Chapter 5

Next Generation Library Management System

5.1 Introduction
Library professionals and experts are talking about next generation library management system since 2007 (Bahr, 2007; Andrews, 2007). Therefore it is necessary to find developments in library management systems in this direction. This chapter presents overview of developments in library management systems towards next generation.

5.2 Library management systems: Developmental history
From late 1780s to 1930s, card catalog started to emerge and gradually its use increased and by 1960s, the card catalog became an essential tool in libraries. However in search of more effective ways and tools, during 1960, the libraries had taken benefit of computer technologies and created MARC (Machine Readable Cataloging) standards. As the use of computers started increasing in the libraries, in early 1970s library automation systems were came into existence known as library management systems. The initially library management systems were basically used to handle circulation activities. However in the next two decades along with computer technology, the library management system functionality also grew and the library management systems were able to process different tasks such as acquisition, cataloging, circulation, serials control etc. In the late 1990s, Online Public Access Catalogs (OPAC) has been emerged due the proliferation and popularity of the Internet. In 21st century library management systems have great impact on efficiency and effectiveness of libraries (Li, 2014).

Since mid 1950s Haravu (2009) has categorized evolution of library management systems into following five phases.

First generation systems (1950s – 1960s): The first generation systems are stand-alone un-integrated applications, without standards metadata and begin with circulation. Most of the systems were home grown and mainframe computer based with batch process system. The emphasis was on library housekeeping efficiencies, little or no concern for user access.

Middle generation systems (1960s – 1970s): During this phase first generation of integrated library management system came into existence. In these systems metadata standard for bibliographic records (MARC) are made available. In this phase the
emphasis was on centralized cataloguing, distribution of catalogue cards and exchanging bibliographic data. These systems are have proprietary backend design, targeted for single libraries, mostly mini-computer based and have command line interfaces. These library management systems leveraged the catalogue data in other modules such as circulation and acquisitions. In this phase some system were developed by vendor and some system were home grown.

**Pre-Internet generation (1970s – up to 1990s):** This phase systems were with richer interface like GUI and had client-server or LAN based architecture. During this phase first generation OPACs come into existence. The z39.50 protocol, RDBMS based back end and SQL based search is implemented in this generation. The home grown system starts disappearing during this phase and most of the systems were vendor based.

**Internet generation (Web 1.0) (1900s – 2000):** The development of internet technology lead to emergence of web based OPAC. The other functional modules such as acquisition, cataloguing, circulation, serial control were still locally administered. Backend of the systems were predominantly RDBMS based and search systems were SQL-based. Open source operating system platforms like Linux made an entry, Java and .net become option for development of web applications.

**Post 2000 – the Web 2.0 Era:** During this phase complete web based systems are available. The different web services like RSS, mashup, interoperability, information reuse, enhanced user experience are made available through protocol and API. New class of library management systems make serious entry into library automation market are knows as open source library management systems.

However during this phase, due to advanced development in technology and their impact on libraries and publishing industry, the library professionals stated showing their dissatisfaction with the monolithic nature of the present generation of library management systems and there is increase in demand for better integration facilities (Haravu, 2009).

The examination of history of library management systems shows that development of library management system started with un-integrated system, and later demand for integrated system. Now professionals are taking on integrating systems and expecting next generation of library management systems with such design approach.

**5.3 Need of Next generation Library Management System**

Since 2000s, the rapid growth, popularity and advances in information and web technologies lead to development of electronic/digital contents. Lots of resources have
been digitized, made available online and also more availability of born in digital information. Libraries are spending a large portion of their budget on licensed electronic resources. The rate of acquisition of electronic collection is increasing therefore now a days library collections are no longer print-dominated and libraries have to manage hybrid collections.

The traditional library automation model was designed and developed at time when libraries mainly dealt with print collection. Now a day libraries subscribes vast number of electronic resources and the present LMSs does not handle such e resources, as the electronic resources collection demands different workflow and more efforts to maintain. The OPACs lack the capability of offering more than titles of e-resources. The inability of traditional library management system to manage steadily growing library’s electronic collections led to the development of various add-on products such as electronic resource management systems, federated search engines, link resolves, discovery layers, and web scale discovery. However the absence of integration imposes challenges to both library staff and users. Users become more and more frustrated by the difficult level of accessing library resources. (Li, 2014).

