The Electronic Library

Integrated library management systems: Comparative analysis of Koha, Libsys, NewGenLib, and Virtua

Margam Madhusudhan Vikas Singh

Integrated library management systems

Comparative analysis of Koha, Libsys, NewGenLib, and Virtua

Margam Madhusudhan and Vikas Singh
Department of Library and Information Science, University of Delhi, Delhi, India

Received 5 August 2014
Revised 6 February 2015
Accepted 4 April 2015

Abstract

Purpose – The purpose of this paper is to analyze the various features and functions of Koha, Libsys, NewGenLib and Virtua with the help of specially designed evaluation checklist and rank them based on features/functions of integrated library management system (ILMS).

Design/methodology/approach – The evaluation approach taken in this paper is similar to that of Singh and Sanaman (2012) and Madhusudhan and Shalini (2014) with minor modifications, comprising 306 features/functions and categorized as ten broad categories.

Findings – The paper explores different features of open source (OS) and commercial ILMS, which reveals that Virtua got the highest total score of 218 (77.86 per cent), followed by Koha ILMS with 204 score (72.86 per cent). Interestingly, NewGenLib got the lowest total score, that is, 163 (58.21 per cent). ILMS under study are lagging behind in exploiting the full potential of the Web 2.0 features, including cloud computing features, and needs to be addressed in their future development.

Practical implications – It is hoped that both the OS and commercial software will attend to the lacunae and soon develop fully functional Web 2.0/3.0 and cloud-based technologies.

Originality/value – The findings of this paper will not only guide the librarians in the selection of a good ILMS, which can cater to the needs of their libraries, but also abreast the knowledge of evaluation of ILMS for the students of Library and Information Science. And the findings will help the ILMS vendors to know the limitations of their ILMS, so that they can overcome the limitations faced by users and improve their products.

Keywords Evaluation, Open source software, Koha, Library automation, Integrated library management systems, Libsys, NewGenLib, Virtua

Paper type Research paper

1. Introduction

Library management systems (LMSs) are established as an essential tool in the support of effective customer services, stock management and management of services offered by libraries. They are "based on the knowledge and experience of library professionals over many decades" (Rai and Kumar, 2011). "Library automation not only improves the image of the library services, but also provides additional services to the users with the existing staff" (Dhanavandan and Tamizhchelvan, 2012). Integrated library management systems (ILMSs) vary by several factors, including scalability, database type, operating system compatibility, support for bibliographic record formats and interoperability. These factors can be influenced by whether an ILMS is open source (OS) or proprietary, and the "selection of relevant software is an important step in the

The Electronic Library
Vol. 34 No. 2, 2016
pp. 223-249

0264-0473
DOI 10.1108/EL-08-2014-0127

library automation process" (Hussain and Ansari, 2007). The purpose of this study is to examine the current features and facilities of the various ILMS under study: namely Koha, Libsys, NewGenLib and Virtua. The study also analyzes these ILMSs for the features in each module to update librarians on what considerations to take when choosing ILMS for their libraries.

2. Review of related literature

There are many articles and case studies available on this topic by various authors; some of the more relevant articles are reviewed below. Singh and Sanaman (2012) stated that "Koha has more specific characteristics/features and advanced database features, whereas NewGenLib has better functionality of modules than Koha", and Anuradha *et al.* (2011) praised the "full-text search features in the widely used open-source library automation package Koha". These "next generation library systems purport to fill the changing needs of libraries" (Wang and Dawes, 2012). Lihitkar and Lihitkar (2011) examined ten selected software packages on the basis of their usability and implementation in libraries. From the ten, Libsys was the most highly rated one having 37 software features, followed by the SOUL software with 36 points. The authors opined that it was necessary to improve the quality of software for providing effective services.

Vasupongayya *et al.* (2011) focused on reviewing OS LMS packages on their abilities to perform four basic components: traditional services, inter-library loan management, managing electronic materials and basic common management systems, such as security, an alerting system and statistical reports. Few ILMS are fully web-compatible and support maximum technological features (Rai and Kumar, 2011). Pratheepan (2013) reported on the merits and demerits of OS and commercial LMSs. Sunil and Harinarayana (2011) presented the performance of nine OS ILMSs of their housekeeping modules and viability indicators. Tajoli *et al.* (2011) described the main Koha features and functions. Pandey and Singh (2011) found that NewGenLib is more specific than Koha, as it does not have digital library functionality towards building digital libraries in terms of the programming, data structure and other required technology, which results in more interactive and powerful features with metadata enrichment. Shalini and Madhusudhan (2011) compared the OS web-based online public access catalogues (OPACs) of select university libraries of east and west to assess the level of changes and development made by libraries in the developing world. OS OPACs are more favourable to the ideal next-generation catalogue than proprietary OPACs, and Koha offers faceted navigation (Yang and Hofmann, 2010).

The Koha 3.0 LMS supports the wide-ranging needs of a busy and fast-growing specialist library (Bissels and Chandeler, 2010). Koha's OPAC integrates many enhanced content features typical of Web 2.0, including really simple syndication (RSS) feeds to notify patrons of new acquisitions in their area of interest, tagging and comment boxes for search results (Pruett and Choi, 2013). The services involved in the open source software (OSS) support might include: conversion services, installation, configuration, training, ongoing support, hosting and custom development (Breeding, 2007). Although dedicated IT staff is not present in many libraries around the world, increased functionalities and better manuals could encourage even in those libraries for the OSS implementation (Macan *et al.*, 2013).

Neelakandan *et al.* (2010) discussed the problems encountered during the implementation of Koha. Virtua covered most of the functional attributes that comply

with international standards, whereas Libsys has tried to incorporate the core functionality of serials control, although its compliance with standards is limited (Ghosh and Panda, 2011). Trainor (2009) provided insight into the use of Web 2.0 and Library 2.0 technologies in ILMSs. Griggs (2009) described Web 2.0 features, chat, RSS feeds and other social networking tools with traditional library content. Unicode eases a lot of ILMS development problems (Zou and Liu, 2009). Kushwah *et al.* (2009) discussed migration from one record standard to another, mapping of data and related issues. Dorman (2008) promoted awareness of the importance of open standards, OSS and open access content for the continued advancement of cost-effective meta-search services.

Evaluation studies of ILMSs are numerous. However, the quantity of studies examining OS and propriety are meagre. Saxena and Srivastava (1998) developed evaluation criteria for LMS for small and large libraries. The checklist was limited to five parameters: facilities provided in the software packages, hardware requirements, operating system platforms, language of software development and search facilities. Kumar (2005) developed a checklist more pertinent to the functional features of four OS ILMSs in six categories with 31 features. Later, Shafique and Mahmood (2008) developed an evaluation checklist covering 77 features and reported on five modules: acquisition, cataloguing, circulation, serials control and searching. Muller (2011) evaluated 20 free and OS ILMSs, based on 40 criteria and analysis of almost 800 functions and features to determine which ILMSs are most suited to the needs of the libraries. Furthermore, Rai and Kumar (2011) developed a comprehensive checklist to assess the features of six software packages by taking into account five aspects, including hardware requirements, facilities available in different modules, technology supported by the ILMSs, security, customer support service with 98 features and so forth. Ghosh and Panda (2011) provided a comparative analysis of the automated serials control systems, organized in eight layers with 60 features.

