=0 style="color: Lime;"
alt=""><i>Home</i><BR>
                </FONT>
            </TD>
        </TR>

```



```
<!---
Name: RequestAction1.CFM
Author: Petros Demilew
Date: May, 2000
This INSERT statement does the actual adding
of the data to the database; notice that the
SQL statement contains Cold Fusion #variables# --->
```

```
<CFQUERY DATASOURCE="serial" NAME="Sendrequest">
INSERT INTO Request
  (DateofRequest,
   NameofLibrary,
   AuthorofArticle,
   TitleofArticle,
   PagesRequested,
   JournalTitle,
   Volume,
   IssueNumberorDate,
   Publisher,
   PublicationDate,
   LibraryID)
VALUES ('#Form.DateofRequest#',
        '#Form.Nameoflibrary#',
        '#Form.AuthorofArticle#',
        '#Form.TitleofArticle#',
        '#Form.PagesRequested#',
        '#Form.JournalTitle#',
        '#Form.Volume#',
        '#Form.IssueNumberorDate#',
        '#Form.publisher#',
        '#Form.PublicationDate#',
        '#Form.LibraryID#')
</CFQUERY>

<CFLOCATION
URL="Confirmletter.cfm">>
```


<!--

Name: ModifyAction1.CFM

Author: Petros Demilew

Date: May, 2000

This template takes info passed from ModifyForm1.cfm and updates the database. --->

<cfquery

NAME="ModifyJournal" datasource="serial" >

UPDATE Journals

SET JournalTitle = '#Form.JournalTitle#',
volume= '#Form.Volume#',
IssueNumberorDate = '#Form.IssueNumberorDate#',
LibraryID='#Form.LibraryID#',
Publisher = '#Form.Publisher#',
PublicationDate = '#Form.PublicationDate#',
Pages = '#Form.Pages#'

WHERE JournalID = #Form.JournalID#

</CFQUERY>

<CFLOCATION

URL="Details1.cfm?JuornalID=#JournalID#">>

```

<!---
Name: List1.CFM
Author: Petros Demilew
Date: May, 2000
This template lists the journals, grouped by library, and lets
the user click on a journal to view details
Get journals (and their locations); and order by
library because that's what we're going to group by
--->

<CFQUERY DATASOURCE="Serial" NAME="Getjournals">
SELECT * FROM Journals, Libraries
WHERE Journals.LibraryID = Libraries.LibraryID
ORDER BY NameofLibrary, Journals.LibraryID, JournalTitle, PublicationDate
</CFQUERY>
<CFINCLUDE TEMPLATE="_header1.cfm">
<h3> Union List of Journals </h3>
<TR>
  <TD COLSPAN="5">

    <TABLE WIDTH="95%" BORDER="0" CELLSPACING="0" CELLPADDING="0" ALIGN="CENTER">

      <!--- Output the query data; the code between this <CFOUTPUT>
           and the next <CFOUTPUT> is only outputted once per
           LibraryID, since it is grouped by LibraryID --->
      <CFOUTPUT QUERY="GetJournals" GROUP="LibraryID">
        <TR>
          <td height="VALIGN" colspan="5">
            <font face="Myriad Web, Verdana, Helvetica" size="2"
color="Navy"><B>#NameofLibrary#</B></FONT>

          </TD>
          <TD VALIGN="bottom" ALIGN="right"><FONT FACE="Arial, Geneva, Helvetica"
SIZE="-1"><A HREF="mailto:#Email#">#Email#</A><BR></FONT></TD>
        </TR>

        <!--- Now we start outputting for every record
             (i.e. every Journal) --->
        <CFOUTPUT>
          <TR>
            <TD WIDTH=25 NOWRAP>&nbsp;</TD>
            <TD ALIGN="left" VALIGN="top">
              <FONT FACE="Arial, Geneva, Helvetica" SIZE="-1">
                <A
href="Details1.cfm?JournalID=#JournalID#">#JournalTitle#, #PublicationDate#, </A><BR>
              </FONT>
              <FONT FACE="Arial, Geneva, Helvetica" SIZE="-2">
                <TD VALIGN="top " ALIGN="right"><FONT FACE="Arial, Geneva,
Helvetica" SIZE="-2"> Volume:#Volume #<BR>
              </FONT>
            </TD>
            <TD VALIGN="top " ALIGN="right"><FONT FACE="Arial, Geneva,
Helvetica" SIZE="-2"> Issue number: #IssueNumberorDate#<BR></FONT></TD>
          </TR>