Therefore there is need of such products which contains all functionalities for managing digital and physical collection and their unified access. This can be done either through redesign the present generation systems or providing better integration and interoperability option for add-on module with current ILS. In response to such expectation the new library management systems are developed and being developed, like Alma by Ex Libris, Intota by Serials Solutions, Worldshare by OCLC, Sierra by Innovative Interfaces, and Kuali OLE by Kuali Foundation; this is one of the open open source next generation library management system. The new system is referred by different names like “the next generation integrated library system “library services platforms” and “library management platforms” “web-scale management solution” “library management service” or referred to generally as the new library system (Yang, 2013).

5.4 What is next generation LMS and How should be the next generation LMS? :

Experts Views

It is important to find the opinions of different library experts on the next generation of library management system. Following are some of the studies, which describe views and opinions of expert on and about next generation library management system.
Bahr (2007) in his article “Dreaming of a Better ILS” records view of some library technology experts on what feature and functions they want to see in the next generation of library management systems. This study shows that librarian is no longer satisfied with the current library management systems and they are looking for alternative and expects new features and functionalities in the next generation of LMSs such as direct read only access to data preferably through MySQL, application programming interface, standard compliant systems with better documentation and security, greater interoperability with systems within library and other system such as courseware, university portal, shared libraries, better and single interface for all holding of the library regardless of format.

Andrews (2007) summarizes and examines library automation market trends in response dissatisfaction with OPAC and ILS. He also presents critical analysis on OPAC and attempt to redefine ILS. He predict that next generation of systems is combination of open URL Link/Resolver, federated search tool, Digital archive; institutional repository, portfolio products, electronic resource management products, compact and robotic storage systems for print materials, portal products, management interface and features like documented API, LAMP, users choice of database, an active effort to create and use “mash-ups etc.

Ruschoff (2008) in her article the integrated library system: “Are you ready for the next generation ILS” describes current library management system and its limitation to fulfill the user and library staff expectation and need for makeover of the present systems. and suggest feature and function that that needs to be incorporated in to next generation ILS such as automate metadata creation, integrating digital and print collection workflow, support multiple metadata schemas, usage reporting, knowledgebase, multi level system i.e. it should support to meet the needs of all types of libraries.

Dougherty (2009) discusses current development in integrated library systems and emphasizes open system architecture and interoperability standards for future library management systems.

Haravu (2009) describes the limitations of both commercial and open source library management systems and provides description of major new initiatives for freeing the LMS from its monolithic nature into one which supports new workflows via services-oriented architectures (SOA) and web. The new initiatives in redesign of LMS are the OLE Project, The DLF discovery interface task force, NISO best practices for designing web services in the library context, eXtensible catalog project and OCLC proposal for a web-scale cooperative library management service are discussed in details.

Collins and Rathemacher’s (2010) presents discussion took place on the forum on the topics like the future of library systems, open-source library systems, cloud computing, and new initiatives by the open library environment. As per expert view in this discussion the ideal future library system should facilitate the management of workflow, incorporate enhanced discovery tools, and be interoperable with other systems inside and outside the library.

Rapp’s (2011) article is based on roundtable discussion in San Diego with top executives in the integrated library system field and expert librarians. This conversation is about the future of the ILS and also covered a range of topics. Some expert opinioned that the future ILS should make provision for the management electronic contents.

Grant (2012) in his article “The future of library system: library service platforms” provides information about available next generation library management system such as Sierra, Intota, Alma, Worldshare management services, Open Skies, Kuali OLE and describe the approaches used to build these available next generation library management systems. He identified three approaches such as a new fresh design, reutilizing sustainable portion of traditional library system and open source software approach. He also lists functionality of next generation library management system such as acquisition (selection), circulation, cataloguing (description), discovery, ERM, ILL, booking, analytics, reporting, one interface, knowledgebase, linked data support, open API and / or SOA, event management, mobile support, streaming video support, multilingual subject heading, FIBR, RDA, preservation capabilities, E book support.

