UNIT 1 INTRODUCTION TO LIBRARY AUTOMATION

Structure

1.0 OBJECTIVES

After going through this Unit, you will be able to:

- understand conceptual views related to library automation and evolution of ILS;
- know features, advantages, requirements, steps, standards and models of library automation; and
- trace the path of progress and future directions in the development of ILS.

1.1 INTRODUCTION

Library services require a series of works like acquiring, preparing and organising documents of different types and available in many formats. The activities related to acquisition of documents, technical processing of acquired documents, circulation and maintenance of processed documents are known as housekeeping operations. In a traditional library system (managed manually) these time consuming, labour intensive activities and routine clerical chores are performed slowly and expensively by library staff. Libraries all over the world, right from 1970s (with the advent of Personal Computer) are increasingly attempting to

automate some of these activities for minimising human clerical routines and thereby optimising productivity and creativity of library staff. Library automation is the generic term that denotes applications of Information Communications Technologies (ICT) for performing manual operations in libraries of any type or size. Library automation process can adopt three routes – i) a piecemeal approach, converting individual operations one at a time (for example installation of Cataloguing module alone to offer OPAC); ii) the process can work towards the integrated system progressively, using a 'planned installation' approach (for example installation of Member management module and Circulation modules after the Cataloguing module); and iii) it can go directly for a fully integrated system to cover operations of all subsystems in the library. Therefore, theoretically, a typical library automation may or may not be integrated and may or may not be applied on a Local Area Network (or Intranet). In such automation process, the functions that may be automated are any or all of the followings: acquisition, cataloging, member management, circulation, serials control, inter library lending, and access to online public access catalogue. But the radical development in hardware, software and connectivity along with the reduced costs paved the path for integrated library automation systems (ILS). Presently, library automation processes are integrated systems of a set of interlinked modules responsible for the management of different operational subsystems.

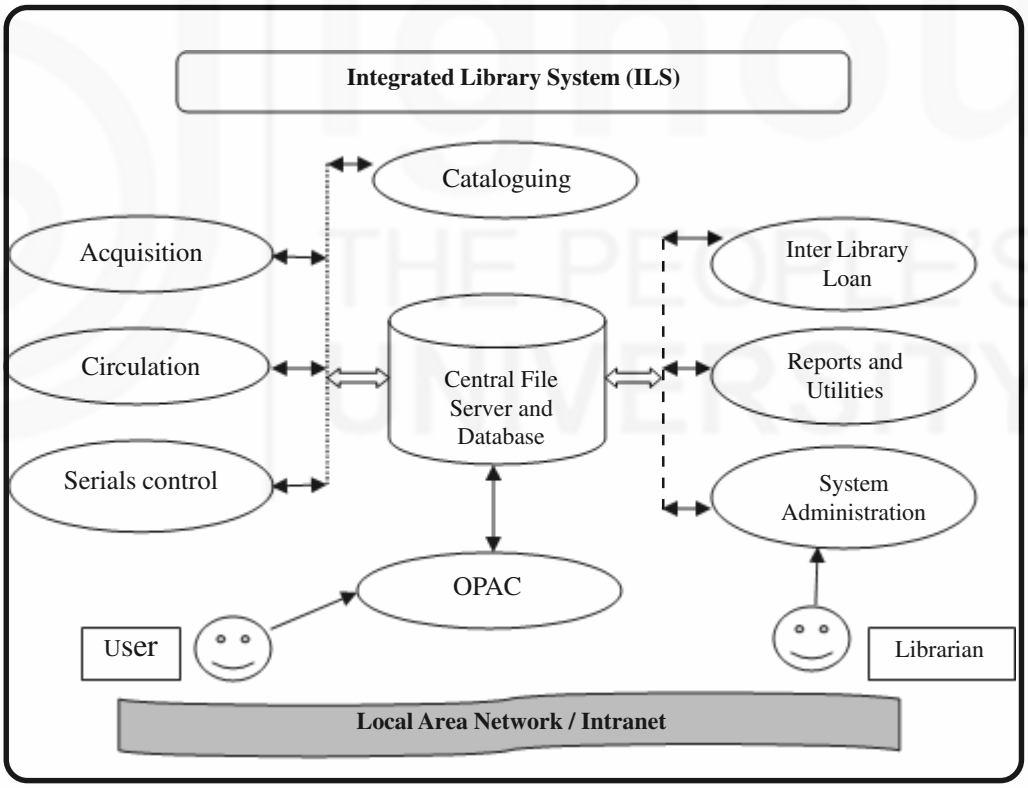

Fig. 1.1: Integrated Library System

Such integrated library automation is also known as Automated Library System. Library Management Software (LMS) forms the core of an automated library system. These LMSs are based on relational database architecture. In such systems files are interlinked so that deletion, addition and other changes in one file automatically activate changes in related files. It means integrated library management system is sharing a common database to perform all the basic functions of a library (see Fig. 1.1). For example, an integrated library system

(ILS) enables the library to link circulation activities with cataloging, serials control, report generation etc. at any given time. It makes use of a file server and clients in a local area network or wide area network (Fig. 1.1). Automated Library Systems now support three broad groups of library activities – i) housekeeping operations; ii) information retrieval; and iii) on-the-fly integration of library materials with open datasets . These are accessible through Local area Network (LAN) or Wide Area Network (WAN) and also over Internet. Modern library automation systems are Web compatible and accessible through Internet, Intranet and Extranet for information retrieval as well as data entry activities. Moreover, automated library systems are now capable to be integrated seamlessly with linked open data (like name authority data, subject access systems etc.), open contents (like book reviews, table-of-contents, cover images etc.) and social networking tools (like Facebook, Twitter etc.) through semantic web technologies and information mashup.

Self Check Exercises

Note: i) Write your answers in the space given below.

ii) Check your answers with the answers given at the end of this Unit.

1) Define library automation. What are the needs of library automation?

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2) What do you mean by integrated library system? Enumerate the features of such systems.

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3) Distinguish between library automation and integrated library system.

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1.2 EVOLUTION OF LIBRARY AUTOMATION

Library automation has a fascinating history. You will be amazed to know that the whole automation process in our society began with a librarian – Dr. John Shaw Billing (Rayward, 2002). Herman Hollerith, the Census Bureau of USA employee, who invented punched card machinery, attributes the idea to a suggestion by Dr. Billing, the then librarian of Surgeon-General's Library (now the National Library of Medicine). Hollerith formed the Tabulating Machine Company in 1896, which later became the International Business Machines (IBM) Corporation, one of the largest organisations in computing industry (Mukhopadhyay, 2005). Library professionals initiated application of computers when existing library practices and procedures began to break down under huge bibliographical pressure (also known as information explosion) emerged during late 1950s and early 1960s. Development of low-cost personal computers in 1970s and improved connectivity of 1980s helped establishment of automated library systems mainly in developing blocks of the world. A decade wise analysis of developments in library automation (Mukhopadhyay, 2005) will help you in understanding the rapid upward changes in this domain.

- **Pre-computer era (1950s):** First there was the pre-computer era of unit record equipment.
- **Stand-alone era (1960s):** Then came the off-line computerisation in 1960s and early 1970s.
- **On-line system (1970s):** This was followed by the on-line systems of the 1970s.
- **Micro-computer era (1980s):** The 1980s saw the advent of microcomputers in the form of PCs, emergence of CDROM technology and Local Area Network (LAN).
- **Web era (1990s):** Internet revolution of 1990s paved the path of Web-enabled integrated library systems to support access and operations from anywhere at any time.
- **Open era (2000s):** Emergence of open library systems powered by open source software, open standards and on-the-fly integration with open data and open contents.

Although library automation began in 1930s (1936 to be exact) when punched card equipment was implemented for use in library circulation and acquisitions, the real library automation started in early 1970s with the use of low-cost PCs and locally developed software to automate library house-keeping operations. The whole phase of development i.e., 1970 to till date may be grouped into **five** distinct periods:

The First Automation Age: This era was characterised by computerisation of library operations by utilising either commercial automation package or software developed in-house. The development of shared copy–cataloguing system (also known as distributed cataloguing) was another significant achievement of this phase that utilised computer and communication technologies for collaboration and cooperation within the library community.

The Second Automation Age: This period of library automation was characterised by the rise of public access i.e., the arrival of OPAC as a replacement for the traditional card catalogue. This period also witnessed major developments in online access to abstracting and indexing databases, union catalogues, resource sharing networks and library consortia.

The Third Automation Age: This era was characterised by the full text access to electronic documents over high-speed communication channels. Digital media archiving was an important element of library automation in this period. The advent of Internet as global publishing platform and largest repository of information bearing objects revolutionised the ways and means of delivering library services. As a result, Web-centric library automation was norm of the time.

The Fourth Automation Age: It is also known as 'networked information revolution' era. This era supports a vast constellation of digital contents and services that are accessible through the network at anytime, from anyplace, can be used and reused, navigated, integrated and tailored to the needs and objectives of each user. Digital libraries, multimedia databases and virtual libraries are major achievements in this era. Most of the automated library systems in our country are in between the third age and fourth age of library automation.

The Fifth Automation Age: The next generation library automation uses interactive, collaborative and participative platform for developing user-oriented library services with the help of Web 2.0 tools and services. This era of library automation also characterised by the capabilities to on-the-fly integration of Linked Open Data (LOD) with local library resources and operations (for example - utilisation of global dataset VIAF (Virtual Internet Authority File) in managing name authority file of local library catalogue, and integration social networking tool such as Facebook with OPAC to post Like against a library document). Cloud based library management and Web-scale library management are norms of the fifth automation age.

Now you know the phases of development in library automation for almost the last forty-five years. However, a time line for the development of ground-breaking events in library automation can be a handy tool for you to grab the path of development.

1936-59 : Major events of this time period were as follows: Introduction of punched card for circulation control in library; Use of IBM 402, 403 and 407 for manipulating, analysis, sorting and retrieval of data; Vannevar Bush introduced the concept of 'Memex' in 1945.

1960-69 : Major breakthroughs of this period were as follows - Use of general-purpose computers that became widely available in the 1960s; H.P. Luhn, in 1961, used a computer to produce the "Keyword in Context" or KWIC index for articles appearing in Chemical Abstracts; Project "MEDLARS" started in 1961 that applied computer in measuring efficiencies of information retrieval systems; Computerised circulation system first appeared in 1962; Project 'Intrex' (aimed to provide a design for evolution of a large university library into a new information transfer system) started in 1965;

Project MARC, initiative by Library of Congress to provide a format for machine readable cataloguing data, started in 1965; Introduction of online interactive computer system in place of off-line batch processing systems began in mid 1960s; Initiation of projects like BALLOTS by Stanford University and MAC by M.I.T. These developments deal with the possibility of a new horizon for the library operations and services.