Breeding (2007) is the most prolific writer on the subject of integrated library systems and provided some necessary statistics for library automation software choices. For libraries that may not have adequate technical ICT expertise, support is available from vendors who have modified and repackaged the OSS for commercial purposes, from the original developers and community support via e-mail lists and Internet relay chat channels. Fayen (2011) compared the OS/proprietary ILMSs with the clearest evaluative rubric. Madhusudhan and Shalini (2011) developed a more comprehensive checklist for web-based OPACs, comprising 174 dichotomous checkpoints and categorized into 11 broad categories. This checklist paid no attention to Web 2.0 features, such as RSS feeds, tagging, open URL, citation creator and so forth. Shalini and Madhusudhan (2011) redesigned their checklist with 195 dichotomous checkpoints in 12 categories, incorporating Web 2.0 features in the OPAC. Later, the same authors further redesigned the evaluation criteria with 214 dichotomous questions in 12 broad categories (Madhusudhan and Shalini, 2014).

Singh and Sanaman (2012) developed a comprehensive checklist based on previous checklists. The ILMS evaluation checklist consisted of ten categories of items (not equal in significance) with 223 features which included the characteristics of the ILMS, general features of the ILMS, technology in design and architecture, database features, core module functionalities, format and standard implementation, software and digital content, ease to use and updates, downloads and documentation and other enhanced features. Surprisingly, this checklist paid no attention to ranking the studied ILMSs (i.e.

Koha and NewGenLib). The evaluation approach taken in the present study is similar to that of Singh and Sanaman (2012) and Madhusudhan and Shalini (2014) with minor modifications and comprises 306 features/functions categorized in ten broad categories, namely:

(1) characteristics of the ILMS;
(2) core modules;
(3) acquisition module;
(4) cataloguing module;
(5) serial control module;
(6) circulation module;
(7) web OPAC features;
(8) article indexing;
(9) Web 2.0/3.0 features; and
(10) other enhanced features.

Previous studies identified relatively new features and improved versions of the studied ILMSs, such as features of Web 2.0 and some of the features related to cloud computing. For example, social media services, such as Facebook and Twitter, provide reasonable substitutes for the community bulletin board, and inventory control is a sub-function of the circulation module (Fayen, 2011). It would be interesting to examine if the selected ILMSs under study have embedded such features and components. In other words, this literature can be applied for studying the ILMS features/functions in depth.

3. Overview of the selected integrated library management systems

3.1 Koha

Koha is an ILMS developed by Katipo Communications for the Horowhenua Library Trust in New Zealand in 1999, with the first installation in January 2000. Since the original implementation, Koha functionality has been adopted by thousands of libraries worldwide, each adding features and functions, deepening the capability of the system. From 2000, companies started providing commercial support for Koha, building to more than 20 today. In 2001, Paul Poulain (of Marseille, France) began adding many new features to Koha, most significantly support for multiple languages. Support for the cataloguing and search standards machine readable catalogue (MARC) and Z39.50 was added in 2002. The Athens County Public Libraries sponsored the 3.0 release in 2005, and with the integration of the powerful Zebra indexing engine, Koha became a viable, scalable solution for libraries of all kinds. By 2010, Koha had been translated from its original English into French, Chinese, Arabic and several other languages. It is under general public license (GNU) license (Koha, 2013).

3.2 NewGenLib

NewGenLib is an ILMS developed by Verus Solutions Pvt Ltd. Domain expertise is provided by Kesavan Institute of Information and Knowledge Management (KIIKM) in Hyderabad, India. NewGenLib version 1.0 was released in March 2005. On 9 January 2008, NewGenLib was declared OSS under the GNU GPL Licence by Verus Solutions. Currently, NewGenLib 3.0.R1 is the latest version running. It is estimated that 2,500

libraries across 58 countries are using NewGenLib as their primary ILMS (NewGenLib, 2013).

3.3 Libsys

Libsys, a New Delhi-based software company, has been engaged in providing software solutions since 1984. Continuous growth for the past 30 years has made Libsys the most trusted brand for libraries in India. Its wide acceptance in the market strengthens its popularity as the most field-proven library system with unmatched depth in functionality and features, and continuous growth is reflected in research and development efforts which have led to the incorporation of the latest technology features and globally accepted standards from time to time (Libsys, 2013).

3.4 Virtua

Virginia Tech Library System (VTLS) is a leading global company which provides library automation solutions to a diverse customer base of more than 900 libraries in 37 countries. As providers of library solutions for more than 30 years, VTLS has a deep and broad knowledge of the current needs of libraries and information centres. At the same time, VTLS is also an innovative leader in developing cutting-edge products for libraries' future needs. Virtua is the first Unicode-compliant ILMS, the first to incorporate functional requirements for bibliographic records (FRBR) functionality and the first to support resource description and access (RDA) implementation (VTLS, 2013).

4. Objectives of the study

The main objective of the study is to compare the different features of the ILMSs. In particular:

- to identify the top four ILMSs from OS and commercial;
- to know the different features/functions in each module of the ILMSs;
- to identify criteria for analysis of different features/functions of the ILMSs;
- to compare and rank the studied ILMSs based on features/functions; and
- to help librarians to become more aware of the different features of selected OS and commercial ILMSs.

The present study is limited to the analysis of the features of two ILMSs each in OS and commercial installations: that is, Koha and NewGenLib (OS) and Libsys and Virtua (commercial).

The structured evaluation checklist was designed keeping in view the stated objectives and literature available so as to examine the various features and functions of the ILMSs, and it is divided into two parts, qualitative analysis and quantitative analysis.

5. Data analysis and interpretation

Testing of the checklist took place from 10 April to 10 June 2013. During this period, a total of 40 hours were spent on observing different features and functions of the ILMSs under study for consistent results. At the time of the testing period, the versions of each of the ILMSs were: Koha 4.10 LiblimeKoha, NewGenLib 3.04 R1, Libsys 7 and Virtua 48.0. All of the studied ILMSs were on the operating system platforms Linux and Windows.

6. Qualitative analysis of the integrated library management systems

The qualitative part of the checklist contains 26 features, which serves as a recording device for descriptive data. For the most part, this information is obtained from the ILMS's home page and its documentation. It does not give any numerical value. Table I presents the characteristics of the ILMSs.

Table I reveals that Koha provides unrestricted use of the software to its clients and is more transparent in comparison to NewGenLib and Virtua, while Libsys provides restricted use to its clients. Koha provides its source code for configuration and customization, while NewGenLib provides only binaries for changes. There are more active community involvements worldwide in the developments of and interaction with Koha and NewGenLib. There is sufficient involvement of their user communities, whereas Libsys and Virtua do not. Compatible with international metadata, interoperability standards and standards requirements of the client library are the common features and were found in all of the studied ILMSs.

The various ILMSs are user-friendly in different aspects, Koha in terms of installation, NewGenLib in terms of functionality of modules, whereas Libsys and Virtua for their instant support. Koha has a consistent updating process of the software

Table I.
Characteristics of the integrated library management systems

Serial no.	Characteristics	Integrated library management system			
		Koha	NewGenLib	Libsys	Virtua
1	Transparency (unrestricted use)	×	×		×
2	Community involvement	×	×		×
3	Interoperability	×	×	×	×
4	Comprehensiveness	×	×	×	×
5	User friendly	×	×	×	×
6	Active development status	×	×	×	×
7	Supports multi-user and multiple security levels	×	×	×	×
8	Usability	×	×	×	×
9	Granularity	×			×
10	Flexibility	×	×	×	×
11	Expandability	×	×		×
12	Version	4.10	3.0.4 R1	Libsys 7	48.0
13	Server and client architecture	×	×	×	×
14	Linux and Windows compatible	×	×	×	×
15	Programming language	Perl	Java	C/C++	Java
16	Toolkit	×	×	×	×
17	Application server	×	×	×	×
18	Web server	×	×	×	×
19	Database server	×	×	×	×
20	Backup	×	×	×	×
21	Browser compatibility	×	×	×	×
22	Data migration services	×	×	×	×
23	Technical support after installation	×	×	×	×
24	Web-based interfaces/modules	×	×	×	×
25	Customization	×	×	×	×
26	Network and standalone	×	×	×	×
Score (maximum 26)		26	25	22	26

as a whole and active development status with frequent updates, and the other ILMSs are not updated regularly, but support multi-user and multi-security levels. Interestingly, the usability of the software is good. Surprisingly, Koha and Virtua have granularity, which describes various types of access permission given to select people who can use the site and help the administrator to edit and publish on a site, whereas this feature is not seen in NewGenLib and Libsys.