Wang & Dawes (2012) examines the state of current library management systems and describes the distinguishing and critical characteristics of the next-generation library management systems. Those characteristics are comprehensive library resources
management, a system based on service-oriented architecture, the ability to meet the challenge of new library workflow; and a next-generation discovery layer. He also examines some of the next-generation library management systems currently in development such as Alma and Kuali OLE.

Balnaves (2013) in his article “From OPAC to Archive: integrated discovery and digital libraries with open source” presents open source model to manage today’s libraries of hybrid nature. This model is combination of three open source software such as Koha, Dspace, and Vufind and this model is practically implemented.

A report by Next Generation Library Taskforce, Dartmouth College Library (2013) describes shortcoming in present generation of library management system and provides suggestion for improvement in following areas of library management systems to cope with the challenges of digital era.

Discovery: convenient, locally relevant, and responsive to users needs, helpful and alert, open and configurable, analog friendly, mobile friendly.

Personalization: customization, smart searching, helpful and alerts.

Reuse: Export (metadata, citations, full text etc.), Tools (manipulate objects such as video, audio, images, and text).

Assessment and analytics: user feedback, broad access and use of data, new business efficiencies, asset tracking.

Collection development: fund management, invoice management, selection (electronic), and data exchange.

Metadata creation and management: metadata repositories should be integrated to communicate with each other.

Collection management: Business processes, inventory control, and electronic resource management system.

System integration: integrated user services, grants systems integration, financial systems integration, course management system integration, reporting systems integration, Multi institutional integration

Yang (2013) describes advanced features of next generation library management systems such as clientless and cloud based, role based login and unified workflow, knowledge base, electronic resource management, license management, user driven acquisition, trial database management, and other feature such as RDA compatibility, direct chat with vendor, ILL, interoperability, integration with other systems, support for multiple formats in addition to MARC.
Li (2014) discusses developmental history, limitations of the current ILSs and lists the features of new library management systems like integration and interoperability, open architecture, scalability, user centered design, cloud computing. He mentions that next generation ILS contains two layers first one is web-based automation system that fully supports the library operation and second is discovery service that replaces the traditional OPAC.

The examination and observation of above studies shows following some of the major expectation about the features of next generation of library management system.

- Provision for the management of electronic collection and Knowledge base
- Unified access to all collection irrespective of format
- Integration, interpretability and open standards
- Open application programming interface (API)
- Service oriented architecture (SOA)
- Unified workflow for digital and print collection
- Cloud supportive and multi-tenant architecture.
- Support for multiple metadata schema

5.5: The Next Generation Library Management System: Functionality

On the basis of studies about next generation library management systems and examination of some available next generation library management systems the next system may comprises following functionality.

5.5.1 Traditional library management system functionality

Acquisition/Select & Acquire: module for selecting, ordering, and paying for library resources.

Cataloguing / Describe & Manage: module for cataloguing, import /export of bibliographic records, authority control, and maintenance of local holdings and item information etc.

Circulation/ Deliver: module for managing all circulation related functions and activities.

Serial control: module for managing serial publications.

Reporting: module for generating various reports

5.5.2 ERM: E resource Management System/Module: Under the e resource module following sub modules are expected.
Acquisition workflow: Request /suggestion for e resource, trial access, assessment, approval, quotation inquiry.

License management: The licensing process consists of requesting a standard license from a publisher for the resource, comparing the license with standard requirements established by the institution/library, back and forth negotiation, if approved, final signatures from parties, storing final license document and related papers.

Subscription / renewal / purchase order, invoice & payment: Comparing quotations, placing order for new subscription, renewal, or for purchase, invoice and payment process.

Creation of E Resource record: The E-Resource record provides information about an electronic resource acquisition such as titles, payment, licensing, publisher, platform and vendor, contact information, administrative information, starting and expiry date of subscription, number of title covered, list of title with period of back volume coverage, subscription status (new, dropped, cancelled, transferred), vendor changes, maintenance of subscription history, and verification of continued access

Acquisitions administrative settings: Support for budget management, fund management, financial reporting, currency, exchange rate, vendor information management.