        </CFOUTPUT>

      </CFOUTPUT>

    </TABLE>
  </TD>
</TR>
</TABLE>

```

<!--

Name: InsertForm1.CFM
Author: Petros Demilew
Date: May, 2000

This template allows the user to provide information about
a new journal, and passes the data to InsertAction1.cfm, which
adds the data to the database --->

```
<CFINCLUDE TEMPLATE="_header1.cfm">
<!-- This fetches the names and ID's of the libraries, which will
allow us to create a drop-down box --->
<h3>ADD JOURNAL FORM</h3>
<CFQUERY DATASOURCE="serial" NAME="GetLibraries">
SELECT * FROM Libraries ORDER BY NameofLibrary</CFQUERY>
<TR><TD WIDTH = 100 ALIGN = "RIGHT" VALIGN = "TOP" HEIGHT = "150"> &nbsp;</TD>
<TD VALIGN = "TOP">
<table border="0" cellspacing="0" cellpadding="2" bgcolor="Lime"
bordercolor="Green">
<TR><td colspan=2>
<B> Please enter journal information to be added:</b><p>
</td>
</TR>
<TR>
<FONT FACE="Helvetica" SIZE="-1">
<TR>
<CFFORM ACTION = "InsertAction1.cfm" METHOD = "POST">
<FONT FACE="Helvetica" SIZE="-1">
<TD><P>Title<BR>
<CFINPUT TYPE = "TEXT" NAME = "JournalTitle" MESSAGE = "You must enter a
title." REQUIRED = YES></P>
<TD><P>Volume<BR>
<CFINPUT TYPE = "TEXT" NAME = "Volume" MESSAGE = "You must enter a volume."
REQUIRED = YES></P></td>
<TR><TD><P>Issue Number or Date<BR>
<CFINPUT TYPE = "TEXT" NAME="IssueNumberorDate" MESSAGE = "You must enter an
issue number or date" REQUIRED = YES> </P>
<TD><P>Publisher<BR>
<INPUT NAME="PUBLISHER" <P></td>
<TR><TD><P>Publication Year<BR>&nbsp;&nbsp;&nbsp;<
<INPUT NAME="PublicationDate" </P>
<TD><P>Pages</P>
<INPUT NAME="Pages" style="HEIGHT: 26px; WIDTH: 145px" <BR></P></td>
<TR><TD><P>Library<BR>
<SELECT NAME="LibraryID">
<CFOUTPUT QUERY="GetLibraries">
<OPTION VALUE="#LibraryID#">
#NameofLibrary#
</CFOUTPUT>
</SELECT></P>
<TD><P><INPUT TYPE="submit" VALUE="Add Journal"></P></TD>
</FONT>
</TABLE>
</CFFORM>
</TD><TD WIDTH = 100 ALIGN = "RIGHT" VALIGN = "TOP" HEIGHT = "150">&nbsp;&nbsp;&nbsp;</TD>
</TR>
<TR><TD HEIGHT = "35" COLSPAN = "3"> &nbsp;&nbsp;&nbsp;</TD>
</TR></TABLE>
```

<!--

Name: InsertAction1.CFM

Author: Petros Demilew

Date: May, 2000

This INSERT statement does the actual adding of the data to the database; notice that the SQL statement contains Cold Fusion #variables# --->

```
<CFQUERY DATASOURCE="serial" NAME="InsertJournal">
INSERT INTO Journals
  (JournalTitle,
   Volume,
   IssueNumberorDate,
   Publisher,
   PublicationDate,
   Pages,
   LibraryID)
VALUES ('#Form.JournalTitle#',
       '#Form.Volume#',
       '#Form.IssueNumberorDate#',
       '#Form.publisher#',
       '#Form.Publicationdate#',
       '#Form.Pages#',
       '#Form.LibraryID#')
</CFQUERY>
<!-- Go back to the Add journal page--->
<CFLOCATION URL="InsertForm1.cfm"
>>>
```