1970-79 : Important achievements of this time period – Minicomputers were introduced to automate circulation and books were bar-coded; Computer based acquisition systems were introduced to procure books and serials; ISBDs started appearing from 1971; OCLC established in 1971 to facilitate library cooperation and to reduce costs of processing works; ISO-2709 was developed in 1973 as the standard for data exchange format; OCLC started development of Worldcat in 1975 (Worldcat now contains 8 billion cataloguing records and considered as the largest bibliographic database in the world); Library networks started appearing all over the world.

1980-89 : Important events of the decade – Shared copy-cataloguing systems by using computer and communication technologies were established as a norm in 1980s; Remote access to on-line databases became a reality; Appearance of CDROM databases on indexing and abstracting journals started in early 1980s; Library automation packages initiated shifting towards relational architecture; Integrated automation packages began appearing in mid 1980s along with bar-coded circulation system; OPAC became very popular in this decade and made available on campus wide LAN for accessing;

1990-99 : Major events were as follows – Library automation packages started upgrading from client server architecture to web architecture; Large scale developments took place in the area of resource sharing, union catalogue and computerised inter library loan. Release of Z39.50 protocol in 1995 to share bibliographical information and to overcame the problems of database searching with many search languages; Formation of collective purchasing consortia started that can negotiate prices for all members of the consortium; Emergence of multimedia databases; Retrieval achieved maturity with an array of search operators; Emergence of Web-based library services; Release of Dublin Core Metadata Standard in 1995; Web-OPAC began appearing for almost all automated libraries; Conversion and digitisation of print contents into electronic format started in a big way; Full text access to information resources over Internet started against IP authentication; Integrated access interface emerged to act as one-stop access interface; IFLA introduced FRBR as a conceptual data model for bibliographical databases in 1998; Introduction and development of Eprint archives and digital libraries; MARC 21 family of standards (Bibliographic format, Authority format, Holdings format, Classification format and Community information format) released in 1999; RFID based inventory management and smart card based user access to on-line library services; OAI/PMH standard developed for metadata

harvesting and initiatives started to make LMSs compatible with this standard;

2000-14 : Remarkable achievements of the present era are – Development of matured and globally competitive open source LMSs; Establishment of open standards like SRW, SRU, MARC-XML and development of standards for different sub-domains of library automation like NCIP (NISO Circulation Interchange Protocol); Applications of Web 2.0 tools and techniques in automated library system; Development of interactive OPAC to support user tagging, rating and comments; Improvements in searching and browsing with a set of newly developed search operators like Fuzzy search, weight-term search etc.; Application of semantic web technologies in LMSs to support integration of Linked Open Data (LOD) with library operations and services.

Self Check Exercises

Note: i) Write your answers in the space given below.

ii) Check your answers with the answers given at the end of this Unit.

4) What are the five ages of library automation? Explain.

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5) Show a decade-wise growth of library automation technologies from 1970 to 2010.

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6) Enumerate the major technology breakthroughs in library automation since the introduction of PCs

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1.3 AUTOMATED LIBRARY SYSTEMS

The decade-wise development of library automation shows that the effects of ICT on libraries and information centers. The path of developments is characterised by three fundamental factors:

- **Mechanisation** – doing what we are already doing though more efficiently;
- **Innovation** – experimenting with new capabilities i.e., introduction of new services and improvement of existing services through the use of ICT; and
- **Transformation** – fundamentally altering the nature of the library operations and services through capabilities extended by ICT.

This section of the unit discusses how library automation – i) helps in mechanisation of library operations; ii) supports innovation in library operations and user-centric services; and iii) promotes transformation in organisation of information resources and dissemination of services. The discussion covers reasons for library automation, requirements for library automation, steps for developing an effective automated library system, model of library automation and how does an automated library system differs from a digital library system.

1.3.1 Rationale

Society is changing and so are the library users. There are many reasons of the ongoing changes but the most visible one is the impact of ICT on society. As a result libraries need to change to keep pace with these societal changes. It is also required for libraries to get continued support – political and financial from parent organisation as well as from government. However, the rationale for library automation may be summarised as below:

- Automation of library housekeeping operations is considered as an especially critical area from which future benefits will emerge. It means that if a library is not automated it cannot take advantages contributed by ICT such as digitisation, web-enabled library system, use of linked open data, remote management of library, interactive user services etc. ;
- Increased operational efficiencies are achieved through library automation;
- Automation of housekeeping operations relieves professional staff from routine clerical chores and thus make them available for end-users services;
- Betterment of library services in terms of speed, quality and efficiencies;
- Automation may create interactive, collaborative and participative platform for user-centric library services;
- Supports improvement of existing services and introduction of new services;
- Makes library free from two fundamental barriers of information access – time and space. A web-enabled library system allows access at anytime from anywhere and by anyone;
- Automated library system with the capability to generate extensive reports and statistics extends support as decision-making tool for library managers and policy makers;

- An automated library system is able to contribute to resource-sharing networks and on the other hand may take the benefits of resources and services of library networks; and
- Better management of staff, physical resources, financial resources and wider dissemination of information products and services.

But at the same time one should remember that library automation requires huge initial investments in developing network infrastructure, procuring hardware, buying/customising software, retraining of staff or in some cases recruitment of technical staff. It may lead to chaos in resource organisation and dislocations in user services during transformation phase. Initially users and staff may feel uncomfortable, but with the passing of time the benefits of library automation will be realised by all stakeholders. As ICT has spillover effect, an automated library system, after initial teething problem, soon begins to search other areas for extension of bibliographic services.

1.3.2 Prerequisites and Steps

After covering the previous sections, you now know that library automation is a challenging task. We need to know what are the requirements, what are the strength and weakness of the library to be automated, how to prepare the proposal and budget, how to select hardware and software, who requires to be trained, how to plan implementation of software, how to handle retro-conversion (RECON or retro-conversion is transferring old bibliographic resource into machine-readable forms in the software system) and finally how to manage the transformation process. The prerequisites of library automation may be studied under the following heads:

System-level requirements

The system level requirements include hardware, network and storage. These components build the necessary infrastructure for implementation of integrated library system. The infrastructural requirements for library automation may vary from simple (inexpensive) to very complex (expensive) depending on factors like functional requirements, software architecture, support for global domain-specific standards, interoperability requirements, number of library sites or branches, number of records to be managed, number of users to be supported, requirements for managing multi-lingual records, retrieval features, federated search capabilities etc. The infrastructural requirements is very high for an automated library system that aims to serve users through Web-OPAC (requires server, IP address and domain name), to support distributed cataloguing (to serve bibliographic data as Z39.50 server), and to take the advantages of cloud computing. Generally hardware level requirements include Server (a centralised mainframe or minicomputer architecture) and client PCs (low-end computers for data entry and end-user searching). Storage devices are required to store bibliographic data (full-text data in case of digital media archiving). Network is required to link server with storage devices and client PCs.

Software-level requirements

An integrated library system is managed by integrated library management software (LMS). LMS manages different functional modules (for different sub-systems of a library) on the basis of a common database (with different tables for

different modules in relational model). Such a LMS supports seamless exchange of data (bibliographic data, financial data, member data etc.) between the different subsystems of an integrated library system. The essential features that should be supported by an ILS (or LMS) must be known before selection of software. These are applicable to all modules of any modern LMS and should include but not limited to the following features:

- The LMS must be fully integrated, using a single, common database for all operations and a common operator interface across all modules;
- The LMS should have capability of supporting multiple branches or independent libraries, with one central computer configuration sharing a common database;
- The LMS must allow unlimited number of records, users and organisation-specific parameters (e.g. loan period rules, fine calculation criteria, hold parameters etc.);
- The package should include following fully developed and operational facilities at multiple customer sites:
    - Bibliographic and inventory control
    - Authority control
    - Public access catalogue
    - Web catalogue interface
    - Information gateway (telnet, www, Z39.50, proxy server)
    - Acquisition management
    - Serials control
    - Electronic data interchange (EDI)
    - Reservation and materials booking
    - Circulation control
    - Customised generation of reports and usage statistics
    - One step administrative parameters setting
    - Z39.50 sever (minimum version 3 and bath profile level complaint) and Z39.50 client
    - Z39.50 copy cataloguing client
    - Marc 21 bibliographic and authority record import/export utility
    - Outreach services
    - Digital media archive system and Multimedia
    - Fund accounting , Bills and fines
    - Inter library loan
    - Interoperability and crosswalk
    - Web 2.0 supports
- LMS must provide continuous backup in suitable media (as per the choice of libraries) so that all transactions can be recovered to the point of failure;
- LMS must be compliant with the following standards (see section 1.4.1 for a list of standards):
    - Z39.50 information interchange format
    - MARC 21, UNCODE (UTF-8 OR UTF-16)
    - Z39.71 holdings statements
    - Z39.50 information retrieval service (client and server version3)
    - EDIFACT (EDI standard)
    - IEEE 802.2 and 802.3 Ethernet
    - HTTP, TCP/IP, Telnet, FTP, SMTP

- The LMS should be based on web-centric architecture and extend support for a range of multi-user and multitasking operating systems and RDBMSs;
- The LMS must be compliant with UNICODE standard for multilingual support and RFID for inventory management and self-issue/return facility;
- Vendor/Developing group should provide training to enable library staff to become familiar with system functions and operation, should supply full and current system documentation in hard copy and in machine-readable form suitable for online distribution and the LMS should include extensive online help for users and staff;
- LMS must support multiple hardware architecture in terms of server, network infrastructure, PC-workstations and peripheral devices;
- LMS must be supported with regular maintenance and on-call service, periodical software upgrades, continuous R & D, trouble-shooting of third-party software such as database package and the library automation package, distribution of problem fixes/patches and emergency services for system failures and disaster recoveries;
- The package must provide security to prevent accidental or unauthorised modification of records through the establishment of access privileges unique to each user on the system and restriction of specific functions to specific users;
- LMS should provide graphical user interface including, but not limited to extensive online help, user self-service and personalisation features. The system should be supported with PC-based alternative that will allow circulation to continue in the event of system failure, communication failure and downtime required for maintenance;
- LMS must be compliant with web 2.0 features to support interactive, collaborative and participative platform; and
- LMS should be updated regularly to take advantages of cutting-edge technologies like cloud computing, linked open data and semantic web.