Usage statistics management: Obtains gathers and organizes usage statistics, Auto load usage statistics using SHSHI, Counter Standards, provide historical statistics, Organize and present usage statistics in tabular, graphical format

Holding management: Identify and maintain appropriate coverage and URLs per title; support holdings display in the catalog.

Integration / interoperability: with catalogue/discovery layer, knowledge base (Collins & Grogg, 2011)

Reporting: Provide query-based reporting as per requirement

5.5.3 Knowledge base

The knowledge base is one of the important components in next generation systems. The data in the knowledge base include publisher and vendor profiles, information about their electronic databases and books and journal titles in those databases, links to titles, platform price, and license terms.(Yang, 2013). The knowledgebase describes electronic journal and books and publishers packages and platforms. There are vendor maintained knowledge bases are available. However development of Global Open Knowledgebase (GOKb) is started in November 2014. This GOKb project is supported by Andrew W.
Mellon foundation and managed by Kuali OLE founding partners and JISC collections. The data from this knowledge base is freely available using web based interfaces and API (http://gokb.org)

5.5.4 Discovery layer / Discovery service: Research and university libraries subscribe thousands of e-journals, e-books, hundreds of databases, and possess lakh of print books. To provide the unified access to all these resources, discovery layer and discovery services play important role. Here the users actually start their discovery with a search engine provided by the library itself, which directs them to the most appropriate content for their search that the library has available, rather than to the mixed bag of results that other general search engines throws out. (Campbell, 2010)

Discovery layer / discovery service is one of the important functionality of new generation library management systems. This functionality can be made available by integrating open source discovery layers such as Vufind, Blacklight and commercially available web scale discovery services such as Summon, (ProQuest), Discovery Service (EBSCO), Primo Central (Ex Libris), WorldCat Local (OCLC) etc.

There are two components in Web scale discovery services.

Discovery Layer: The user interfaces and search system for discovering, displaying, and interacting with the content in library systems, such as WSD central index.

Central Index: The collection of pre harvested and processed metadata and full text that comprises the searchable content of a WSD service. It also called the base index, unified index, or foundation index (Hoeppner, 2012).

5.5.5 Local digital collection management: Libraries have digitized valuable rare collection and also acquiring born in digital collection. Research and academic libraries also possess research publication of their faculties. For the management of such collection, digital collection management functionality i.e. digital library functionality is also expected either in LMS itself or integrating available digital library software with LMS.

5.5.6 E Book management: Libraries are acquiring e books on perpetual access or subscription access. Different e book platform are also available.

5.5.7 Content management System: For the management of library website and other content there is need to have content management functionality in the ILS. The some of the presently available library management systems either provides their own content management functionality or provides integration facility with the existing popular content management software.
5.5.8 Other functionality
Citation management
Mobile compatibility
Integration with course management system
Link revolvers and Open URL compatibility
RDA

5.5.9 Features
5.5.9.1: API / SOA
For the purpose of integration and communication with other system API / SOA are important elements.
Application Programming Interface (API) is a set of routines, protocols and tools for building software application. API allow integration of new features into existing applications (so-called "plug-in API"), or to share data between distinct applications (Wikipedia, n. d.).
Service-oriented architecture (SOA) is a software design and software architecture design pattern based on distinct pieces of software providing application functionality as services to other applications. It is independent of any vendor; product or technology (Wikipedia, n. d.).

5.5.9.2: Unified workflow: Some expert also expecting unified workflow for both print and digital, Kuali OLE has implemented it.

5.5.9.3: Integration: interoperability with systems within library and outside library such course management system, student system, finance system etc.

5.6 Next Generation library management Systems: The Yang (2013) lists the following presently available next generation LMS and their date of release.