```
<!DOCTYPE HTML PUBLIC "-//W3C//DTD HTML 4.0 Transitional//EN">
<!--Name: ConfirmationLetter.CFM
Author: Petros Demilew
Date: May, 2000
This templates displays a message for requestor for successful request made by users ---->
<html>
<head>
  <title> Thank you for Your request</title>
</head>

<body>
<CFINCLUDE TEMPLATE="_header1.cfm">
<h3> Confirmation Letter</h3>
<TR>

  <td width="100" height="150" align="RIGHT" valign="TOP" bgcolor="Silver"
bordercolor="Silver" bordercolorlight="Fuchsia" style="color: white;" nbsp="YES"></TD>

  <TD VALIGN="TOP">
    <font face="Arial, Helvetica" color="Navy">
    Thanks for Your recent request. It will be processed as quickly as possible.
    Feel free to continue review our site.If there is any thing we can do
    to make our site more useful,please
    <A HREF="Mailto:sis.aau@telecom.net.et#">drop us a line</a>

</body>
</html>
```

**LITHOLOGIC AND STRUCTURAL MAPPING OF THE
NORTHEAST LAKE ZIWAY AREA, ETHIOPIAN RIFT,
WITH THE HELP OF LANDSAT TM DATA**

Tesfaye Korme

Department of Geology and Geophysics, Faculty of Science
Addis Ababa University, PO Box 1176 Addis Ababa, Ethiopia

ABSTRACT: By integrating the interpretation of interactively enhanced Landsat Thematic Mapper (TM) image with field data it was possible to map the lithology and structures of the area located in the central part of the Main Ethiopian Rift (MER). Most lithologic contacts, faults and lineaments that were not identified in previous geological and structural maps of the region are mapped with better accuracy, minimum cost and shorter field season. Different image enhancement techniques were applied to enhance the original data. The resultant image is interpreted visually. The results of the work showed four major volcanic rock units, namely: 1. the lower series of pyroclastic deposit, 2. the basaltic series, 3. pyroclastic deposits of the rift floor and 4. recent lava flows. Three sets of faults were also mapped; 1. NE-SW striking rift-margin faults, 2. NW-SE to NNW-SSE trending trans-rift faults and lineaments and 3. the youngest and active NNE-SSW to N-S faults of the Wonji Fault Belt (WFB).

Key words/phrases: Ethiopia, fault, landsat TM, lithology, rift, volcanism

INTRODUCTION

Due to its rough topography, poor accessibility and other factors, large part of the resourceful land of Ethiopia has remained geologically unexplored. To overcome some of these barriers and unravel the resource potential of the country, the importance of integrating multi-source data such as remote sensing with that of conventional method field geological mapping is unquestionable.

Prior to the availability of satellite imageries, geologists relied on aerial photographs to obtain synoptic coverage of a study area. However, geologic interpretation of aerial photos is limited by many factors including poor spectral resolution, higher geometrical distortion, large number of photos required to recognise large surface features and higher cost (Rothery, 1984). Landsat TM data overcomes such handicaps in geological mapping and also provides the possibility of further treatment of the data in such a way that it fulfils the required sense of interpretation.