Koha is more flexible as compared to NewGenLib, Libsys and Virtua. Koha and NewGenLib are customized, modified and are expanded according to the requirement of the library and their patrons. This facility is not seen in Libsys and Virtua, because the source code is kept confidential by the system-providing commercial agency.

Koha is written in PHP and Perl, NewGenLib and Virtua in Java and Libsys in C/C++. Further, the ILMSs under study have the facility of toolkits and use application servers, web servers, database servers and also have a backup facility for data security. Moreover, browser compatibility through an Intranet is possible, and data migration services are present and provide technical support after installation and web-based modules. Additionally, customization, networking and stand-alone features are present in all of the ILMSs under study.

Table I indicates that 95.2 per cent scored by the studied ILMSs in this part. The highest scoring is provided by Koha and Virtua with 100 per cent, and the lowest scoring ILMS is Libsys with 84.6 per cent. However, these qualitative scores are not meant to assign rankings to the ILMSs, but they are nevertheless useful to know about the different characteristics of each ILMS.

7. Quantitative analysis

The quantitative part of the checklist contains 170 dichotomous questions and 280 features/functions relating to nine categories, namely:

(1) core modules;
(2) acquisition module;
(3) cataloguing module;
(4) serial control module;
(5) circulation module;
(6) web OPAC features;
(7) article indexing;
(8) Web 2.0/3.0 features; and
(9) other enhanced features.

Each time a cell (i.e. specific feature in the checklist) was checked (marked "x"), one point was assigned to the respective feature of the ILMS concerned. The score for a system is the total number of cells checked for those ILMSs. Each part has a set of related questions, and the responses of each part and their sub-parts were analyzed with the help of tables followed by the interpretation of the data.

7.1 Core modules of the integrated library management systems

Core modules of the ILMSs are functional working features of an ILMS. These vary from one ILMS to another depending on architecture and design. In general, the core

modules are: acquisition, cataloguing, serial control, circulation, web OPAC and other enhanced features. Table II presents the core modules of the ILMSs under study.

Table II reveals that the majority of the studied ILMSs received good scores for this section, except for article indexing, but core modules have a different view of functionality. The highest scoring ILMS is Virtua and Libsys with 100 per cent, followed by NewGenLib and Koha with 83.3 per cent. However, this is not the final assessment. The final assessment should take into account all the features of an ILMS. Therefore, the scores obtained in this table are consolidated with the other scores (the means were transferred to the total score) (Table XI).

7.2 Acquisition module

Acquisition module is one of the main modules of any ILMS and deals with ordering of library materials, monitoring their receipt, invoice processing and accessioning. It also maintains expenditures and budgets under a variety of accounts/headings. This module has 24 features, of which 6 are reporting features (Table III).

Table III reveals that the majority of acquisition features were found in almost all of the studied ILMSs, except claims for unfulfilled orders, currency code, electronic data interchange (EDI), standard address number (SAN), Unicode editor and new books listings. The main function of an acquisition module is to process requests for on-approval supplies, and this was present in all of the studied ILMSs, not only firm orders functionality but also facilities for receiving orders and deleting invoices. Further, all of the studied ILMSs have processing of gifts and donations, as well as accessioning of received items. Once the accession number is entered into the ILMS, sometimes it needs to be deleted. This function is found in all the studied ILMSs. Interestingly, the processing of invoice payments exists in all of the studied ILMSs.

Claims for unfulfilled orders are processed easily from Koha, NewGenLib and Virtua, but not Libsys. Currency code, EDI, Unicode editor and new books listings are found in 75 per cent of the ILMSs, followed by SAN found in 50 per cent. On the other hand, acquisitions statistics are able to be generated by all of the studied ILMSs. The preparation of order cards/slips is present in Koha and Virtua, whereas the print-out of received or non-supplied documents is not found in Libsys. Reporting functions, such as status of orders, request and funds, are present in all ILMSs, except NewGenLib.

Table III shows that the majority of the ILMSs received a good score for their acquisition module. The highest scoring ILMS is Virtua with 100 per cent and the least

Table II.
Core modules of the integrated library management systems

Serial no.	Core module	Integrated library management systems			
		Koha	NewGenLib	Libsys	Virtua
1	Acquisition	×	×	×	×
2	Cataloguing	×	×	×	×
3	Serial control	×	×	×	×
4	Circulation	×	×	×	×
5	Web OPAC	×	×	×	×
6	Article indexing			×	×
Score (maximum 6)		5	5	6	6

Serial no.	Acquisition functions and reports	Integrated library management systems			
		Koha	NewGenLib	Libsys	Virtua
1	Acquisitions administration	×	×	×	×
2	Acquisitions system preferences (configuration)	×	×	×	×
3	Process request	×	×	×	×
4	Processing of on-approval supplies	×	×	×	×
5	Firm orders functionality	×	×	×	×
6	Receive orders	×	×	×	×
7	Delete invoices	×	×	×	×
8	Processing of gifts to the library	×	×	×	×
9	Accessioning of received items	×	×	×	×
10	Delete accession number	×	×	×	×
11	Processing of payments of invoices	×	×	×	×
12	Invoice payment details	×	×	×	×
13	Claims for unfulfilled orders	×	×		×
14	Currency code (ISO 4217)	×		×	×
15	Electronic data interchange (EDI)	×		×	×
16	Standard address number (SAN)			×	×
17	Unicode editor		×	×	×
18	New books listings	×		×	×
Reports					
19	Acquisitions statistics	×	×	×	×
20	Preparation of order cards/slips	×			×
21	Print-out of received or non-supplied document	×	×		×
22	Status of orders	×		×	×
23	Status of request	×		×	×
24	Status of funds	×		×	×
Score (maximum 24)		22	16	21	24

Table III.
Acquisition module

scoring ILMS is NewGenLib with 66.6 per cent. However, again, this is not the final assessment, and the consolidated assessment is provided in Table XI, wherein other scores are also integrated with the above data.

7.3 Cataloguing module

The key concept behind cataloguing today is access to internal tools and resources (Hussain and Ansari, 2007). The cataloguing module provides various orders maintained in traditional libraries and makes available instant listings under a variety of searchable fields to suit the requirements of a modern library. In addition to the data entry facility, the system has additional functionality to accept data in standard machine readable formats, such as common communication format and MARC, making it possible for the ILMS to import/export bibliographic data in standard exchange formats, thus meeting the specific requirements of the library. The cataloguing module has 30 functions, including report features (Table IV).