<table>
<thead>
<tr>
<th>System</th>
<th>Vendor</th>
<th>Installation Option</th>
<th>Release date</th>
</tr>
</thead>
<tbody>
<tr>
<td>Alma</td>
<td>Ex Libris</td>
<td>Cloud hosting</td>
<td>2012</td>
</tr>
<tr>
<td>Intota</td>
<td>Serial solutions</td>
<td>Cloud hosting (SaaS)</td>
<td>2014</td>
</tr>
<tr>
<td>Kuali OLE</td>
<td>Kuali Foundation</td>
<td>Cloud hosting and local</td>
<td>2013 (Open Source)</td>
</tr>
<tr>
<td>Sierra</td>
<td>Innovative Interfaces</td>
<td>Cloud hosting and local</td>
<td>2012</td>
</tr>
<tr>
<td>Worldshare</td>
<td>OCLC</td>
<td>Cloud hosting</td>
<td>2011</td>
</tr>
</tbody>
</table>

Table 5.1: Next Generation library management Systems

5.7 Approaches for development of next generation library management system.
Grant (2012) categorized approaches that are used to build presently available next generation library management systems into following three categories.
5.7.1 A start with a new fresh design: This approach involve recreating new product with ground up, the supporters of this approach justify that the amount of change in computer technology and library management / operations are substantial and best way to accommodate all changes is to start with fresh design. These new systems are built on new architecture that allows multi tenant operation, data aggregation, analytics, and redundant and secure data centers and also incorporate digital and print process in to common workflow (Grant, 2012).

5.7.2 Reutilizing substantial portion of present system: Don’t throw the baby out with the bath water: This is evolutionary approach. This approach re-utilizes the substantial portion of previous generation of technology and couples it with new technology. The logic of this approach is that, many libraries understand that in current situation their focus is on meeting their users’ needs. By this approach they can do quickly and shows real and substantial progress at reasonable cost without breaking everything that works (Grant, 2012).

5.7.3 Open source software approach: This approach can be again divided into above mentioned two approaches. The presently available Kuali OLE uses this approach. (Grant, 2012)

Actually “fresh design approach” and reutilizing the present system approach” are two main approaches and applicable to both open source software and proprietary software.

The system first approach i. e. fresh design approach, some functionality is lacking in initial releases and it is real danger to develop new system and at the same time to address broad market. The existing library management systems taken number of years and efforts of hundreds of persons for development, testing and documentation. It is difficult to replicate all this functionality in new software architecture in short period of time. The system may take long to become full featured and completely mature. The experience of applying this approach to other products in other field shown that, this approach doesn’t produce enough quality and progress to keep everyone happy at the same time (Grant Carl, 2012).

The systems built with second approach may not take benefit of multi-tenant architecture and installation of new version of software likely take longer time. It keeps running cost of hardware and software higher than newer multi-tenant cloud computing architecture; It does not provide more integrated streamlined workflow like new design product. If Saas is not used cost of upgrade need to be bear (Grant Carl, 2012)
We can’t predict right now, the new cloud based, multi-tenant architecture will be economical and cost effective to the libraries or not. The first priority is the functionality and services rather than architecture. Another argument in support new design approach is unified workflow to print and electronic collection. In traditional ILS we have separate workflow for print periodicals and books but don’t have much effect on staff efficiency and effectiveness. Handling both workflows separately will not cause much more problems; however the important issue is to provide unified access of all resources irrespective of format to the users. Therefore the researcher feels that the second approach i.e. reutilizing the present system is the more logical; because present generation system is now very well mature only thing is that they do not handle electronic collection but by modifying or reutilizing substantial portion of these system, new functionality can be incorporated and integrated. This revolutionary approach is one of the best ways to develop next generation system.

In case of Kuali OLE, the development is started in 2010 and it uses open source approach with fresh design however wherever possible it uses some available open source component also. Even though till April 2015 some functional features are under development. It may take some more time to become full flagged complete systems and mature with all essential functional features.

Looking into above facts the second approach appears more logical and on basis of this approach researcher suggests following model for development next generation system from available open source library systems and related open source software.