The objective of this study is therefore, to show how remote sensing data and methods of image interpretation improve the conventional methods of geological mapping, and to test some of the digital image processing techniques suggested for geological applications. Mapping structures in the inaccessible parts of the region and reconstructing the possible tectonic relationships among the faults of different phases and volcanism are the final results of this study.

LOCATION AND ACCESSIBILITY

The study area is located about 140 km south of Addis Ababa in the central part of the Main Ethiopian Rift (MER). It lies within 38°45' and 39°15'E. longitude and 8°00' and 8°15'N. latitude, covering about 1250 km² area (Fig. 1).

The topography of the central part of the MER is characterised by intensively faulted blocks with steep scarps forming local horst and graben structures. Long and relatively narrow (1–5 m) extension fractures (Tesfaye Korme *et al.*, 1997), brecciated lava flows, lava domes, cinder cones, craters and calderas are the most notable features within the study area. These features produced extremely rough topography. Due to such rough topography and absence of routes, accessibility to some localities in the area is rather difficult. There is only one dry weather road joining Asela and Meki towns. This road helped to accede at some of the representative geologic sections which were used as test areas while mapping the lithology of the inaccessible zones applying techniques of remote sensing.

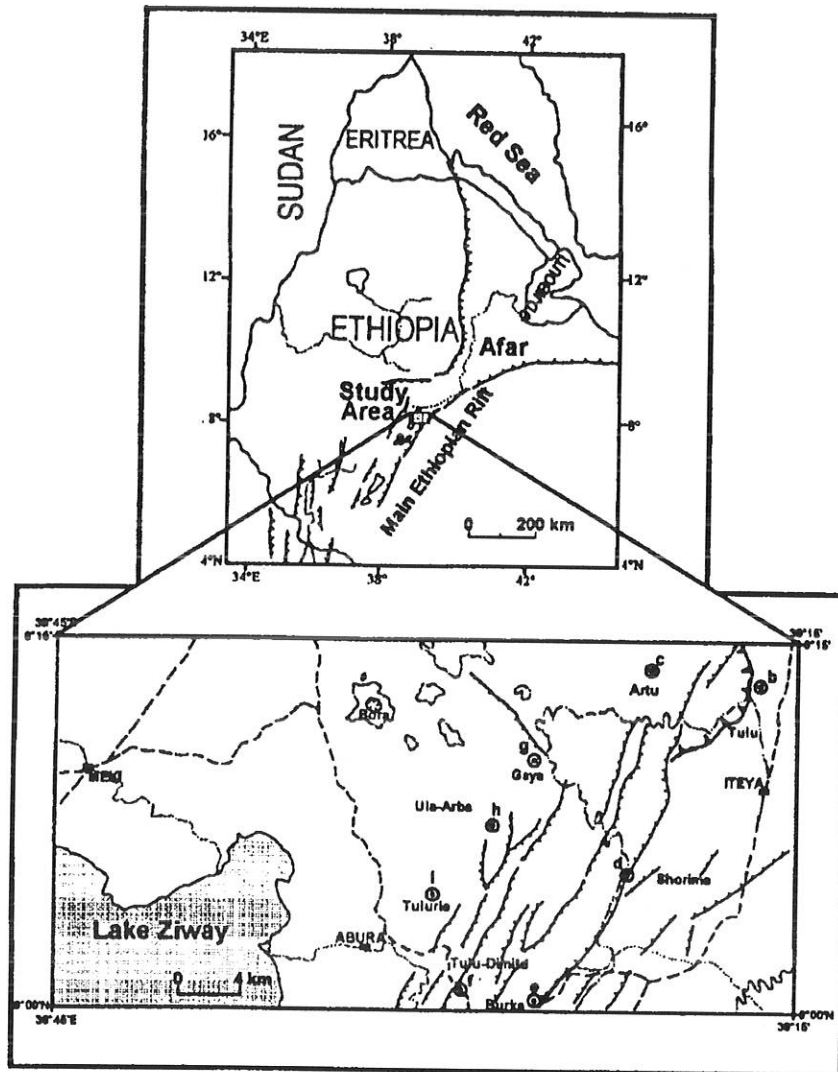


Fig. 1. Location map of the study area. Circles with dot at the centre show location of stratigraphic columns, broken lines with dot are contours, dotted lines are rivers and dashed lines are all weather roads.

GEOLOGY OF THE ETHIOPIAN RIFT

The MER is part of the great East African rift and lies within 5°00' and 9°00'N. latitude and 37°30' and 40°00'E. longitude (Mohr, 1967b). The Main Ethiopian Rift is geographically divided into three sub-sectors: Northern, Central and Southern sectors (Gidey Wolde-Gabriel *et al.*, 1990). Its geometry is characterised mainly by normal step faults of various dimensions with orientations ranging from NNE-SSW to NW-SE (Mohr, 1967b; Di Paola, 1977). These faults are commonly arranged in side-stepping an en-echelon style. The adjacent plateaux on the either side of the rift are formed by huge piles of Tertiary basaltic and rhyolitic lava and a number of Tertiary shield volcanoes. However, there are also windows of metamorphic basement rocks of Precambrian age and Mesozoic sedimentary rocks in a few localities. These pre-Tertiary rocks are exposed along the eastern, western and southern Afar margins (Huchinson and Engels, 1970; Zanettin and Justin-Visentin, 1974; Black *et al.*, 1975; Chessex *et al.*, 1975). They also occur along the western margin of the central sector of the MER at Kella Horst, and at Amaro Horst in the southern sector of the MER (Levitte *et al.*, 1974; Zanettin *et al.*, 1980). In the southern sector of the MER, crystalline basement is unconformably overlain by various Tertiary (12.7–49.4 Ma) and quaternary volcanic rocks, including the oldest known (Eocene) flood basalt in Ethiopia (Davidson and Rex, 1980). The floor of the Ethiopian Rift is in general covered by Mio-Pliocene to present volcanics and volcano-sedimentary deposits.