Steps of library automation

Library automation is a complex process and should be planned astutely. The complete process of library automation may be divided into following steps:

- Software selection
- Hardware selection
- Site preparation
- General training
- Customisation
- Defining procedures for
    - Bibliographical data entry
    - Administrative data entry
    - Financial data entry
- Commissioning

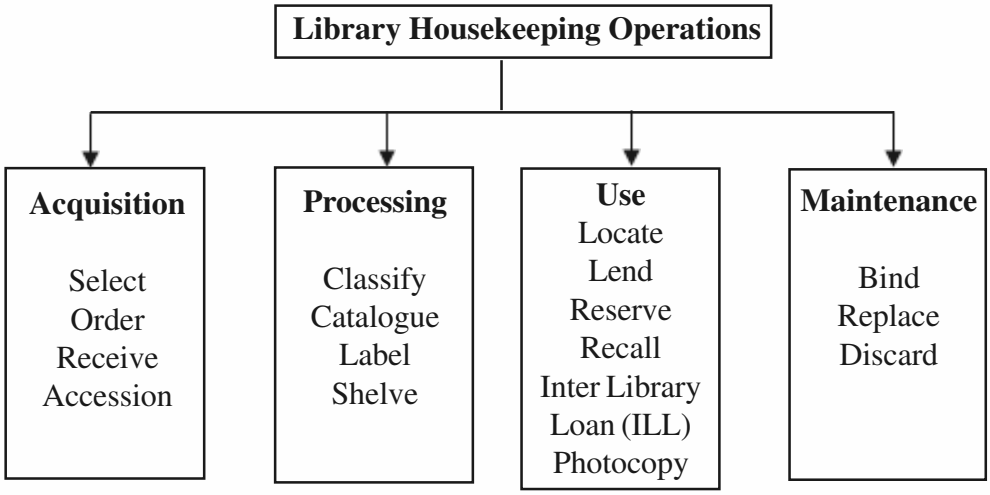
It is quite obvious that implementation of the above steps in library automation requires background study or analysis of the library system (see section 1.3.3 for system analysis process). It is a precondition to utilise library automation package for effective results. A library will not be able to take full advantages of automation until and unless it's manual functions are perfect and justified. Therefore, the procedures and tasks followed in different sections should be analysed in terms of :

- Special features of the library system
- Local variations (their validity and usefulness)
- Limitations of the existing system
- Nature and objectives of library
- Total number of collection and nature of collection
- Per year acquisition and procedures followed for acquisition
- Per year subscription of serials and number of back-volumes
- Number of users and their categories
- Per day transactions (issue/return/reservation)
- Availability of multilingual documents
- Need of information services (CAS/SDI etc.)
- Future plan (in terms of networking and consortia, digitisation, cloud computing)
- Available manpower (computer literate staff, retraining of staff, recruitment of technical staff).

This is an illustrative list of factors to be considered during the process of library automation. In reality a library needs to prepare a comprehensive of list of such factors for effective utilisation of the automated library system.

1.3.3 Procedural Model

Library automation aims to support workflows of a library in an integrated setup. It means different subsystems of a library (like acquisition, cataloguing, circulation, serials control, OPAC etc.) need to be supported by an ILS. Therefore, to understand library automation we need to understand first the library workflows. In fact an ILS (or LMS) automates the workflows of a library system. Most of the LMSs are based on a model called **procedural model of library automation** (first proposed by P.A. Thomas in an analytical study of library automation conducted by the then ASLIB). The model proposes that a library system has mainly two subsystems – administrative subsystem and operational subsystem. We cannot automate the process of administration but if we can automate operational subsystem, it may help administrative subsystem in taking right decision at the right time. In fact automation of operational subsystem may provide a wholesome MIS (Management Information System) to library managers. Operational subsystem comprises mainly four subsystems for performing housekeeping jobs through eighteen procedures. These procedures under each and every operational subsystem require one or more of six possible activities. There are fifteen basic tasks for performing procedures and activities. In short, procedural model of library automation proposes two basic subsystems, four operational subsystems, three levels, eighteen procedures, six activities and fifteen basic tasks as library workflow irrespective of the type and size of libraries and it advocates automation of the procedures, activities and tasks through different modules of an ILS.



The functions and activities of one division is entirely different from other divisions but they are closely related and the combined efforts lead towards the better library services. It is quite clear now that libraries are complex systems that include subsystems and components. The main two subsystems are operational subsystem and administrative subsystem. Library housekeeping operations are part of the operational subsystem. As per the analytical study of ASLIB (Association of Information Managers, UK), the operational subsystem may be divided into four further subdivisions namely Acquisition, Processing, Use and Maintenance. Within each of these divisions there are a number of procedures and within each procedure there is one or more of six possible activities. The tabular presentation of the place and scope of housekeeping operations related to different subsystems in a library system (as per the procedural model) is given below:

Table 1.1: Procedural model of library automation (Source: Mukhopadhyay, 2005)

System	Subsystems	Operational Subsystems	Procedures	Activities (Common to all Procedures)
Library System	**Operational Subsystem**	**Acquisition**	Select Order Receive Accession	***Initiate*** (To commence a procedure) ***Authorise*** (To approve a procedure) ***Activate*** (To implement a procedure through appropriate action) ***Record*** (To record what action has been taken) ***Report*** (To notify staff or user about the action taken) ***Cancel*** (To stop a procedure or undoing an action)
		Processing	Classify Catalogue Label Shelve	
		Use	Locate List Lend/Issue Reserve Recall/Return ILL (Inter Library Loan) Photocopy	
		Maintenance	Bind Replace Discard	
	Administrative Subsystem			

In considering libraries from one general organisational point of view, the analysis of housekeeping system is useful for automation of a library. It is a prerequisite to design and use library management software and to communicate with software vendors and programmers. A close analysis of the operations involved in library housekeeping provides us three hierarchical levels – **procedures, activities and tasks**.

Procedures and Activities

The eighteen procedures listed in the previous paragraph are common to libraries of different types. The design and use of an automated library housekeeping system requires the analysis of all these procedures into their atomic structure. It will help to understand and implement mechanised housekeeping operations in an automated environment. The procedures under each and every operational subsystem have been analysed by P.A. Thomas in terms of six possible activities – *initiate, authorise, activate, record, report and cancel*. All of these activities may not be involved in every procedure. There are one or more six possible activities against each procedure. The six common activities are defined as:

- **Initiate** – That which makes it apparent that a procedure should be commenced.
- **Authorise** – In some cases, the decision to carry out a certain procedure must be approved before any further action is taken.
- **Activate** – When a procedure is known to be necessary and in some cases approved, it is usually implemented by taking appropriate actions.
- **Record** – The function that states or records what action has been taken.
- **Repor**t – To notify library staff or user that an action has been taken.
- **Cancel** – To stop a procedure, in particular the aspect of revoking or undoing an action.

Tasks

The third level in the hierarchy is concerned with 'tasks' within an activity under each procedure. Task means a related group of operations carried out to perform a particular kind of job. In an automated library system a task is the collective functions of the elements for the accomplishment of the module at the next higher level. Tasks within each activity, just as the activities themselves, may not all be necessary to each procedure. Most of the works in the operational subsystems of a library include making or using discrete records with bibliographic and administrative information referring to one particular document. In this context, ASLIB defined a set of fifteen tasks for the basic procedures. These are – *pass, receive, discard, place, remove, search, duplicate, attach, separate, move, sort*. Such tasks are supported by other four element tasks namely *read, verify, enter and decide*.

1.3.4 Traditional, Automated and Digital: Three Eras of Library Systems

The application of ICT tools in the form of hardware, software and network changed conventional library system considerably right from 1970s. Now, we have an array of modern information handling systems named as computerised library system, automated library system, electronic library system, digital library

system and virtual library system. However, we are going to restrict discussion to two stable modern library systems – automated library system and digital library system. You already know what an automated library system is. Now question comes what is a digital library system and how does it differ from automated library system? Digital libraries are major application entities of Internet and Web technologies. These are considered as next generation library services. In simple words, Digital libraries are managed collections of digital objects. These entities enable the creation, organisation, maintenance, management, access to, sharing and preservation of digital knowledge bearing objects or document collections. Digital libraries are being created today by many institutes and agencies for different target groups and in diverse fields like agriculture, cultural heritage, education, health, governance, science, social sciences, social development, etc. In its final shape a digital library system will be a single-window federated search interface for a diverse range of information resources collected or optimised by a library system.

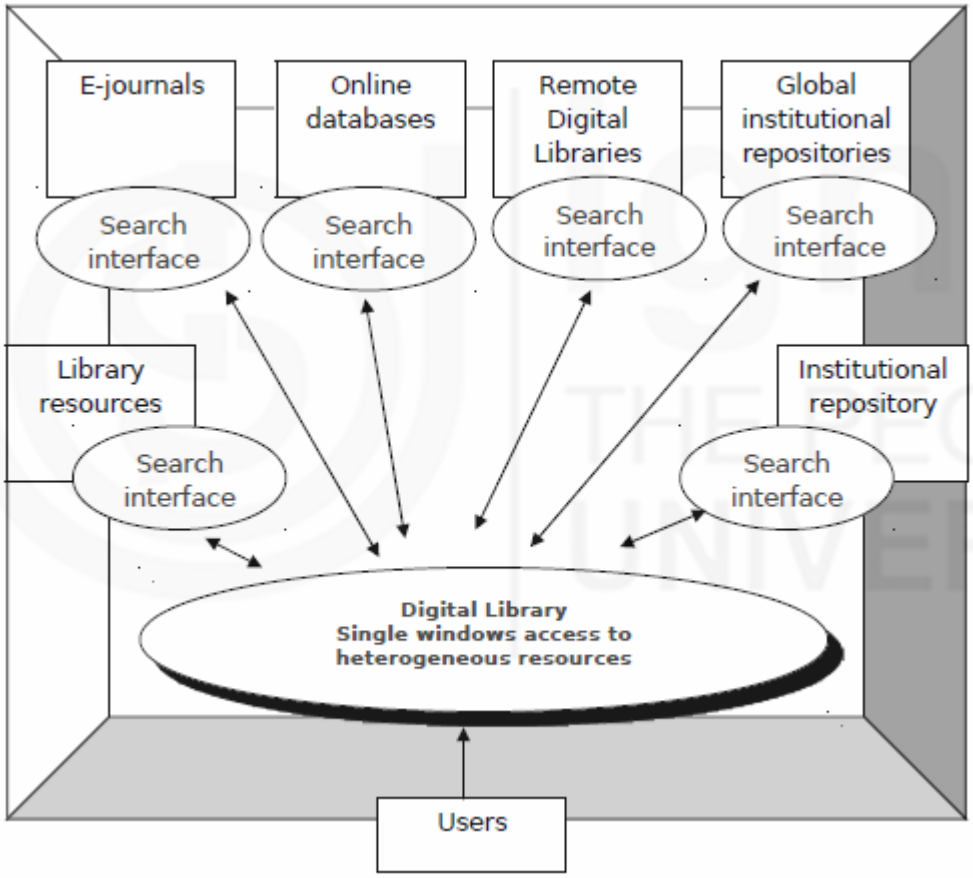


Fig. 1.2: Digital library system

Availability of free/libre open source software (FLOSS) based digital library software packages, application of open standards and sharing of domain knowledge through Wiki, Blogs etc. help in designing Digital libraries even in developing block of the world. Now the question comes that what are the advantages of digital libraries? There are some obvious benefits of Digital libraries over the automated library systems. Some of the key benefits of digital libraries are:

- Traditional libraries are associated with the organisation and provision of access to physical material like print-on-paper publications.