Table IV indicates that most of the cataloguing features are found in all of the studied ILMSs. Search catalogue functionality, open archive initiative-protocol for

Serial no.	Cataloguing functions and reports	Integrated library management systems			
		Koha	NewGenLib	Libsys	Virtua
1	Catalogue administration	×	×	×	×
2	Technical processing and database development parameters (configuration)	×	×	×	×
3	Items ready for technical processing	×	×	×	×
4	Copy catalogue or import of catalogue records	×	×	×	×
5	Primary or original cataloguing	×	×	×	×
6	Modify catalogue records	×	×	×	×
7	Search catalogue functionality	×	×	×	
8	OAI-PMH		×	×	×
9	Cataloguing scope				×
10	Article level		×	×	×
11	Customization of additional collections		×	×	×
12	Search databases (federated)	×	×	×	×
13	Cataloguing for web resources (856 field)	×	×		
14	Search the Internet along with query	×	×	×	×
15	Authorities	×		×	×
16	Cataloguing guides	×			×
17	Printing of catalogue in AACR-II format	×	×	×	×
18	Printing of catalogue in CCC format	×	×	×	×
19	Printing of catalogue in tagged format (MARC)	×	×	×	×
20	Language list	×		×	×
21	Generating spine labels	×		×	×
22	Barcode generation	×		×	×
23	Union cataloguing	×	×	×	×
24	Z39.50 client and server for data interchange	×		×	×
25	Copy cataloguing using Z39.50	×		×	×
26	Retro conversion	×	×	×	
27	Library standards compliant with MARC 21	×	×	×	×
Reports					
28	List of new catalogue records	×		×	×
29	List of new or dropped authority terms	×		×	×
30	Catalogue statistics	×	×	×	×
Score (maximum 30)		26	20	27	27

Table IV.
Cataloguing module

metadata harvesting, article level, customization of additional collections, authorities, printing of catalogue in tagged format (MARC), language list, generating spine labels, barcode generation, Z39.50 client and server for data interchange, copy cataloguing using Z39.50 and retro conversion features are found in 75 per cent of the ILMSs, whereas 50 per cent of the ILMSs are facilitating cataloguing for web resources (856 field) and cataloguing guides. Surprisingly, the Virtua ILMS has a cataloguing scope functionality, while the others do not. In reporting functions, catalogue statistics is a common reporting function, and the listing of new catalogue records and listing of new or dropped authority items are expedited by 75 per cent of the studied ILMSs.

Table IV indicates that the majority of the studied ILMSs received good scores in their cataloguing modules. The highest scoring ILMS is Virtua and Libsys with 90.0 per cent, and the least scoring ILMS is NewGenLib with 66.7 per cent.

7.4 Serial control module

The serial control module provides control of periodical subscriptions and subsequent monitoring of the scheduled arrival of individual issues. It maintains records of the budget sanctioned for serials under different categories, both amounts encumbered and expended, thus providing complete budgetary control. It also handles serials which are received gratis or in exchange. The serial control module has 18 features, and the reporting features are presented in Table V.

Table V reveals that the average scores of the studied ILMSs is 76.4 per cent in this module. Many serial control features/functions are common and are found in all the studied ILMSs. Interestingly, the subscription option in staff client is present in Koha, whereas subscription in OPAC was present in Koha and Libsys. Binding management was present in NewGenLib, whereas field 863 MARC tags are found only in Koha and Virtua. Some other holding functions, such as add holding notes and textual holdings functionality, are present in Koha and Virtua.

Table V indicates that the majority of the ILMSs (except NewGenLib) received a good score for the serial module. The highest scoring ILMS is Koha with 88.9 per cent, and the least scoring ILMS is exactly half the score of Koha; that is, NewGenLib with 66.1 per cent.

Table V.
Serial control module

Serial no.	Serial functions and reports	Integrated library management systems			
		Koha	NewGenLib	Libsys	Virtua
1	Serials administration	×	×	×	×
2	Serials management parameters (configuration)	×	×	×	
3	Process subscriptions	×	×	×	×
4	Register serials issues	×	×	×	×
5	Receive serial issues	×	×	×	×
6	Create a routing list	×	×	×	×
7	Subscriptions in staff client	×			
8	Subscriptions in OPAC	×		×	
9	Renew subscriptions	×	×	×	×
10	Binding management			×	
11	863 MARC tag (enumerator and chronology option)	×			×
12	*Holding features*				
	Add holding notes	×	×		×
	Textual holdings	×	×		×
	Add special issues	×	×	×	×
	Add supplements and indexes			×	×
Reports					
13	List of serials holdings	×		×	×
14	Serial reminders and claimers	×		×	×
15	Serials statistics	×	×	×	×
Score (maximum 18)		16	11	14	14

7.5 Circulation module

The circulation system maintains up-to-date membership records, as well as the latest status of the collection meant for circulation. It performs all the functions related to circulation, providing suitable checks at every stage and takes care of infrequent but routine functions, such as bindery record management, books on display in the library, latest additions to the library and so forth. The circulation module has 32 features, of which 26 are circulation functions and the remaining are reporting features. The availability of the above features in the studied ILMSs is presented in Table VI.

Table VI reveals that the average scores of the studied ILMSs in the circulation module is 83.6 per cent. Circulation administration and circulation set-up parameters for

		Integrated library management systems			
Serial no.	Circulation features/functions	Koha	NewGenLib	Libsys	Virtua
1	Circulation administration	×	×	×	×
2	Circulation set up parameters (configuration)	×	×		×
3	Check-in	×	×	×	×
4	Check-out	×	×	×	×
5	Reservations functionality	×	×	×	×
6	Circulation messages	×	×	×	×
7	Transfers	×		×	×
8	Renewal of loans	×	×	×	×
9	Short-term loans		×	×	×
10	Set library	×			×
11	Fast add cataloguing	×		×	×
12	Tracking in-house use	×		×	×
13	In processing/book cart locations	×			×
14	Offline circulation utility	×	×		×
15	Binding/inventory management		×	×	×
16	Collect overdue	×	×		×
17	Integration of RFID	×	×	×	×
18	Weed out process		×	×	×
19	Circulation alert	×		×	×
20	Patrons with most check-outs	×		×	×
21	Most circulated items	×		×	×
22	Patron with no check-outs	×		×	×
23	Lost items	×	×	×	×
24	Average loan time	×		×	
	Reports				
25	Patron statistics	×	×	×	×
26	Circulation statistics	×	×	×	×
27	Book status	×		×	×
28	Book issue history	×		×	×
29	Period-wise issue history	×	×	×	×
30	Overdue notice production	×	×	×	×
31	Production of membership cards	×	×	×	×
32	List of members	×	×	×	×
Score (maximum 32)		29	20	27	31

Table VI.
Circulation module

configuration are available in both Koha and NewGenLib with variations in their options and sub-options. Koha has functionality for checking items out, check-out messages, warnings and e-mail check-out slips, whereas NewGenLib has functionality for patron, inter library loan (ILL) requesting library and ILL requesting patron. Check-in or return of items includes checking items in and check-in messages in Koha, whereas item barcode and print consolidated check-in slips are possible in NewGenLib. The reservations functionality for items (i.e. place, manage, receive, cancel and search catalogue) is possible in Koha and NewGenLib.

Circulation messages are allowed in Koha. Defining library transfer limit option and renewal of loans (on library/item type/category code level) are not found in NewGenLib. Short-term loans functionality is not available in Koha, whereas set library is present in Koha and Libsys. Further, fast add cataloguing and tracking in-house use are not present in NewGenLib. In processing/book cart locations is available in Koha and Virtua. Offline circulation utilities are not present in Libsys, but binding/inventory management with the separation of items requiring binding, check-out items to binders and recall document are present in Libsys and Virtua. Integration of RFID is a common feature. The weed out process is not found in Koha.

Circulation alerts, patron with most check-outs, most circulated items and patron with no check-outs are present in 75 per cent of the ILMSs. Further, lost item functionality is a common feature, but average loan note is present in only 50 per cent of the ILMSs. In reporting functions, patron and circulation statistics, period-wise issue history, overdue notice production of membership cards and listing of members are common features. Book status and book issue history is not present in NewGenLib.