LANDSAT TM DIGITAL IMAGE PROCESSING, INTERPRETATION AND GEOLOGICAL MAPPING

Digital data and the software

The study area lies within a scene of LANDSAT-5 Path-168 and Raw-54 taken on November 22, 1989. A window of 1950 columns and 1289 lines containing four TM bands was extracted and treated using ERDAS software installed on PC. Further treatments were also made on an APOLLO station with TGV software which is developed locally at the University of Pierre and Marie Curie, Laboratory of Remote Sensing.

Image processing includes mathematical manipulations on raw digital data that enables us to get images containing more information that are essential for the

final goal of the work. In this study, image processing was carried out with some information from the existing geological map at 1:250,000 scale and additional geological data from reconnaissance field work. The bands available were TM band2, band3, band4 and band5 (while TM band1, band6 and band7 are lacking). Various methods and processing techniques were applied to enhance the images and compensate for the lack of information from TM band7. Band rationing, principal component analysis and spatial filtering were among the principal mathematical manipulations applied on the four bands to extract the maximum possible information which are required for geological mapping.

Digital data processing

a. Colour combinations

Covariance matrix is calculated (Table 1) to investigate the distribution of information among the four bands. The matrix indicates the joint variance (co-variance) between bands about their weighted mean. When the co-variance between two bands is positive, the information in the bands are positively correlated, and hence there is high redundancy. If it is negative, an inverse relationship exists, and consequently, features represented by higher digital number values (brighter pixels) in one of the bands will have lower values (darker pixels) in the other band. If co-variance is zero, then the information contained in the two bands are independent. Co-variance matrix also helps in selecting bands for colour combinations. According to the covariance matrix of the data used in this study (Table 1), there is relatively higher redundancy of information among the bands used except for band3, band4, and band5. Thus, a good colour combination image showing diverse surface covers (e.g., rocks, soil and vegetation) is obtained by composing the TM bands 5, 4 and 3 in red, green and blue (RGB) order.

Table 1. Covariance matrix of the four bands.

Bands	B2	B3	B4	B5
B2	719.4			
B3	159.5	58.72		
B4	309.5	112.8	223.3	
B5	207.4	70.34	135.4	173.8

b. Principal component analysis