- Automated library systems are providing improved access to their collections but online access facilities are limited to the computerised library catalogue (OPAC).
- Digital libraries differ significantly from such libraries because these entities facilitate online access to and work with digital versions of full text resources in multimedia-driven environment.

Library automation activities address two major issues – library housekeeping operations and access to library resources. An automated library system has cataloguing data in digital format but source documents are mostly available in print formats. In a digital library setup both metadata (document description data) and documents are available in digital format. The other major differences are:

Table 2: Automated Vs. Digital library systems

Automated library system	Digital library system
Only metadata (cataloguing data) is finely searchable	Both metadata set and full-text resources are finely searchable
Provides document description data set, not documents.	Provides document description data set and source documents
Based on Z39.50 standard for cross-system catalogue search/retrieve	Based on OAI/PMH protocol for metadata harvesting
Supports standard bibliographic formats (MARC 21, CCF) for document description	Supports generic and domain-specific metadata schemas (e.g. Dublin Core, LOM, GILS etc.) for resource description
Processes global resources for local users	Processes global and local resources for local and global users
Generally follows centralised processing – distributed access architecture	Generally follows distributed processing – distributed access architecture

Self Check Exercises

Note: i) Write your answers in the space given below.

ii) Check your answers with the answers given at the end of this Unit.

7) What is the rationale for integrated library system?

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8) Discuss the software-level prerequisites for an integrated library system.

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9) What is Procedural model of library automation? Illustrate.

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10) What is a digital library system? How does it differ from automated library system?

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1.4 AUTOMATED LIBRARY SYSTEM: STANDARDS AND SOFTWARE

Integrated library systems depend on two core components – standards and software architecture. Libraries are now operating in a distributed networked environment, where standards are essential for efficiency and interoperability. Order, collaboration and interoperability are three most important prerequisites for effective application of ICT in library operations and services. Library automation is no exception. Therefore, we need to know about standards for developing automated library systems and LMSs should follow strictly different global and national standards prescribed for the domain of library automation.

1.4.1 Standards

Standards are developed by general agreement among stakeholders of an area of human activity. These are used by professional like scientists, engineers, technologists etc. for their respective domain of activities. We often use the terms *standards, guidelines and specifications* synonymously. A "guideline" is a statement of policy by a person or group having authority over an activity. A "standard" is formulated by agreement and applicable to an array of levels – corporate, national, or international. A "specification" is a concise statement of

the requirement for a material, process, method, procedure or service. Standards are frequently updated, modified or revised to keep pace with the technological changes and practical requirements (Withers, 1970). ANSI (American National Standards Institute) defined a standard as a specification accepted by recognised authority as the most practical and appropriate current solution of a recurring problem. IEC Guide 2:2004 of ISO (International Standards Organisation) defines a standard as a document, established by consensus and approved by a recognised body, that provides, for common and repeated use, rules, guidelines or characteristics for activities or their results, aimed at the achievement of the optimum degree of order in a given context. Standards perform important roles in the development of integrated library systems in view of the followings:

- to act as the pattern of an ideal;
- to set a model procedure;
- to achieve interoperability in heterogeneous environment;
- to establish measure for appraisal;
- to act as stimulus for future development and importance; and
- to help as an instrument to assist decision and action.

Standards are mainly developed by Standards Development Organisations (SDOs). An SDO is any entity whose primary activities are developing, coordinating, promulgating, revising, amending, reissuing, interpreting, or otherwise maintaining standards. SDOs are generally grouped by two parameters – geographic designation (e.g. international, regional, national) and organisational authority (e.g. governmental, quasi-governmental or non-governmental entities). Library professionals are generally interested in the library standards developed by their national standard organisations (e.g. BIS – Bureau of Indian Standards in India) and library standards developed by ISO (International Standards Organisations), NISO (National Information Standards Organisation, US) and BSI (British Standards Institute, UK). The library standards developed by NISO are American national standards but in many cases these standards are used by libraries/related organisations across the globe (e.g. Z39.50). These SDOs develop standards in the domain of library services through designated committees and sub-committees. The committee IDT/2 is entrusted by BSI (http://www.bsi-global.com/) for Information and Documentation. There are mainly three American National Standards Committees under NISO that develop standards affecting libraries, information services and publishing (www.niso.org). These are X3 (Information Processing Systems); PH5 (Micrographic Reproduction); Z85 (Standardisation of Library Supplies and Equipment); and Z39 (Library and Information Sciences and Related Publishing Practices). Of these, Z39 has developed more standards directly related to LIS fields than others. TC 46 committee of ISO (www.iso.org/iso/) is responsible for standardisation of practices relating to libraries, documentation and information centres, publishing, archives, records management, museum documentation, indexing and abstracting services, and information science. The secretariat of TC 46 is in France (AFNOR - Association française de normalisation). It works through three working groups (WG), four sub committees (SC) and one coordinating group (CG). In BIS, India, MSD 5 (www.bis.org.in) is the Sectional Committee for Documentation and Information.

Although it is difficult to list all the standards related to automated library systems, we may go for listing a set of minimum standards that need to be supported by an ILS/LMS to remain globally competitive and interoperable. These are:

- ISO – 2709 for bibliographic data interoperability;
- Standard bibliographic formats compliant with ISO - 2709 (e.g. MARC 21, UNIMARC, CCF/B);
- Z39.50 protocol standard for distributed cataloguing;
- Z39.71 standard for holdings statements;
- BS ISO 9735-9:2002 Electronic data interchange for administration, commerce and transport (EDIFACT);
- Z39.83-1 (NISO Circulation Interchange Part 1: Protocol (NCIP));
- Z39.83-2 (NISO Circulation Interchange Part 2: Protocol (NCIP));
- ISO/CD 28560-1(Information and documentation — Data model for use of radio frequency; identifier (RFID) in libraries — Part 1: General requirements and data elements);
- ISO/CD 28560-2 (Information and documentation — Data model for use of radio frequency; identifier (RFID) in libraries — Part 2: Encoding based on ISO/IEC 15962); and
- ISO/CD 28560-3 (Information and documentation — Data model for use of radio frequency identifier (RFID) in libraries — Part 3: Fixed length encoding); and
- ISO/IEC 10646: 2003 (Universal Multiple-Octet Character Set or UCS).

Apart from these formal standards (de jury standards), there are a few specifications (may be considered as de facto standards) in the domain of library services, which are widely in use across different library systems in different countries. Most of these internationally agreed upon informal standards are developed by national libraries (e.g. Library of Congress) and library associations (e.g. ALA, IFLA etc.). Some of these very important non-formal standards are –

- MARCXML – MARC 21 data in an XML structure (developed by Library of Congress - http://www.loc.gov/standards/marcxml/) acting as base standard for bibliographic data export/import in place of ISO-2709;
- MODS (Metadata Object Description Standard) – XML markup for selected metadata from existing MARC 21 records as well as original resource description (developed by Library of Congress – http://www.loc.gov/standards/mods/);
- MADS (Metadata Authority Description Standard) – XML markup for selected authority data from MARC21 records as well as original authority data (developed by Library of Congress – http://www.loc.gov/standards/mads/);
- METS (Metadata Encoding & Transmission Standard) – Structure for encoding descriptive, administrative, and structural metadata (developed by Library of Congress -http://www.loc.gov/mets/);

- PREMIS (Preservation Metadata) – A data dictionary and supporting XML schemas for core preservation metadata needed to support the long-term preservation of digital materials. (developed by Library of Congress – http://www.loc.gov/standards/premis);
- SRU/SRW (Search and Retrieve URL/Web Service) – Web services for search and retrieval based on Z39.50 (developed by Library of Congress - semantics http://www.loc.gov/standards/sru/); and
- OAI/PMH Version 2.0 – Open Archive Initiative/Protocol for Metadata Harvesting (developed by Open Archive Initiative).

1.4.2 Software

You already know that library management software forms the core part of integrated library automation. You also know what are the prerequisites for an ILS, what are the standards that need to be supported by ILS, and how procedural model of library automation is guiding development of ILS all over the world. The rapid development in utility of hardware, software and connectivity along with the reduced costs paved the path for integrated library automation systems. Current library automation software also known as Library Management Software (LMSs) are integrated systems of a set of related modules responsible for the management of different operational subsystems. These LMSs are based on relational database architecture. Most of the LMSs are presently based on procedural model of library automation and follow a modular approach to perform the tasks related to housekeeping operations. Generally, the whole package is divided in **modules** for each operational subsystem. Modules are divided into **sub modules** and each sub module supports various **facilities** to carry out tasks related to the procedures.

Library Automation Package	→ Modules	→ Sub-Modules	→ Facilities

For example, the SOUL package library automation software developed by INFLIBNET, Ahmadabad) includes six modules of which four are for operational subsystems. The other two, namely administration and OPAC are meant for setting up various administrative parameters and searching and retrieving the library resources respectively. Another example may be cited from KOHA – an open source library management software, developed by Horowhenua Library Trust (Katipo team), Newzealand and running at libraries all over the world. It includes one common module for acquisition and cataloguing and other five modules are related with circulation, OPAC, administration etc. A typical LMS supports selection, ordering, acquisition, processing, circulation, serials control, dissemination of information services and also extend help in library administration, planning & decision making process as a management tool. The individual tasks carried out by an ILS under each prime functional subsystems may be identified as below (see Unit 2 in this block for a detail discussion on housekeeping activities):

Ordering and Acquisition

- Ordering
- Receipting

- Claiming
- Vendor database management
- Budgeting and Fund accounting
- Currency conversion
- Suggestions (from users) management
- Enquiries (order status, receiving status)
- Accessioning (in MARC 21 format)
- Bill processing
- Payment
- Reports and Statistics.

Cataloguing

- Standard formats support
- Authority control (in MARC 21 authority format)
- Integration with Linked Open Data (LOD)
- Unicode-compliant multilingual data processing
- Retrieval with sophisticated search operators
- Integration with virtual keyboard for multilingual searching
- Shared cataloguing
- Z39.50 based copy cataloguing
- Output generation and holdings information
- User services (interactive and participative).

Access Services

- Online access
- Public access interface (OPAC)
- Web access and Remote access
- Social-network enabled OPAC
- Gateway services.