It is observed from Table V that Koha supports more functions than NewGenLib under the open access ILMSs. In the commercial ILMSs, Virtua has more advanced features than Libsys, which meets the requirements of all types of libraries with sophisticated use of technology.

Table VI indicates that the majority of the ILMSs received good scores regarding their circulation modules. The highest scoring ILMS is Virtua with 96.9 per cent, and the least scoring ILMS is NewGenLib with 62.5 per cent.

7.6 Web online public access catalogue

OPAC is considered to be the heart of library operations (Madhusudhan and Shalini, 2011), as it facilitates patrons having access to various services of the library. An OPAC which is accessed via the library's website is referred to as a web OPAC. It has revolutionized library services for three reasons:

(1) it offers up-to-date information;

(2) it offers multi-access points to the information held in the library; and

(3) it enables access to information in local, regional or national networks.

Web OPAC functionality makes up the largest group of features in this study, consisting of 19 questions and 74 features (Table VII).

Table VII clearly indicates that browsing and searching are two main paradigms for finding information online. Browsing makes the content come alive and satisfies the hunger for information for the users who get positive reinforcement as they proceed.

Serial no.	OPAC features	Integrated library management systems			
		Koha	NewGenLib	Libsys	Virtua
1	*Offers types of searches*				
	Basic search/keyword	×	×	×	×
	Advance search	×	×	×	×
	Truncation search			×	×
	Boolean operators	×	×	×	×
	Parenthesis search			×	×
	Proximity search			×	×
	Browse search				×
	Exact matching			×	×
2	*Full search capability on conventional access points*				
	Title	×	×	×	×
	Keyword any where	×	×	×	×
	Keyword (using and, or, not)	×	×	×	×
	Publisher name	×		×	
	Publication place	×		×	
	Publication date			×	
	Series	×		×	
	Author or editor or organization	×	×	×	×
	Subject	×	×	×	×
	Class number (or call number)	×	×		
	ISBN	×	×	×	×
	ISSN (serials)				×
	LCCN				×
	Theses			×	
	Notes				
	Abstract				
	Table of content		×		
	Accession number			×	
	Imprint				×
3	*Hypertext links in full bibliographic record display*				
	Authors	×	×	×	×
	Title	×	×	×	×
	Subject	×		×	×
	Call number	×		×	
	Series				
	Location map				
	Edition				×
	Imprint				×
4	*Setup files*				
	Publication				×
	Format				×
	Language				×
	Context year				×
	Nature of content				×
	Place of publisher				×

Table VII.
Web OPAC features

(*continued*)

Serial no.	OPAC features	Integrated library management systems Koha	NewGenLib	Libsys	Virtua
5	Access to Z39.50	×		×	×
6	Results can be printed	×	×	×	×
7	Search results can be saved	×	×	×	×
8	E-mailed search results				×
9	Search results can be added to the user's list	×	×		×
10	Interface with the circulation system	×	×	×	×
11	Provision for exporting/downloading of retrieved records	×	×		×
12	Provision for the transmission of retrieved records through e-mail	×	×		×
13	Provision for options, such as ILL, renewal, reservations, etc.	×		×	
14	*Links to external sources*				
	Free sources selected on the Internet (URL)	×	×	×	×
	Links to book review	×	×		
	Links to table of contents companion and supplemental materials	×	×		
	Links to e-journals and e-books	×	×	×	
15	Online tutorial provided		×	×	×
16	Help messages provided		×	×	×
17	Spell check software available to the user		×		
18	*OPAC 2.0 features*				
	Relevancy ranking (not just sort)	×	×		
	Reviews (professional)	×	×		
	User reviews and ratings		×		×
	"More like this" suggestions				
	User-added tags (internal)				
	Del.icio.us tagging				
	Customer written reviews				×
	"E-mail this link"		×		
	"Text this link"				
	RSS feed from the search		×		
	Citation creator (formats)				
	Saved items/formats	×	×	×	×
	Built in open URL resolver			×	×
	Breadcrumb trail				
	Incorporate outside content			×	×
	Accessibility (poor, fair, good, excellent)			×	×
19	Catalog by item type	×			×
Score (maximum 74)		33	32	36	46

Notes: LCCN = Library of congress control number; ISSN = international standard serial number

Table VII.

Web-based OPACs offer different types of searches. Basic/keyword search, advance search and Boolean operators are common features, whereas truncation search, parenthesis search and proximity search are found only in Libsys and Virtua. Browse search is present in Virtua.

All of the studied ILMSs offer the features of full search capability on conventional access points, whereas publisher name, publisher place and series are only present in Koha and Libsys. Koha and NewGenLib offer searches through class number (or call number). Libsys offers search through publication date, accession number and thesis. Virtua offers LCCN, ISSN (serial) and imprint search options. Interestingly, searching through notes and abstracts is not found in any of the studied ILMSs.

Hypertext links in the full bibliographic record display offered through author and title are common features and are found in all of the studied ILMSs. Call number is surprisingly offered only by Koha and Libsys. Other features, such as publication, format, language, year, nature of content and place of publisher, are available only in Virtua. Access to Z39.50 features is not found in NewGenLib. The e-mail facility for sending OPAC search results is found solely in Virtua.

The search result can be added to the user's list, provision for exporting/downloading of retrieved records and provision for the transmission of retrieved records through e-mail are unseen features in Libsys, whereas an interface with the circulation system is common across all ILMS. The provision for inter-library loan, renewal, reservations and so forth is available in Koha and Libsys. All of the studied ILMSs offer to link to external free sources selected on the Internet, but link to book review and link to table of content companion and supplemental material are just present in Koha and NewGenLib. Interestingly, links to e-journals and e-books are not found in Virtua. Online tutorials and help messages are valuable features for users for effective searching of the web OPAC; yet they are not accessible in Koha. NewGenLib offers spell check software to the user.

With the advent of new technologies, particularly Web 2.0, features for searching are growing at a rapid rate. Koha and NewGenLib offer relevancy ranking (not just sorting) and reviews (professional), whereas user reviews and ratings are found in NewGenLib and Virtua. Interestingly, the customer written reviews option is available in Virtua. Surprisingly, features like "e-mail this link" and RSS feeds from the searches are present in NewGenLib. Saved item/formats are part of all of the studied ILMSs, whereas built-in open URL resolver, incorporate outside content and accessibility (poor, fair, excellent) are present in Libsys and Virtua. None of the studied ILMSs have OPAC 2.0 features like breadcrumb trail, citation creator (format), text this link, Del.icio.us and tagging. This is a clear indication that the studied ILMSs are lacking OPAC 2.0 features and need improvement for present-day users.

Table VII indicates that the majority of the ILMSs did not receive a good score for their web OPAC. The highest scoring ILMS is Virtua with 62.2 per cent, and the least scoring ILMS is NewGenLib with 43.2 per cent.

7.7 Article indexing

Article indexing provides the facility to create and maintain a separate articles database and facilitates special services, such as SDI, listing of current articles, bibliographies and so forth. The article indexing part has ten features (Table VIII).

Serial no.	Article indexing features	Integrated library management systems: Koha	NewGenLib	Libsys	Virtua
1	Article indexing		×	×	×
2	Current awareness service (CAS)		×	×	
3	Selective dissemination of information (SDI) service		×	×	×
4	Full text searching	×	×	×	
5	Data import/export	×	×	×	×
6	*Online searches*				
	Author	×		×	×
	Title	×		×	×
	Subject	×		×	×
	Title keyword	×		×	×
	Combination search	×		×	×
Score (maximum 10)		7	5	10	8

Table VIII.
Article indexing

Table VIII reveals that CAS is available in NewGenLib and Virtua, while SDI is present in all of the studied ILMSs, except Koha. Full text searching is not possible in Virtua. The data import/export function is a common feature, and online searches are provided by Koha, Libsys and Virtua.