Principal component analysis is a mathematical method of improving the spread of data about a new set of axes in multi-dimensional space (Drury, 1992). It avoids redundancy of information in different bands. In the case of the data used in this study, the original bands (band2, 3, 4 and 5) are projected onto four new principal axes as linear additive combinations using calculated eigen vectors (Table 2). Each eigen vector is a loading factor for the contribution of individual band to a principal component. The co-variance matrix of the original bands is transformed in such a way that the new co-variance between the transformed canals (principal components) becomes zero. This means that, there is no more redundancy among the transformed canals. Variations within information contained in individual transformed canals are recognised as eigenvalues which are considered as variances of the principal components (Table 3).

Table 2. Eigen vectors and calculated principal components of the four bands.

Band	B2	B3	B4	B5	
PC1	0.83	0.21	0.42	0.00	$\Rightarrow PC1 = 0.83B_2 + 0.21B_3 + 0.42B_4 + 0B_5$
PC2	-0.53	0.22	0.43	0.90	$\Rightarrow PC2 = -0.53B_2 + 0.22B_3 + 0.43B_4 + 0.90B_5$
PC3	-0.18	0.31	0.67	-0.65	$\Rightarrow PC3 = -0.18B_2 + 0.31B_3 + 0.67B_4 - 0.65B_5$
PC4	0.00	0.90	-0.44	-0.02	$\Rightarrow PC4 = 0B_2 + 0.90B_3 - 0.44B_4 - 0.02B_5$

The highest eigenvalue corresponds to the first principal component and, the values decrease rapidly towards the higher order principal components (Table 3). The result is that, the first principal component is generally a weighted average of all of the data and approximates an image of albedo and topography in the range covered by remote sensing systems (Drury, 1992). High order principal components contain detailed information concerning the different types of lithologic and vegetation covers of the area. By applying directional and edge enhancement filters on the first principal component image we have obtained large number of fault zones and other lineaments in a preferred direction, well defined lithologic boundaries and other land-cover limits.

Table 3. Eigenvalues.

Neocanals (PC)	Eigen values	Variance (%)	Cumulative variance (%)
PC1	991.83	84.41	84.41
PC2	122.58	10.43	94.84
PC3	59.06	5.03	99.87
PC4	1.52	0.13	100.00

c. Band rationing

The ratio images have the effect of suppressing unnecessarily detailed spectral responses which are introduced due to rough topography, while better enhancing the colour boundaries. Therefore, they are very useful in lithological mapping since they directly exaggerate subtle colour differences among the different rocks exposed on the surface. Many geological problems such as tracing lateral facies variations require fine lithologic mapping. For such type of mapping ratio images derived from infrared and visible bands gives better result than detailed field mapping. However, rationing reduces the ability to discriminate between two rocks with very different albedos, but similar spectral reflectance (Drury, 1992).

The ratio image used in this study is computed with the formula indicated below from TM band3 and band5 which are the least correlated bands (Table 1). After rescaling its dynamic range between 0 and 255, the ratio image is found to be rich in information that are useful for lithologic mapping.

$$\text{Ratio image} = \text{Band5} - \frac{\text{Band5} - \text{Band3}}{\text{Band5} + \text{Band3}} (K)$$

where, k is a constant for re-scaling the dynamic of the resultant image.

d. Edge enhancement and linear directional filtering