Circulation Control

- Setting of user privileges
- Circulation rules
- Issue, return and renewal
- Reservation (user-driven)
- Fine calculation
- User management
- Reminders and recalls
- Enquiries (about item, borrower, reservation)
- Reminders and notices
- Reports and statistics and patron self services.

Serials Control

- Order placement and renewal of subscriptions
- Kardex management
- Receiving and claiming
- Binding control
- Fund accounting
- Cataloguing of serials
- Enquiries (arrival of serials issues)
- Reports and statistics.

MIS

- Reports and statistics
- Analysis of statistics
- Usage statistics (compliant with COUNTER).

Inter Library Loan (ILL)

- ILL protocol
- ILL management.

Outreach Services

- Community information services
- Social-networking support
- Library blog
- Online help for users.

Digital Media Archiving

1) Full-text search
2) Support for media formats
3) Federated search facilities.

System Administration

- Privileges control
- Branch management
- Backup and restoration
- System configuration.

A library may procure commercially available ILS or may opt for implementing an open source ILS. But the above-mentioned basic tasks of an ILS are common to all types of ILSs or LMSs.

Self Check Exercises

Note: i) Write your answers in the space given below.

ii) Check your answers with the answers given at the end of this Unit.

11) What is a standard? Why an ILS should support global standards? List the standards required for a globally competitive ILS.

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12) Discuss the typical tasks performed by an integrated library system.

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1.5 AUTOMATED LIBRARY SYSTEM: GLOBAL RECOMMENDATIONS

Libraries of developed countries started taking benefits of ICT through library automation during mid-seventies. Libraries in developing block of the world realised advantages of library automation in early eighties and the process is still going on. But the socio-economic and socio-technical environments within which these libraries operate are changing more rapidly than libraries (in developing block of the world) are changing to meet it. However, in general we can say that present library systems are outgrowing their traditional organisation and discovery tools. Almost all the basic library activities and services are now maintained in an Integrated Library System (ILS) that manages acquisitions, cataloging, circulation, reporting, resource discovery and automatic alerting services. With the advent of socio-technical changes all over the world users expectations have expanded to demand more services in an interactive, quicker and easy way. In many cases, such demands go beyond the scope of a typical ILS. Users now want to find, locate, navigate and obtain resources available in his/her library, at nearby institutions and from open access public domain through a single-window search interface seamlessly. They also want full-text search facility from a single-window federated search interface and when they do find something of interest, they expect to use the library's services for obtaining resources from wherever possible. This situation calls for a set of global recommendations in developing new generation ILS. Such global standards are also required to act as pathfinders for library professionals as well for ILS developers. There are three such sources that can guide us in shaping integrated library systems in view of the future requirements – 1) Open Library Environment (OLE) project recommendations;

2) Digital Library Federation (DLF) - ILS Task Group (ILS-DI) recommendations; and 3) study of Request for Proposals developed by different libraries.

1.5.1 OLE Recommendations

Open Library Environment project (OLE project - http://oleproject.org) or the OLE project, funded by Andrew W. Mellon Foundation and participated by more than 300 libraries, started with following objectives – i) to analyse library business processes; ii) to define a next-generation library technology platform; iii) to design Service Oriented Architecture (SOA) for library software; and iv) to frame a community-source model of development and governance. The principal aim of OLE project is cost-effective integration of library management with other institutional systems. The OLE project published the Enterprise Resource Planning (ERP) based Abstract Reference Model (http://oleproject.org/overview/ole-reference-model) in 2009. This model shows the relationship between OLE middleware, OLE components, entities, and third-party components, such as Identity Management, Institutional Repositories, and Course Management Systems. As a whole, the OLE framework for future library system is characterised by – 1) Flexibility (Supports for wide range of resources; accessed by a wide range of customers in a variety of contexts); 2) Community ownership (Advocates systems that are designed, built, owned, and governed by and for the library community on an open source licensing basis); 3) Service Orientation (Prescribes technology-neutral service-oriented framework that ensures the interoperability of library systems); 4) Enterprise-Level Integration (Facilitates integration with other enterprise systems such as research support, student information, human resources, identity management, fiscal control, and repository and content management); 5) Efficiency (Provides a modular application infrastructure that integrates with new and existing academic and research technologies); and 6) Sustainability (Creates a reliable and robust framework to identify, document, innovate, develop, maintain, and review the software necessary to further the operation and mission of libraries). See Unit 3 in this Block for a summary of OLE recommendations. The Open Library Environment Project Final Report is available at http://oleproject.org/final-ole-project-report/.

1.5.2 ILS-DI Recommendations

In regards to the integrated systems of libraries (automation and digitisation), DLF ILS Discovery Internet Task Group (ILS-DI) Technical Recommendation is playing a pivotal role. These recommendations are framed in view of the variations in user demands and developments in ICT. As per these recommendations library software systems should – i) improve discovery and use of library resources; ii) support a clear set of expectations (framed systematically) for users (end users and power users) and developers; iii) be open and extensible for recommendations applicable to existing and future system requirements; iv) support interoperability, inter-operation and cooperation; and vi) be responsive to the user and developer community. ILS-DI recommendations can be logically related with a set of twenty-five interlinked functions. Each of the twenty-five (25) functions can be grouped into one of four overall categories: 1) Data aggregation (harvesting and distributed searching); 2) Search (simple and advance search operators); 3) Patron services (general and interactive interfaces); and 4) Integrated service framework (on-the-fly integration of open contents, data sets etc.). A summary of ISL-DI recommendations is provided in

Unit 3 of this block. For DLF ILS Discovery Internet Task Group (ILS-DI) Technical Recommendations visit www.diglib.org/architectures/ilsdi/DLF_ILS_Discovery_1.0.pdf and for DLF ILS Discovery Internet Task Group (ILS-DI) Technical Recommendations see www.diglib.org/architectures/ilsdi/DLF_ILS_Discovery_ 1.1.pdf.

1.5.3 Request for Proposals (RFPs)

RFPs, developed by different libraries, library associations and ILS experts, are good source of information to trace the recent developments in automated library systems. Study of RFPs helps us to determine requirements, prescribing standards and demanding services from ILS vendors and developers. It acts as a guiding document for ILS developers and library automation managers. A request for proposal (RFP) is a formal request for a bid from suppliers of library systems. The RFP provides the ILS vendor with the outline, purpose, scope, description, minimum service requirements, minimum standards requirements, administration and security issues etc. for the automated library system in a comprehensive manner. The RFP process is useful in identifying the needs and priorities of the library including the future plans related with library automation. The RFP prescribes the resources that need to be acquired, the services that need to be offered, the standards that need to supported, the selection criteria for ILS, and the requirements for the software vendor. It also sets the timeframe for the project of automating a library. A RFP for library automation is a critical document in the process of implementing an ILS. L. T. David (2001) advocated consulting following online resources for developing RFP on ILS:

- Cohn, John M. and Kelsey, Ann L. Planning for automation and use of new technology in libraries. Online. URL: http://web.simmons.edu/~chen/nit/NIT'96/96-065-Cohn.html
- Integrated Library System Reports. Sample Request for Proposals (RFPs) and Request for Information (RFIs) for library automation projects. Online. URL: http://www.ilsr.com/sample.htm
- Kirby, Chris. and Wagner, Anita. The Ideal Procurement Process: The Vendor's Perspective. Online. URL: http://www.ilsr.com/vendor.htm
- Planning and Evaluating Library Automation Systems. Online. URL: http://dlis.dos.state.fl.us/bld/Library_Tech/Autoplan.htm
- Sample RFP. Library HQ. Online. URL: http://www.libraryhq.com/rfp.doc.

Self Check Exercises

Note: i) Write your answers in the space given below.

ii) Check your answers with the answers given at the end of this Unit.

13) Discuss how ILS-DI and OLE recommendations may help in shaping futuristic ILSs.

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14) What is a RFP? How RFPs may help us in library automation?

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1.6 AUTOMATED LIBRARY SYSTEM: DEVELOPMENT OF RFP

You already know what RFP is and how these documents may help us in planning and implementing integrated library system for developing automated library system. It's already clear to you that the first logical step in library automation is to develop RFP. The RFP acts as a base document in developing automated library system, just as a blueprint helps in developing a building. A comprehensive RFP aims to achieve two broad groups of tasks – 1) guides the library in evaluation of integrated library systems; and 2) helps the library to choose and acquire the most appropriate system. Although not all libraries in India (also in abroad) that purchase ILS prepare RFPs, the process of preparing an RFP helps the library identify its needs, priorities, options and also in setting future course-of-action for ICT-enabled library services. Moreover, it may guide a library in customising open source ILS according to goals and requirements set in RFP, if the library decided to use open source software.

Needs for developing RFP

You already know that the widespread use of Integrated Library Systems (ILS), global communications via the Internet, increasing numbers of digital library initiatives, availability of web 2.0 tools, rising of cloud computing, evolving of linked open data have made the need for compliance with standards for a library system more crucial than ever. But which standards are important when considering a library system, what services are necessary for next generation library users, what software architecture is suitable for rapidly changing computing environment, what data formats are the most comprehensive? And how can one determine if a commercially available ILS or an open source ILS really complies with global standards related to functional subsystems of a library? Here lies the importance of developing RFP for library automation. The RFP aims to answer these questions through:

- Setting criteria for evaluating RFP responses and ILS products;
- Prescribing standards compliance needs;
- Identifying the current national, regional and international standards including de facto standards;
- Conforming requirements specific to the library system;
- Assisting in effective and clear communication between library managers and ILS developers; and
- Guiding application of relevant standards for major functional areas of library automation, e.g. Bibliographic Format, Record Structure, Information Retrieval, Serials, etc.

Components of RFP

The RFP requires being a structured document. The components of a typical RFP are as follows:

1) Background information about the library
   - What are its mission, vision and goals?
   - What services does it offer?
   - What is the size of its collection, circulation and user community?
2) Detailed Statement of needs
   - What are the objectives of the library automation?
   - What are the needs for compliance with standards for a library system?
   - What are the service level requirements?
   - What are the functional requirements?
3) Vendor name and contact addresses and numbers
   - Who are the potential ILS vendors that may satisfy library requirements?
   - How these vendors can be contacted?
   - Who are the third-party service providers for potential open source ILSs?
4) Time frame
   - What are the steps/activities and when should each be finished?
   - What are the priority-level for required activities?
   - What should be the schedule for completion of tasks?
5) Evaluation criteria and method
   - What are the critical factors that must be present?
   - How to frame parameters for evaluating different responses against RFP?
   - What should be the method for evaluating ILS products?
6) Systems requirements and specifications
   - What specific features of the system must be present?
   - What are infrastructural requirements?
   - What are the software-level requirements?
7) Request for quotation
   - What should be the format for quotation?
   - How much will the system cost?
   - What are the conditions for on-site services and updating of software?
   - How to calculate ROI (Return on Investments)?