The majority of the ILMSs received an average of 67 per cent concerning their ability to index articles. The highest scoring ILMS is Virtua with 100 per cent, and the least scoring ILMS is NewGenLib with 50 per cent.

7.8 Web 2.0/3.0 features

Web 2.0/3.0 features are those features which have been added by the software-providing agencies, because of user demand. Today, every user wants information in a flash and only the information which are of his/her need which was not possible before the advent of these features in these ILMSs. This module has 15 features, and Table IX presents the advanced features related to Web 2.0/3.0 and cloud computing in the ILMSs under study.

Table IX shows that RSS feeds are present in 75 per cent of the ILMSs, whereas SMS alerting is not present in Libsys but is in all of the other ILMS. Blog feature is not present in Virtua, while wiki functionality is present only in NewGenLib. Web 2.0 services (Webex) are available in all of the studied ILMSs, but instant messaging is present only in Koha and NewGenLib. SNSs are the part of NewGenLib and Virtua.

Tag clouds in an OPAC is a way of visually displaying subjects to communicate content in the library, and tagging allows users to understand terms as it reflects socio-cultural backgrounds or depth of subject knowledge. By adding tagging systems to OPACs, libraries create more potential access points, and users can see what libraries have to offer, but these are typically used in library OPACs. Cloud computing features, such as WorldCat and cloud-based automation system, are present in Koha and Libsys, whereas discovery layer/services are present in Libsys and Virtua. LibraryThing is present in Libsys. Software as a service (SaaS) is present in Libsys and Virtua, and infrastructure as a service (IaaS) is present in NewGenLib and Vitua. Interestingly, platform as a service (PaaS) is present in Libsys.

Serial no.	Web 2.0/3.0 features	Integrated library management systems: Koha	NewGenLib	Libsys	Virtua
1	RSS feeds	×		×	×
2	SMS alert			×	
3	Blog	×	×	×	
4	Wiki		×		
5	Web 2.0 services (Webex)	×	×	×	×
6	Instant messaging	×	×		×
7	Social networking sites (SNSs)		×		×
8	*Cloud computing features*				
	Discovery layer/services			×	×
	WorldCat	×		×	
	Cloud-based automation system	×		×	
	LibraryThing			×	
	SaaS (software as a service)			×	×
	IaaS (infrastructure as a service)		×	×	
	PaaS (platform as a service)			×	
9	RSS feed for new acquisition/search updates	×		×	
Score (maximum 15)		7	6	12	6

Table IX.
Web 2.0/3.0 features

As shown in Table IX and by this discussion, only Libsys scored well. The other three studied ILMSs scored less than 50 per cent in terms of Web 2.0/3.0 features. The highest scoring ILMS is Libsys with 80 per cent, and the least scores are held by NewGenLib and Virtua, each with 40 per cent.

7.9 Other enhanced features

Other enhanced features are an essential part of the ILMS, especially downloads, documentation, training, extended bibliographical services, ease to use and updates, and this section provides the second largest group for analysis, consisting of 31 questions and 71 features. Table X presents the features and updates related to other enhanced features of the ILMS under review.

Table X reveals that the OS, as well as the commercial, ILMSs have the hot keys option (i.e. Ctrl + A and Ctrl + C in NewGenLib; Alt + Q, Alt + R and Alt + U in Koha, NewGenLib, Virtua and Libsys). New features are added frequently in Koha and Virtua, while new features are added with full release of new versions of NewGenLib and Libsys. Next, SIP2 integer is not present in NewGenLib. Patron services in Koha provide online reservations and borrower purchase suggestion support and NewGenLib, but Libsys and Virtua provide only simple forms of patron services. The generation of no-dues certificate is possible in NewGenLib, Libsys and Virtua. An advanced and sophisticated searching feature is available in Koha, Libsys and Virtua. Location map is present in NewGenLib, Libsys and Virtua, which saves time, energy and other resources. All of the studied ILMSs are used as commercial management software. Interestingly, live options are not available in any OS studied ILMS.

Some of the extended bibliographic services, such as book reviews and TOC, are present in all of the studied ILMSs, whereas summaries and annotation, excerpts, author notes, basic cover image and mobile data are present in Koha, Libsys and Virtua, but

Serial no.	Other enhanced features	Integrated library management systems Koha	NewGenLib	Libsys	Virtua
1	Important links	×	×	×	×
2	Hot keys	×	×	×	×
3	Website	×	×	×	×
4	Addition of new feature	×			×
5	SIP2 integration	×		×	×
6	Patron services	×	×	×	×
7	Generation of no due certificate		×	×	×
8	Advance and sophisticated searching feature	×		×	×
9	Location map		×	×	×
10	Used as commercial management software	×	×	×	×
11	Live option			×	×
12	*Extended bibliographical services*				
	Book review	×		×	×
	Table of contents (TOC)	×	×	×	×
	Summaries and annotations	×		×	×
	Excerpts	×		×	×
	Author notes	×		×	×
	Basic cover image	×		×	×
	Mobile data	×		×	×
	Video trailer			×	×
13	Authority file and controlled vocabulary	×	×	×	×
14	Z39.71 and Z39.76 for display of serial holding		×	×	
15	Zebra search engine	×			×
16	Arabic version		×	×	×
17	Uses open source components	×	×		
18	Compatibility with international metadata and interoperability standards	×	×	×	
19	No vendor lock-in	×	×		
20	Configurable form letters (XML-based)	×	×	×	
21	Stock taking	×	×	×	
22	Form letters		×	×	×
23	Dual database design	×		×	
24	*Software and digital content*				
	Digital library functionality module	×	×	×	×
	Ability to build digital content/library	×	×	×	×
	Ability to build repository	×	×	×	×
	Approach to use software as digital library	×	×	×	×
	Support digital content attachments/library management	×	×	×	×
	Technology required to design and develop digital library	×	×	×	×
	Stages of implementation	×	×	×	

(*continued*)

Table X.
Other enhanced features

Serial no.	Other enhanced features	Integrated library management systems: Koha	NewGenLib	Libsys	Virtua
25	*Downloads and documentation and training*				
	Source code compilation to end users	×			
	Binaries (particular OS) compilation links		×		
	Documents and notes for installation (particularly OS and version)	×	×	×	×
	User reference manual support	×	×	×	×
	Tutorials	×	×	×	×
	Demos	×	×	×	×
	Donate to development	×			
	Multimedia tour/videos		×	×	×
	Training	×	×	×	×
26	Metadata standards	×	×	×	
27	Language/character encoding standards	×	×	×	×
28	Web service protocols standards	×	×	×	×
29	LDAP authentication	×		×	×
30	*Ease to use and updates*				
	Discussion forums/mailing lists	×	×		×
	Frequently asked questions (FAQs)	×	×	×	×
	Project FAQ	×			×
	Telephone	×	×	×	×
	Bug track/troubleshooting	×	×		×
	Feature request system	×	×		×
	Error references	×			×
	Help desk support (paid/free)	×	×		×
	Open source community	×	×		×
	Real-time chat	×			×
	Presentations		×		×
	Book locator	×			×
	News/events	×	×		×
	User registration	×	×		×
	Commercial support	×	×		×
	E-mail support	×	×	×	×
	SMS-based support	×		×	×
	Glossary/definitions	×			
	Education collaboration programme		×		
	Evangelist programme		×		
	Updates		×		
31	Version updates	×			×
	Score (maximum 71)	59	49	47	56

Table X.