Edge enhancement and linear directional filtering are particularly important in smoothing images, in enhancing certain lineaments of preferred orientations and in detecting lines and edges such as lithologic contacts and lava flow structures. They are also used to reduce the effect of differences in illumination over the area.

A consequent limitation of filters, mainly the high pass ones, is that, only local variations with respect to neighbouring pixels become important and the absolute DN-values have no significance in image interpretation (Gupta, 1991). The image used in structural mapping of the study area is obtained by applying first, a high-pass NE-SW directional filter of (7 x 7) to the TM band 4 and, then adding the filtered image to the original. This process has strongly modified the individual pixel values near the edges and lines that are enhanced. It has largely enhanced the visibility of the NW-SE to NNW-SSE striking trans-rift faults and lineaments which will be discussed in the structural mapping section of this manuscript.

e. Geometric correction

Like any other Satellite data, the geometric distortion associated to Landsat TM data requires correction. Due to relatively unstable mechanical scanning system of the Landsat TM sensor, the associated geometrical distortion in TM images is irregular and it can not be easily modelled like that of SPOT images (Story and Congalton, 1986). However, the geometric correction of images used in this study is done with respect to a Universal Transverse Mercator (UTM) topo-map of 1:50,000 scale. To perform this correction, 33 ground control points (GCP) which are uniformly distributed in the image have been carefully selected on both the image and the reference topo-map. The first calculation of geometric correction is done with the first order transformation at total root mean square (RMS) error of 2.5. The result obtained after iteration indicated that about half of the total GCP have been correctly identified at RMS of 2.5. However, the maximum acceptable total RMS error for good geometric correction is 2.0. Therefore, it is necessary to reduce the RMS error as lower as possible keeping the maximum number of GCP (Tables 4 and 5). At the total RMS error = 1.43398 seven ground control points are accepted. These seven ground control points are sufficient to correct the geometry of the image at the required scale.

The DN-values of the raw image are interpolated to the new geometrically corrected grid using the method of bicubic interpolation. This method uses a polynomial surface to fit the DN values into the new grid. Hence, the resultant image is not only corrected geometrically, but also modified radiometrically (Gupta, 1991), and it has identical projection and scale to the referenced UTM topo-map of scale 1:50,000.

Table 4. Ground control points (GCP) after iteration at RMS = 1.43398

Ground control point (GCP) number	Co-ordinates on topo-map (UTM)		Co-ordinates on image (pixels)	
	Latitude	Longitude	X	Y
2 nd	476015.0000	892075.0000	252	987
4 th	489087.0000	896045.0000	707	797
8 th	478050.0000	908080.0000	252	415
17 th	506055.0000	903053.0000	1255	456
20 th	501053.0000	887075.0000	1078	832