Steps in the development of RFP

The above-mentioned components of a typical RFP require to be developed methodically through appropriate steps. David, L. T. (2001) prescribed a set of steps for developing RFP in his guide book entitled *Introduction to integrated library systems* published by Information and Informatics Unit, UNESCO

Bangkok, Thailand. The steps are as follows:

1) Needs assessment
2) Studying available ILSs (including open source ILSs)
3) Listing potential vendors of the ILSs (third-party vendors for open source ILSs)
4) Specifying needs and standards compliance
5) Specifying criteria for evaluation for ILSs
6) Developing a time frame for task completion
7) Writing the RFP (with necessary components)
8) Submitting to legal office for comment on contract agreements
9) Rewriting according to the specifications of the legal office
10) Submitting to vendors for requesting proposals
11) Receiving proposals from vendors
12) Evaluating proposals against a set of parameters
13) Preparing a short list of vendors/third-party service providers
14) Requesting a demo of the system
15) Purchasing/commissioning the system
16) Preparing the final contract
17) Implementing the system
18) Evaluating the implemented system.

Experts recommend that the actual evaluation (both software and responses received from vendors and third-party service providers in case of open source ILS) must be done by a team, and not by an individual.

Time frame for completion of steps needs to bet set and follow strictly to achieve targets. David (2001) suggested a time frame for steps to provide standard length of time need to complete each stage of the process. Table 1.3 is an illustration of the time frame developed by Davis (2001) for the RFP and selection processes.

Table 1.3: Time frame for steps in RFP development (source: David, 2001)

Steps	Month 1	Month 2	Month 3	Month 4	Month 5+
Needs assessment	×				
Studying available ILS	×				
Listing potential vendors of the ILS	×				
Specifying needs	×				
Specifying criteria for evaluation					
Developing a timeframe	×				
Writing the RFP		×			

Submitting to legal office for comment		×			
Rewriting according to the specifications of legal office		×			
Submitting to vendors		×			
Receiving proposals from vendors			×		
Evaluating proposals				×	
Preparing a short list of vendors				×	
Requesting for a demo of the system				×	
Selecting your system				×	
Preparing the contract				×	
Implementing the system					×
Evaluating the implemented system					×

Self Check Exercises

Note: i) Write your answers in the space given below.

ii) Check your answers with the answers given at the end of this Unit.

15) What is need of a RFP in developing automated library system? Enumerate essential components of a typical RFP.

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16) Discuss the steps for developing a RFP as suggested by L. T. Davis.

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1.7 AUTOMATED LIBRARY SYSTEM: TRENDS AND FUTURE

This Unit ends with listing a set of ongoing trends and upcoming changes in automated library system. The issues related with changes have been discussed here in full length and linked with global recommendations in Unit 3 of this Block which deals with library management software. This section attempts to introduce you with the cutting-edge technologies that are going to influence the processes, procedures, architectures and platforms for integrated library systems.

1) **Service-oriented Architecture (SoA) in ILS**

Service-Oriented Architecture (SOA) is an ICT architectural style that supports seamless flow of information, which is independent of systems, platforms, software architecture, data structures etc. In short it supports sharing of services and datasets in heterogeneous information infrastructure. The term service-orientation indicates a way of thinking in terms of services, service-based development and the outcomes/deliverables of services. SoA is now established as a mature architectural style and the ILSs have started switching to this promising architectural style to provide end users innovative library services and opportunities to other libraries to utilise resources and services (through application program interface). The SoA is an essential attribute of an ILS to support Cloud Computing. It facilitates the effective use of the Cloud.

2) **Cloud-based library automation**

Cloud computing is network based computing facilities that support on-demand use of hardware and software resources. Libraries can take advantages of cloud computing in the following ways:

i) using ILS available in remote server through web browser without any installation;

ii) hosting the Web-OPAC and staff interfaces in remote server without burden of local management of server and arrangement of IP address and domain name;

iii) setting up own remote file storage and database system (with scheduled backups).

The cloud computing mainly supports three facilities. These are Infrastructure as a Service (IaaS), Platform as a Service (PaaS) and Software as a Service (SaaS). The Cloud based library automation has following advantages:

i) Resource pooling (cloud computing providers provides a vast network of servers and hard drives for use by client libraries);

ii) Virtualisation (libraries do not have to care about the physical management of hardware, software, user interface, data backup and hardware compatibility);

iii) Elasticity (addition of storage space on-demand in hard disk or increasing server bandwidth can be done easily);

iv) Geographical scalability (cloud computing allows libraries to replicate data to several branch libraries world-wide);

v) Automatic resource deployment (libraries only needs to choose the types and specifications of the resources required and the cloud will configure it automatically);

vi) Metered billing (library will be charged for only what they use).

As a whole cloud-based library automation is quite useful and cost effective for small and medium sized libraries. Large-scale libraries may offer datasets on the cloud for use by small libraries (Data as a Service (DaaS)). Some of the well-known cloud-based services are listed in Table 1.4 for your ready reference.

Table 1.4: Cloud platform, systems and services

Cloud platform	Cloud systems	Cloud services
Software as a Service (SaaS)	Server Virtualisation, Open URL resolver, Application software	GoogleDoc, GoogleApps, OpenID, Adobe
Platform as a Service (PaaS)	Cloud based ILS, Inter Library Loan	LibLime, OSSLab, N-LARN project in India, Polaris, Exlibris
Infrastructure as a Service (IaaS)	Discovery services, Digital repository, Web hosting, Storage	Amason Elastic Compute Cloud (EC2), Amazon Simple Storage Solution (S3), Dropbox Cloud storage

The major cloud service providers and related services are listed in Table 1.5.

Table 1.5: Cloud providers and services

Cloud providers	Types of services
Amazon Web Services	IaaS, PaaS, SaaS
EMC	SaaS
Eucalyptus	IaaS open source Software
Google	PaaS (AppEngine), SaaS
IBM	PaaS, SaaS
Lincode	IaaS
Microsoft	PaaS (Asure), SaaS
Rackspace	IaaS, PaaS, SaaS
Salesforce.com	PaaS, SaaS
VMware vCloud	PaaS, IaaS

3) Linked Open Data (LOD)

Linked Open Data (LOD) refers to publishing and connecting structured data on the Web for use in public domain. The three Key technologies that support LOD are: URI (Uniform Resource Identifier, a generic means to identify entities or concepts in the web), HTTP (Hypertext Transfer Protocol, a simple yet universal mechanism for retrieving resources, or descriptions of resources over the web), and RDF (Resource Description Framework, a generic graphical data model to structure and link data that describes things in the web). Linked Open Data (LOD) has two basic purposes:

i) publish and link structured data on the Web; and

ii) create a single globally connected data space based on the web architecture.

Tim Berners-Lee advocated four rules for converting dataset to LOD. These are:

1) Use URIs as names for things;

2) Use HTTP URIs so that people can look up those names;

3) When someone looks up a URI, provide useful information, using the standards (RDF, SPARQL); and

4) Include links to other URIs, so that they can discover more things.

W3C established Library Linked Data Incubator Group in 2011 "to help increase global interoperability of library data on the Web, by bringing together people involved in Semantic Web activities — focusing on Linked Data — in the library community and beyond, building on existing initiatives, and identifying collaboration tracks for the future." Libraries may utilise bibliographic data, authority data, classification schemes, vocabulary control devices etc. available as LOD for enriching existing library services and for introducing new information services. Some major examples of library LOD are – AGROVOC multilingual structured and controlled vocabulary, British National Bibliography (BNB) published as Linked Data, VIAF, LCSH, LC Name Authority File (NAF) provides authoritative data, MARC country, and language codes, Dewey.info etc. ILSs are taking advantages of integrating LOD available in library domain through appropriate APIs. For example, the cataloguing module of Koha can be linked with VIAF (Virtual Internet Authority File – a linked dataset of authority data from 21 major national libraries of the world) for getting authority data automatically to control name authority in local library catalogue.

4) Web-scale library management

Web-scale library management service is essentially, a cloud based solution developed by OCLC. In this service OCLC member libraries are not only getting shared computing infrastructure but also shared data from WorldCat. OCLC is successfully mixing four basic elements of cloud computing i.e. IaaS, PaaS, SaaS and DaaS (see cloud computing section above). There has been a change in trends of library automation. It is no longer about which library provides the largest collection but about which library can provide their community with the best means to access the materials they need, regardless of location (OCLC, 2011). Libraries can increase visibility at the global scale and accessibility to services at the wider scale by using the new Web-scale library management facility.

The architecture of OCLC's Web-scale library management is given in Fig. 1.3.

Fig 1.3: Web-scale Library System

Source: OCLC (2011), Libraries at web-scale, Dublin, p. 23

5) Web 2.0 compliant ILS

The present web (often referred as web 1.0 in blogsphere) is progressing towards a User-centred entity with the support of an advanced set of technological tools that are collaborative, interactive and dynamic in nature. Radfar (2005) identified following characteristics of web 2.0 – i) a platform enabling the utilisation of distributed services; ii) a phenomenon describing the transformation of the web from a publication medium to a platform for distributed services; and iii) a technology that leverages, contributes, or describes the transformation of the web into a platform for services. ILSs are all set to take advantages of participative architecture of the web and introducing new services like user tagging of subject descriptors, ratings of documents by users, RSS feed for search query, integration with web 2.0 services like read/write web, collaborative web, social networking tools and information mashup. This new trend ILS is also termed as ILS 2.0.

6) Information mashup

Information mashups tools allow remixing of data, technologies or services from different online sources to create new hybrid services (O'Reilly, 2005) through lightweight application programming interface (API). ILS uses information mashup in managing and integrating virtual contents distributed globally with local library resources. Information mashups are becoming popular application of Web 2.0 around the world such as KohaZon (integration of Koha OPAC with Amazon services), WikiBios (a mashup where user can create on-line biographies of each other in a Wiki setup), LibraryLookup (integration of Google maps with library directory service in UK) and many more such instances.