Note: LDAP = Lightweight directory access protocol

video trailer is present only in Libsys and Virtua. Authority file and controlled vocabulary are common features. Z39.71 and Z39.76 for display of serial holding are present in NewGenLib, Libsys and Virtua. The Zebra search engine exists in Koha and Virtua.

NewGenLib, Libsys and Virtua have Arabic version features, and the same three have compatibility with international metadata and interoperability standards. The facility of no vendor lock-in is present in Koha and NewGenLib. Koha, NewGenLib and Libsys are XML-based, and stock taking is present in the same ILMSs. Form letter is present in NewGenLib and Libsys. The feature of dual database is present in Koha and Libsys. Some of the features of software and digital content, such as digital library functionality module, ability to build digital content/library, ability to build repository, approach to use software as digital library, support digital content attachments/library management, technology required to design and develop digital library and stages of implementation, are common features and are present in Koha, NewGenLib and Libsys. Koha provides source code to end users, and NewGenLib provides only a binary compilation link, whereas the other two studied ILMSs are not given such facility by the service/software-providing agency.

All of the studied ILMSs offer documents and notes for installation, user reference manual support, tutorials and demo features. Multimedia tour/video is provided in NewGenLib, Libsys and Virtua, whereas training for staff is available in all of the studied ILMSs. LDAP authentication is present in Koha, Libsys and Virtua. Some ease of use and update features and discussion forum/mailing list are present in Koha and NewGenLib. Frequently asked question (FAQ) feature is present in Koha, NewGenLib and Libsys, but project FAQ is present in Koha as well. Help through the telephone is available in all of the studied ILMSs, whereas bug track/troubleshooting feature request systems, help-desk support (paid/unpaid), OS community, news/events, user registration and commercial support are present in Koha and NewGenLib. E-mail support is present in all of the studied ILMSs, but SMS-based support is present in Koha and NewGenLib. Error references, real-time chat and glossary/definitions are present in Koha. Presentations are given in NewGenLib, but not in any of the other ILMSs. The book locator function is present in Virtua. Further, education collaboration programme and evangelist programmes are present in the NewGenLib ILMS. Interestingly, the update of version is present frequently in Koha, and NewGenLib is less frequently updated, but in the other ILMSs, they are updated after some interval of the earlier version.

Table X indicates that the average score in this module of ILMS is 77.1 per cent. The highest score in the studied ILMSs is by Virtua with 88.7 per cent, and the least scoring ILMS is Libsys with 67.6 per cent. Interestingly, the highest and lowest scored ILMS belong to commercial brands.

8. Total scores of the studied integrated library management systems

The total score of the studied ILMSs is presented in Table XI. Calculations are based on the data shown in Tables II-X.

Table XI reveals that the highest score in the studied ILMSs is received by Virtua which is 77.9 per cent, followed by Koha with 72.9 per cent and Libsys with 71.4 per cent. NewGenLib is the least scoring ILMS with 58.2 per cent.

9. Comparative feature-wise statement of integrated library management system

Table XII presents the comparative scores of the different features of the ILMSs as per the evaluation checklist and as compiled from previous tables.

Table XII reveals that among the nine categories, core module features received the highest average score of 91.7 per cent, followed by acquisition module features with 86.5 per cent. In contrast, web OPAC features are the weakest category with only 49.7 per cent. The results also indicate that some of the studied ILMSs reach the maximum scores in some categories. Graphical representation of Table XII is presented in Figure 1.

Figure 1 shows the mean, minimum and maximum percentages of the examined features. In general, the mean percentage of features related to core modules, acquisition,

Table XI.
Total scores of studied integrated library management systems

Table no.	Integrated library management system features (maximum score)	Koha	NewGenLib	Libsys	Virtua
1	Core modules (6)	5	5	6	6
2	Acquisition module (24)	22	16	21	24
3	Cataloguing module (30)	26	20	27	27
4	Serial control module (18)	16	11	14	14
5	Circulation module (32)	29	20	27	31
6	Web OPAC (74)	33	32	36	46
7	Article indexing (10)	7	5	10	8
8	Web 2.0/3.0 features (15)	7	6	12	6
9	Other enhanced features (71)	59	49	47	56
Score (maximum 280)		204 (72.9%)	163 (58.2%)	200 (71.4%)	218 (77.9%)

Table XII.
Comparative feature-wise analysis

Table no.	Integrated library management system features category	Maximum score	Total points awarded	% of maximum score
1	Core modules	24	22	91.7
2	Acquisition module	96	83	86.5
3	Cataloguing module	120	100	83.3
4	Serial control module	72	55	76.4
5	Circulation module	128	107	83.6
6	Web OPAC	296	147	49.7
7	Article indexing	40	30	75.0
8	Web 2.0/3.0 features	60	31	51.7
9	Other enhanced features	284	211	74.3

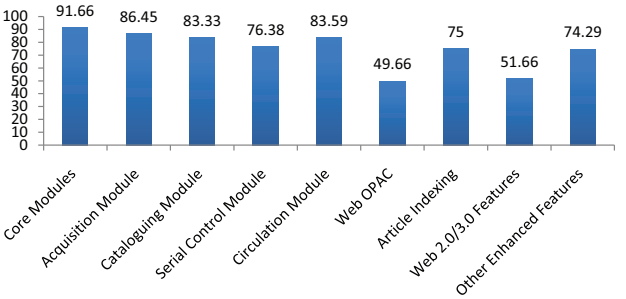

Figure 1.
Percentages of the integrated library management system features

cataloguing and circulation are high (above 86 per cent). In contrast, the features related to Web OPAC and Web 2.0/3.0 have a score of less than 51 per cent.

10. Rating scale for the ILMSs

Using data gathered from the analysis of the different features of the studied ILMSs, a numeric score was generated for each ILMS in the study. The rating scale was designed using intensity scales (Taylor-Powell, 2008) to range from "very high" to "very low" to rank the ILMSs under study. The five-point rating scale was fixed equally based on the maximum score of 280 points (Table XIII).

11. Ranking of the integrated library management systems

A ranking of the studied ILMSs on the basis of a five-point rating scale and points taken from Table XI is presented in Table XIV.

A cursory glance at Table XIV reveals that of the four ILMSs under study, none of them received a "very high" ranking; three of them received a "high", and the remaining one was ranked with a "low". Graphical representation of Table XIV is presented in Figure 2.

Figure 2 reveals that the Virtua ILMS receives the highest total score of 218 (77.9 per cent), followed by the Koha ILMS with a 204 score (72.9 per cent). Interestingly, the NewGenLib ILMS got the lowest total score (163, 58.2 per cent).

Range (score)	Rank
225-280	Very high
169-224	High
113-168	Medium
57-112	Low
01-56	Very low

Table XIII. Rating scale

Serial no.	Integrated library management system	Maximum score (280)	% of features	Rank
1	Virtua	218	77.9	High
2	Koha	204	72.9	High
3	Libsys	200	72.1	High
4	NewGenLib	163	58.2	Low

Table XIV. Ranking of the studied integrated library management systems

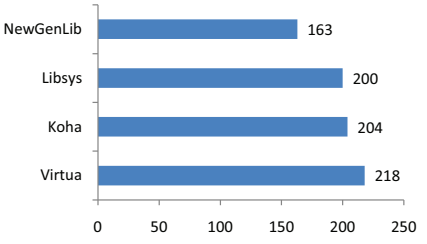

Figure 2. Total scores obtained by the integrated library management systems

It is generally true that the Virtua ILMS ranked higher than the other studied ILMSs, possibly due to its development having a specific team dedicated to either library automation issues or emerging technology issues, whereas the lower ranked ILMSs tended to have fewer personnel dedicated to these issues. The rating system proved to be an efficient and effective means of representing data collected in each part of the instrument.