5.8 Model for Next Generation Open Source Library Management System

The next generation library management system is the combination of different systems/modules required for the management prints and electronic collection and various user related services and library related activities. It is combination of library management system, E resource management system, knowledge base i.e. discovery layer/service, content management system, digital library etc.

This model suggests development the next generation Library management system using available open source library management systems and related open source software. Therefore it essential to discuss the present state of open source library management systems.

The study conducted by researcher found that presently available traditional open source library management systems are slowly moving to this direction by adding features and functionalities like RSS, user contribution like ratings, reviews, comments, tagging;
enriched content like images of book covers, CD and movie cases, tables of contents, summaries, reviews, photos of items; faceted navigation; relevancy; did you mean.; integration with discovery layers; integration with web scale discovery services; content management functionality, basic provision for digital object/file attachment to records and adding URL of e-books in MARC record. These are very small effort to the next generation direction. The researchers also send questionnaire regarding software architecture to developers of eight selected LMS software. Only Evergreen and PMB replied. Among present generation system only Evergreen claims that it is built with oriented architecture that can be configured in cluster. PMB claims for availability of API if needed. Kuali OLE is the already based on SOA.

Presently available open source library management system needs to take major steps like adding electronic resource management module and different API for integration with other systems and components.

Considering the above facts the researcher is proposing following models for open source library management system to become next generation library management system.

5.8.1 Developing Next generation system by integration of existing open source library related software by developing API and software reuse principle.

“Software reuse: is the reapplication of knowledge encapsulated in software code in order to reduce the effort of developing and maintaining a new software system. Many things can be reused in addition to software such as data formats, high-level designs, algorithms, documentation or other items may be. There are two types of software reuse, black-box and white-box. Black-box means that the code implementation is hidden from the end user by well-defined and documented interfaces, usually an application programming interface (API), which allow the consumer to use the component without needing to know how it has been implemented. White-box reuse is reuse in which the user requires access to the internal implementation of the component in order to make modifications. It is more popular with many implementers because the component can be tailored to fit the exact needs of the target system.” (OSS Watch, n. d.)

As per the following diagram the next generation system can be developed using available open source software and integrating them through API. Though it said that traditional LMS are tightly integrated however many LMS supports standards like
Z29.50, SRU/W, MARC, SIP2, OAI-PMH, Open URL etc. through these standards integration may be achieved.

One of the problems is that numbers of API are required and needs to be developed by each LMS for each kind of software. It looks practically difficult. Therefore following model is suggested.

5.8.2 Developing Next generation system by developing common open source service oriented architecture, framework and software reuse

This approach suggests development of common open source service oriented architecture framework. Using this framework any library related existing open source software and even some commercial component / individual modules of LMS can be integrated and interoperability can be achieved between the systems. Unified access all resources available in library and subscribed by library can be provided to users. The figure 2 shows conceptual sketch of suggested SOA framework. However the traditional LMS are tightly integrated therefore this framework will also provide some standards connector by implementing library and related standards so that it can connect to LMS
and in some cases LMSs has to be also provide some way and means of communication with this framework. This way we can achieve to next generation functionality without disturbing the mature present systems. Only thing is that library has maintained different systems.

The Evergreen already using Open SRF a open scalable request framework, possibilities of using this framework for integrating different library related system need to be explored.

![Figure 5.2: Model 2](image)

*Optional (If WSD used)*

### 5.9 Conclusion

The developmental history of the library management systems shows that, initially the library management systems were not integrated. In the later phase there was demand for integrated systems to avails benefit of integration. However during the decade due to the advancements in the information and web technologies and proliferation and use of electronic resources, there is demand for integrating different components and services with library management systems. i.e. demand for integrating the systems rather than
integrated systems. Therefore professionals are expecting such systems which support integration, i.e. systems with service oriented architecture.

In response to this type of demand few vendor have developed and developing such kind of systems but are very few in number. Kuali OLE is the only open source next generation library management system. There is need of more efforts in this direction.

Li (2014) remarked that “Facing the unprecedented challenges, major ILS vendors are pressed to develop the next generation ILS; nonetheless, the concrete ideas of the future ILSs are still being investigated”.

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