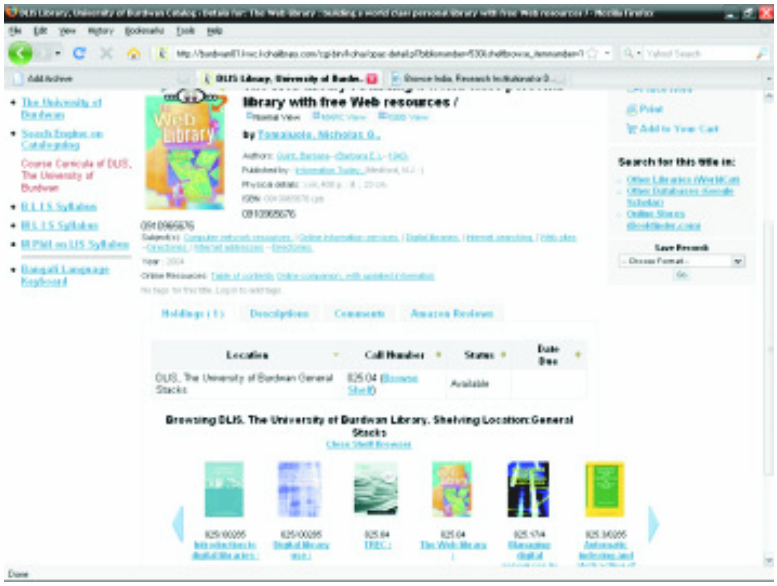

Fig. 1.4: KohaZon: Mashup of Koha with Amazon

7) Interactive user interface: OPAC 2.0

Most of the ILSs now support web-OPACs. OPAC 2.0 is the next generation web-OPAC where users can interact, collaborate and participate in library workflows such as describing resources (folksonomy), tagging subject descriptors, rating of documents, creating personalised information environment, posting on library blog, suggesting new documents, commenting on library services, publishing book reviews, posting likes on facebook for library books and many such facilities. ILSs are increasingly taking advantages of web 2.0 technologies and services to convert static OPAC into dynamic OPAC 2.0.

8) New cataloguing standards

Document description models and standards are changing rapidly. We have now E-R (entity-relationship) based bibliographic data model known as FRBR (Functional Requirements for Bibliographic Records, developed by IFLA in 1998) in place of flat data structure of ISBD. Similarly FRAD ((Functional Requirements for Authority Data, developed by IFLA in 2009), FRSAR (Functional Requirements for Subject Authority Records, developed by IFLA in 2010) are now established data models for managing name authority and subject authority respectively. These changes call upon necessary data structures in ILSs to suite FRBR, FRAD and FRSAD. Both commercial ILS group (e.g. Vitua ILS from VTLS group) and open source ILS group (e.g. Koha) are in the process of implementing the structural changes to address the improvements in cataloguing.

9) Application of discovery tools

Uses of discovery tools are increasing in libraries. Discovery tools, powered by federated search mechanisms, allow library patrons to perform concurrent searching in the library catalogue (metadata level), journal articles (full-text level), electronic theses and dissertations, consortia databases, public web, open access repositories, union catalogues etc. through a single-search interface with a set of feature-rich tools to support users. Discovery tools – i) can be integrated with existing library OPAC; ii) can import metadata into one index; iii) can apply one set of search algorithms to retrieve and rank results. As a result these tools support

rich user experiences in terms of speed, relevance, and ability to interact consistently with results. Moreover, the unified interface is a big boost for users as they no longer need to choose a specific search tool to begin their search. These tools are available commercially (e.g. EBSCO Discovery Service) and also as open source products (such as VuFind, SOPAC, Blacklight, OpenBib etc.).

10) **Digital media archiving module**

The distinction between automated library system and digital library is blurring day-by-day. This is because of the fact that most of the ILSs are integrating digital media arching module or DMA (e.g. NewGenLib 3.0 onwards) to handle full-text discovery of documents in different formats. This trend of ILS is important in the sense that in future library can handle both automated and digital library systems through a single instance of ILS. Another advantage of DMA is the scope to integrate courseware in multimedia formats in case of academic libraries. Some ILSs are also achieving compatibility with OAI/PMH standard to support metadata harvesting in ILS (e.g. Koha version 3.10.1 onwards).

11) **Community information services as outreach process**

Community information services meant to support community members with the information originated in the community. The service includes three broad groups – survival information such as that related to health, housing, income, legal protection, economic opportunity, political rights etc.; citizen action information required for effective participation as individual or member of a group in the social, political, legal, economic process; and local information i.e. basic information concerning courses, educational facilities, government agencies, local organisations, fractional groups, health professionals etc. including a calendar of local events. ILSs now (e.g. Vitua ILS and Koha are supporting MARC 21 community information format to handle community information resources) are trying to include community information service module to extend the role of ILS to provide outreach services.

12) **Increasing use of open source software**

The domain of library and information science, right from the beginning of the open source movement, is benefitted through structured effort and software philanthropy. We have matured ILSs like Koha (comparable to any global ILS), Evergreen, Emilda, NewGenLib; comprehensive digital library software like DSpace from the MIT, US (with support from HP), Greenstone Digital Library Software (or GSDL) from University of Waikato (presently supported by UNESCO). Use of open source ILSs are increasing all over the world because of the transparent use of library standards and scope of customisation to suite the specific requirements of a library. Moreover commercial ILSs are also utilising open source components like MARCEdit & ISISMARC (MARC cataloguing tools), YAS toolkit (Z39.50 client and server), Lucene & Solr (Text retrieval engines), Unicode-compliant multilingual tools etc. The use of open source software in library automation ensures 3F – fund (as these are free of cost), freedom (as these are free to customise) and fraternity (as these are supported by international communities).

13) **Emergence of open standards**

Open standards are available in public domain. These are the standards that anyone can incorporate into their software, service and system. MARC record standard is possibly the most visible open standard in the domain of library services. Library systems of any type or size are required to be compatible with global standards to achieve interoperability. Here lies the importance of open standards. These are developed, approved and maintained via collaborative process to facilitate exchange of datasets. These standards are available at no cost, well-documented, transparent and free from any kind of use restriction. ILSs are increasingly depending on open standards such as MARC 21 family of standards (Five standards), OAI/PMH, CCL (Common Command Language), SING, Dublin Core metadata standard, SRU, SRW, OpenURL, MARC-XML, METS, MODS etc.

14) **Interoperability capabilities**

Interoperability refers to communication between systems (external interaction) or system parts (internal interaction). Libraries are now operating in distributed information environment and many library systems communicate electronically with sources of bibliographic records (publisher or cataloguing agencies), book vendors, and users. They also now interconnect themselves with networked information resources outside of the library and deliver these through library-maintained interfaces (e.g. inter library loan, distributed cataloguing, metadata harvesting etc.). ILS developers are aware of these facts and thereby supporting more and more interoperability standards in different modules of ILSs.

15) **Multi-lingual records management through Unicode**

Multilingual (including Indic scripts) information processing requires standard text encoding scheme (such as Unicode), which can store, process and retrieve regional language based documents. But creation of multi-script databases requires not only Unicode-compliant operating system (OS) and other application programmes such as Virtual Keyboards to enter multi-script records, Open Type Fonts (OTF) to support extended character sets and layout features, and Rendering Engines to display script specific conjuncts and ligatures properly (Mukhopadhyay, 2006). ILSs are trying to support Unicode (especially UTF-8) to store native character sets, integrated virtual keyboard and supportive text retrieval engines to ensure processing and retrieval of multilingual documents.

Self Check Exercises

Note: i) Write your answers in the space given below.

ii) Check your answers with the answers given at the end of this Unit.

17) Write in brief the trends in the development of ILSs.

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18) What is cloud computing? How is it to going to help libraries?

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1.8 SUMMARY

Library automation is an area from where future benefits will emerge. It means that if a library is not automated it won't be in a position to take the advantages of ICT-enabled library services in future. This Unit acts as foundation and aims to introduce you with the concept of integrated library system and the advantages associated with it. It covers historical and theoretical foundations of library automation supported by a timeline of development of related technologies. In this Unit you can find guidance – 1) to identify the requirements for library automation; 2) to follow model for integrated library system; 3) to differentiate automated and digital library system; 4) to understand the typical steps for accomplishment of library automation; 5) to appreciate needs for standards in ILS and to recognise essential standards that need to be ensured; 6) to identify features of ILS in rapidly changing technological environment. This unit also provides knowledge about emerging global recommendations for developing ILS in the context of cutting edge technologies like cloud computing, linked open data and web scale library management. It also covers roles and components of RFP and steps for developing RFP for library automation, and allows you to develop skills in preparing RFP. This unit ends with a brief discussion on forthcoming features and ongoing changes in the arena of ILS against a fifteen-point checklist.

1.9 ANSWERS TO SELF CHECK EXERCISES

1) Library automation is the generic term that denotes applications of Information Communications Technologies (ICT) for performing manual operations in libraries of any type or size. It supports three broad groups of library activities – i) housekeeping operations; ii) information retrieval; and iii) on-the-fly integration of library materials with open datasets. Library automation requires for – 1) increased operation efficiencies; 2) betterment of library services; 3) innovative information services; 4) wider user access and 5) more productive use of library staff.

2) An ILS is capable of managing the operations of more than one basic library functions by sharing the files in the server to perform them. For example data from the book catalog master file and the patron master file can be retrieved and used in the circulation module to perform the circulation function of the ILS. In such systems files are interlinked so that deletion, addition and other changes in one file automatically activate changes in related files. It means integrated library management system is sharing a common database to perform all the basic functions of a library.

3) Library automation is a generic term that refers to the application of computers in libraries to automate operations. It can be standalone system supporting only one module like cataloguing or it can be integrated to link all modules or library subsystems through a common shared database. On the other hand, ILS is an automated library system that utilises shared data and files to provide interoperability of multiple library functions, e.g. cataloging, acquisition, circulation, serials, etc.

4) There are five generations of library automation categorised on the basis of technological breakthroughs. Alternatively these are also called five ages of library automation. The first age is characterised by the introduction of PCs in library automation and the second age is dominated by LAN based ILSs. The third age is marked by the Web-enabled ILS and the fourth age is featured by integration of full-text digital objects in ILS. The fifth and the present age is characterised by cutting edge technologies like cloud computing, linked open data and web 2.0 features for interactive user interfaces.

5) Library automation initiated in 1930s and applied in large scale in 1970s with the availability of low-cost PCs. The decade of eighties witnessed application of global standards and local area networks in library automation with the advent of campus-wide ILS and relational database architecture. The decade of nineties is dominated by the application of web technologies in library automation. Technologies like CGI architecture, Web-OPAC, digital media archiving are some of the well known features of this decade. The first decade of 21st century is the decade for application open source software, open standards and extended web technologies like web 2.0, cloud computing and linked open data in library automation.

6) The chronological order of the technological breakthroughs in the domain of library automation is as follows – i) Low-cost PCs used in 1970s; ii) LAN-based ILS with relational database backend, global exchange format and client-server architecture; iii) use of web technologies to provide time-space independent user services including Web-OPAC; iv) digital media archiving, interoperability standards and open source software; v) interactive user interfaces and seamless integration of linked open data.

7) Library automation has manifold advantages. Automation of library housekeeping operations is considered as an especially critical area from which future benefits will emerge. It means that if a library is not automated it can't take advantages contributed by ICT such as digitisation, web-enabled library system, use of linked open data, remote management of library, interactive user services etc. Library automation ensures acceptability of library to new generation users.