26 th	524055.0000	894040.0000	1927	681
33 rd	511060.0000	881060.0000	1527	1197

Table 5. Errors contributed by the ground points.

Ground control point (GCP) number	Total error	Error contributed by the GCP
2 nd	1.5506	1.0813
4 th	1.6232	1.1319
8 th	1.6958	1.1826
17 th	1.4915	1.0401
20 th	1.1640	0.8118
26 th	0.9814	0.6844
33 rd	1.3467	0.9392

Image interpretation and geological mapping

In remote sensing application to geologic mapping, the most important task that follows image processing is the interpretation. Even though it is possible to identify and classify the different themes in the image automatically, more accurate result is obtained by visually interpreting the images. In this study, interpretation is done on a 1:100,000 scaled printed image and at a screen having higher resolution contemporaneously. This interactive interpretation permits to zoom the digital image where detailed interpretation is required.

Using the colour combination image of TM band5, ratio of band5 and band3 and principal component 2 in RGB order, nine different themes were identified of which seven of them represent the different rock units (Fig. 2). The geological map shown in Figure 3 is a result of compilation by integrating image interpretation with field geological data. The spectral separation among the different themes in each transformed (neocanals) and original bands indicated in Figure 2 confirms that, TM band5, ratio image, and PC1 and PC2 contain the DN values characterising the themes established.

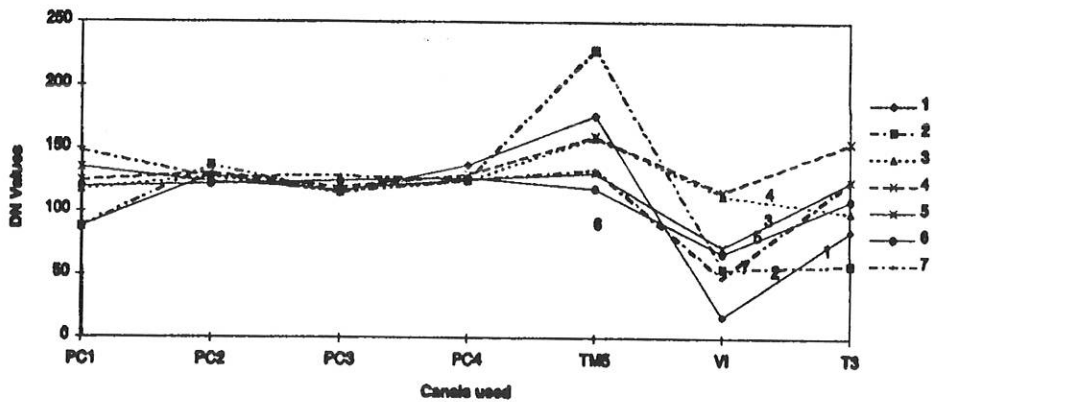


Fig. 2. Scatterogram showing the separation of different themes among the canals used. PC, principal component image; TM5, TM band5 original image; VI, Vegetation index (band ratio) image; and T3, Texture image derived by applying texture filter on TM band3. Themes: 1. Rift margin pyroclastic deposits, 2. Porphyritic olivine basalt, 3. Trachytic rocks, 4. Rift floor pyroclastic deposits, 5. Rift floor scoriaceous porphy. basalt, 6. Obsidian flows forming lava domes and 7. Very recent scoriaceous basalt.

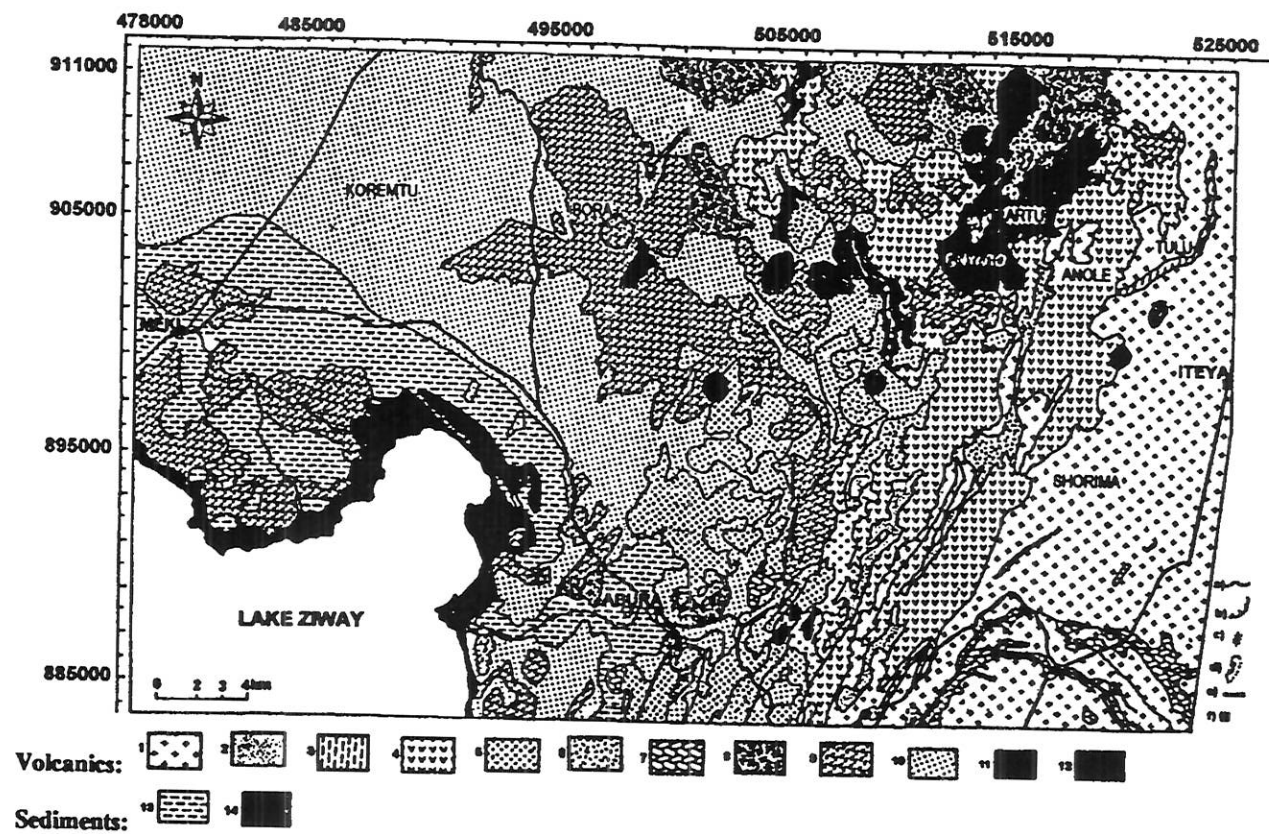


Fig. 3. Geological map of Northeast Lake Ziway area as interpreted from Landsat TM images. Lithologic contacts that were not identified on satellite image are mapped during the field verification stage. (1, Rift margin pyroclastic deposits; 2, Ash falls and ignimbrites; 3, Co-ignimbrite breccia and caldera-rim rock suit; 4, Porphyritic olivine-plagioclase basalt; 5, Olivine basalt; 6, Scoriaceous porphyritic basalt; 7, Rhyolitic lava and sheeted ignimbrites; 8, Trachytes; 9, Rift floor pumice dominated pyroclastic flows; 10, Rift floor ash dominated pyroclastic fall and alluvial deposits; 11, Rift floor scoriaceous basaltic flows and cones; 12, Obsidian flows and domes; 13, Sand and silt deposits; and 14, Mud. a, Lithologic contacts; b, Caldera; c, Socoria and tuff cones; d, Volcanic craters; e, All weather roads; f, Towns.)

DECLARATION

The thesis is my original Work and has not been presented for a degree in any other university.



Petros Demilew Misikir
May 2000

The Thesis has been submitted for examination with my approval as University advisor



Dr. Taye Tadesse