8) Library management software or ILS forms the core component of library automation. An ILS should support all the basic activities of library, seamless integration in different modules, global and national standards in the domain, suitable software architecture, interoperability standard data formats, multilingual processing and retrieval, and integration with open datasets. ILSs need to be future friendly, user friendly and open for customisation.

9) Procedural model of library automation is proposed by ASLIB (Association of Information Managers, UK) as a general model for automating library housekeeping operations. Presently most of the ILSs follow this model for designing different functional modules of ILSs. The model proposes that a library system has mainly two subsystems – administrative subsystem and operational subsystem (amenable for automation). The operational subsystem may be divided into four further subdivisions namely Acquisition, Processing, Use and Maintenance. Within each of these divisions there are a number of procedures (eighteen in total) and within each procedure there are one or more of six possible activities. The procedures and activities are carried out by fifteen basic tasks.

10) Digital libraries are managed collection of digital objects that provide full-text access to resources and differ significantly from automated library systems in terms of – 1) search features (metadata only vs. full-text and metadata); 2) document description (MARC 21 vs. Dublin Core); 3) interoperability standards (Z39.50 vs. OAI/PMH); and 4) software architecture (centralised vs. distributed).

11) Standard is a specification accepted by recognised authority as the most practical and appropriate current solution of a recurring problem. Establishing order to chaos and building collaboration are two most important prerequisites for effective information services. Both of these requirements depend on shared understanding i.e. on standards. Libraries all over the world are entering into the next wave of development to meet volume and variety of users' information demands. Interoperability and interactive user interface are two buss words in developing global information infrastructure. Libraries are no exceptions. Automated library systems are trying to be compatible with globally agreed upon standards related with information processing such as data formats (MARC 21 data formats, CCF, UNIMARC); interoperability standards (ISO 2709, MARC-XML, Z39.50, SRW, SRU OAI/PMH) and character encoding standards (Unicode).

12) ILSs support three broad groups of library activities – i) housekeeping operations; ii) information retrieval; and iii) on-the-fly integration of library materials with open datasets. A typical ILS supports selection, ordering, acquisition, processing, circulation, serials control, dissemination of information services and also extends help in library administration, planning and decision making process as a MIS tool.

13) Designing of future friendly ILS requires guidelines. OLE project and ILS-DI recommendations are acting as such guidelines recognised globally. The principal aim of OLE project is cost-effective integration of library management with other institutional systems on the basis of Enterprise Resource Planning (ERP) enabled Abstract Reference Model. On the other hand, ILS-DI guides developers in – 1) Data aggregation (harvesting and distributed searching); 2) Search (simple and advance search operators); 3) Patron services (general and interactive interfaces); and 4) Integrated service framework (on-the-fly integration of open contents, data sets etc.).

14) A request for proposal (RFP) is a formal request for a bid from suppliers of library systems or third-party software vendor in case of open source

software. RFPs are aiming to determine library requirements, prescribing standards and demanding services from ILS vendors and developers. The RFP prescribes the resources that need to be acquired, the services that need to be offered, the standards that need to supported, the selection criteria for ILS, and the requirements for the software vendor including a time schedule for each level of activities. It guides the library in evaluation of integrated library systems and helps the library to choose and acquire the most appropriate system.

15) RFP is required to guide us in framing requirements, selecting ILS and implementing ILS. The components of a typical RFP includes: 1) library profile; 2) automation need profile; 3) vendor profiles; 4) time frame; 5) evaluation parameters and method; 6) system requirements and specifications; 7) format for proposal.

16) L. T. David in 2001 advocated a set of steps for developing RFP. The process starts with need assessments and ends with evaluation of implemented system. It includes a total of eighteen steps.

17) The rapidly changing technological environment leads to corresponding changes in the development of ILS. The influence of technologies leads to the development of ILSs from stand-alone system to web-enabled systems in five decades. The major trends that are influencing ILSs presently are web architecture, Unicode-compliant processing and retrieving environment, supports for interoperability standards, open source movement and cutting edge technologies like cloud computing, web scale platform, web 2.0 and linked open data.

18) Cloud-based library automation is quite useful and cost effective for small and medium sized libraries. Cloud computing is network based computing facilities that support on-demand use of hardware and software resources. Libraries can take advantages of cloud computing in the following ways – i) by using ILS available in remote server through web browser; ii) by hosting the Web-OPAC in remote server; iii) by setting up own remote file storage and database system (with scheduled backups).

1.10 KEYWORDS

Acquisition : The process of obtaining resources for the library's collection, typically including ordering, receiving and payment.

API : Application Programming Interface. A language and message format used by an application program to communicate with the operating system or some other control program such as a database management system (DBMS).

Authority record : A record that shows the preferred form of a personal or corporate name, geographic region or subject. It also includes variant forms of the preferred form as cross references.

Barcode : A printed code, consisting of lines and spaces that can be read by a bar code scanner (reader), affixed to physical materials in a library collection to identify particular items for tracking and circulation.

Bibliographic identifier: A unique identifier which unambiguously identifies a bibliographic record within an ILS catalog and is assumed to persistent, at least as long as the records are managed within the ILS.

Bibliographic metadata: Information about a resource that serves the purpose of discovery, identification and selection of the resource. Includes elements such as title, author, subjects, etc.

Discovery application: A computer application designed to simplify, assist and expedite the process of finding information resources.

Dublin Core : A fifteen element metadata set for use in resource description intended to facilitate discovery of electronic resources.

EDI : Electronic Data Interchange (EDI) is a standard method for exchanging structured data, such as purchase orders and invoices, between computers to enable automated transactions.

EDIFACT : EDI For Administrations, Commerce and Transport The concept of utilising a single set of specifications for bibliographic records regardless of the type of material they represent.

ERMS : Electronic Resources Management System is used to manage a library's electronic resources, primarily e-journals and databases. Systems can include features to track trials, license terms and conditions, usage, cost, and access.

FRBR : Functional Requirement for Bibliographic Records is a conceptual model for the aggregation and display of bibliographic records. FRBR is an entity-relationship model, with four primary entities - work, expression, manifestation, and item - which represent the products of intellectual or artistic endeavor.

ILL : Inter Library Loan (ILL) is the process between two libraries of borrowing and lending a physical bibliographic item, or obtaining a copy of it.

ILS : An automated library system that utilises shared data and files to provide interoperability of multiple library functions, e.g. cataloging, acquisition, circulation, serials, etc.

Interoperability : The ability for two different computer systems to communicate and exchange information in a useful and meaningful manner.

LAN : A digital communication system capable of interconnecting a large number of computers, terminals and other peripheral devices within a limited geographical area.

Library Automation: Library automation is the mechanisation of housekeeping operations and information handling mainly by using computer and communication technologies.

MARC 21 : A harmonised MARC format developed by LoC in 1999 for encoding standards related to bibliographic data, authority data, holdings data, classification data and community information. It is used for the communication and exchange of bibliographic information (mentioned earlier) between computer systems.

MARCXML : A metadata scheme for working with MARC data in a XML environment.

Metadata : Structured information that describes an information resource. "Data about data" for an information bearing object for purposes of description, administration, legal requirements, technical functionality, use and usage, and preservation.

Metadata harvesting: A technique for extraction of metadata from individual repositories for collection into a central catalog.

Module of ILS : Functions specific to a particular system capability such as the online public access catalog, cataloging, acquisitions, serials, circulation, etc.

NCIP : NISO Circulation Interchange Protocol (NCIP) is a standard which defines a protocol for the exchange of messages between and among computer-based application to enable them to perform functions necessary to lend and borrow items, to provide controlled access to electronic resources, and to facilitate co-operative management of these functions.

Network : A group of computers and other devices connected together so that they can communicate with each other, share data and resources such as printers, and perhaps share the workload of running complex programs. They may have one or more central servers to coordinate and run things, or all devices may be of equal standing (called "peer-to-peer"). The connections between them may be physical wires and cables, or wireless using infrared or radio frequency.

OAI-PMH : OAI - Protocol for Metadata Harvesting. Protocol for application-independent interoperability framework based on metadata harvesting, open standards HTTP (Hypertext Transport Protocol) and XML (Extensible Markup Language).

OPAC : On-line Public Access Catalog is a library catalog which can be searched on-line and is a module of the ILS. It is the interface between library resources and users and is designed to be "user friendly."

Open Source : A concept through which programming code is made available through a license that supports the users freely copying the code, making changes it, and sharing the results. Changes are typically submitted to a group managing the open source product for possible incorporation into the official version. Development and support is handled cooperatively by a group of distributed programmers, usually on a volunteer basis.

Open Search : A collection of technologies developed by Amason that allow publishing of search results in a format suitable for syndication and aggregation.

Open URL : A URL with stored metadata that is user context sensitive in what information or hypertext link is delivered.

Protocol : A standard procedure for the message formats and rules that two computer systems must follow to communicate with each other.

RSS : Really Simple Syndication is an XML format used for distribution or syndication of frequently updated Web contents.

SIP2 : Standard Interface Protocol Version 2 is a standard for the exchange of circulation data and transactions between different systems.

SRU : Search/Retrieve via URL is a standard search protocol for Internet search queries, utilising CQL (Common Query Language), standard query syntax for representing queries.

SRW : Search/Retrieve Web service is web services implementation of the Z39.50 protocol that specifies a client/server-based protocol for searching and retrieving information from remote databases.

System Analysis : A powerful technique for the analysis of an organisation and its work.

Unicode : A universal character-encoding standard used for representation of text for computer processing. Unicode provides a unique numeric code (a code point)

for every character, no matter what the platform, no matter what the program, no matter what the language. The standard was developed by the Unicode Consortium in 1999.

WAN : A computer networking system that operates nationwide or worldwide by utilising telephone line, microwave and satellite links. It is also used to interconnect LANs.

Web Service : Software system designed to support interoperable machine to machine exchange of data/information, typically using the XML, SOAP, WSDL and UDDI open standards.

XML : eXtensible Markup Language is an open standard for describing data from the World Wide Web Consortium. It is used for defining data elements on a Web page, business-to business documents, and other hierarchically structured text and data.

Z39.50 : A NISO and ISO standard protocol that specifies a client/server-based protocol for cross-system searching and retrieving information from remote databases. It specifies procedures and structures for a client system to search a database provided by a server.

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Alibaba.com offers 99 library automation system products. About 3% of these are pos systems. A wide variety of library automation system options are available to you, such as stainless steel. There are 92 library automation system suppliers, mainly located in Asia. The top supplying countries or regions are China, Malaysia, and Taiwan, China, which supply 93%, 5%, and 1% of library automation system respectively. Library automation system products are most popular in Australia, United States, and India. Related Search