The ranking table was especially helpful in bringing together all of the individual ILMS feature scores and then in generating a final composite rating. The system performed extremely well in accomplishing its original two goals:

(1) to provide quantitative indicators of quality; and

(2) to serve as a means of justification for quantitative data.

12. Suggestions

The comparative analysis of the studied ILMSs indicates that library professionals should expect the following changes:

- There is a need to release versions more frequently in NewGenLib, Libsys and Virtua as shown in the case of Koha.
- The selection of an ILMS needs to be more technically sound and user-friendly and should support more international standards.
- NewGenLib needs to develop its administration module and user documentation in comparison to Koha, whereas Libsys needs to be sounder in cloud computing features as in the case of Virtua.
- It is suggested that Koha be more compatible with various international languages for its efficient and effective use. Virtua to some extent fulfils these needs.
- Koha should focus on digital data creation and open access repositories as in case of NewGenLib, whereas Libsys should have more holding feature as in Virtua.
- The article indexing module is lacking in both of the OSS (i.e. Koha and NewGenLib) and needs incorporation of such features.
- All of the studied ILMSs should improve in various aspects with the help of Web 2.0/3.0 features to cope with the demands from collaborative age users.

13. Conclusion

The study analyzed in a step-by-step manner the features and functions found in different modules of Koha, NewGenLib, Libsys and Virtua. The number of features provides adequate data points for both qualitative and quantitative analysis. However, none of the surveyed ILMSs received the rank of "very high". The ranks clearly indicate that there is a need to further improve web OPAC and cloud computing features which are lagging behind in exploiting the full potential of Web 2.0 features. Virtua has more advanced features than Libsys which meets the requirements of all types of libraries with sophisticated use of technology. In contrast, NewGenLib has to improve features/functions in all modules, whereas each ILMS under study has its own features and limitations. All systems have to improve with variations in serial control, circulation, web OPAC and Web 2.0/3.0 features.

Further, these ranks clearly indicate that there is a need to improve the above features to survive in the present collaborative environment. It is true that there is no substitute or escape to avoid redesigning an ILMS with state-of-the-art web technologies and meeting the web challenges to strengthen their vital web-based library services is imminent. It is hoped that the ILMSs under study here are moving towards a next-generation ILMS. They need to provide live options, SMS-based support and reservations, link to e-journals and e-books, e-mailed search results option, book locator, spell check, searching through notes and abstracts, RSS feeds from the searches, online tutorials, easy to customize, modify, expend according to the requirement of the library, OPAC 2.0 features and help messages which are valuable features for users for effective search and for the betterment of the present-day users.

References

Anuradha, K.T., Sivakaminathan, R. and ArunKumar, P. (2011), "Open-source tools for enhancing full-text searching of OPACs: use of Koha, greenstone and fedora", *Program: Electronic Library and Information Systems*, Vol. 45 No. 2, pp. 231-239.

Bissels, G. and Chandeler, A. (2010), "Two years on: Koha 3.0 in ISE at the CAMLI hospital", *Program: Electronic Library and Information Systems*, Vol. 44 No. 3, pp. 283-290.

Breeding, M. (2007), "An industry redefined: private equity moves into the ILS, and open source support emerges", *Library Journal*, Vol. 132 No. 6, p. 36.

Dhanavandan, S. and Tamizhchelvan, M. (2012), "An evaluative study of automation software applications and database management systems in academic libraries", *Journal of Emerging Trends in Computing and Information Sciences*, Vol. 3 No. 5, pp. 677-682.

Dorman, D. (2008), "The potential of metasearching as an 'open' service", *Library Hi Tech*, Vol. 26 No. 1, pp. 58-67.

Fayen, E.G. (2011), "Integrated library systems", in Bates, M.J. and Maack, M.N. (Eds), *Encyclopedia of Library and Information Sciences*, 3rd ed., Taylor and Francis, Oxford.

Ghosh, T.K. and Panda, K.C. (2011), "Automated serials control at the Indian institutes of technology: an overview", *Program: Electronic Library and Information Systems*, Vol. 45 No. 2, pp. 173-184.

Griggs, K. (2009), "Library information made to order: an open source project built for and with the librarians", *Computers in Libraries*, Vol. 29 No. 2, pp. 12-47.

Hussain, S. and Ansari, M.A. (2007), "Library automation software packages in India: a study of the cataloguing modules of Alice for windows, Libsys and Virtua", *Annals of Library and Information Studies*, Vol. 54 No. 3, pp. 146-151.

Koha (2013), *Koha-open Source Integrated Library Management System*, available at: www.koha.org/ (accessed 2 April 2013).

Kumar, V. (2005), "Free/open source integrated library management systems: comparative analysis of Koha, PhpMyLibrary, and OpenBiblio", paper presented at the National Library Week Celebration, University of Calicut, Thenhipalam, available at: http://eprints.rclis.org/archive/00008074 (accessed 16 May 2014).

Kushwah, S.S., Gautam, J.N. and Singh, R. (2009), "Migration from CDS/ISIS to KOHA: a case study of data conversion from CCF to MARC 21", *International Cataloguing and Bibliographic Control*, Vol. 38 No. 1, pp. 6-10.

Libsys (2013), *LIBSYS – Library Management System*, available at: http://libsys.co.in/ (accessed 1 April 2013).

Lihitkar, R.S. and Lihitkar, S.R. (2011), "Ranking of selected library software packages in India", *Library Hi Tech News*, Vol. 28 No. 4, pp. 8-17.

Macan, B., Fernandez, G.V. and Stojanovski, J. (2013), "Open source solutions for libraries: ABCD vs KOHA", *Program: Electronic Library and Information Systems*, Vol. 47 No. 2, pp. 136-154.

Madhusudhan, M. and Shalini, A. (2011), "Web-based online public access catalogues of IIT libraries in India: an evaluative study", *Program: Electronic Library and Information Systems*, Vol. 45 No. 4, pp. 415-438.

Madhusudhan, M. and Shalini, A. (2014), "Online public access catalogues of selected university libraries in Delhi: an evaluative study", *World Digital Libraries*, Vol. 7 No. 1, pp. 15-42.

Muller, T. (2011), "How to choose a free and open source integrated library system", *OCLC Systems and Services*, Vol. 27 No. 1, pp. 57-78.

Neelakandan, B., Duraisekar, S., Balasubramani, R. and Ragavan, S.S. (2010), "Implementation of automated library management system in the school of chemistry Bharathidasan university using Koha open source software", *International Journal of Applied Engineering Research*, Vol. 1 No. 2, pp. 149-167.

NewGenLib (2013), *NewGenLib*, available at: www.verussolutions.biz/web/ (accessed 1 April 2013).

Pandey, S.R. and Singh, P.K. (2011), "Enabling ILAP as digital library software: a case study with KOHA", *Proceedings of the 8th International CALIBER 2011*, *Goa University, Goa*, *2-4 March*, pp. 254-264.

Pratheepan, T. (2013), *Integrated Library Management Systems (ILMS) – Open Source and Commercial Software: An Assessment of the Merits and Demerits*, Rochester, New York, NY.

Pruett, J. and Choi, N. (2013), "A comparison between select open source and proprietary integrated library systems", *Library Hi Tech*, Vol. 31 No. 3, pp. 435-454.

Rai, N. and Kumar, S. (2011), "Comparative features of integrated library management software", *The Electronic Library*, Vol. 29 No. 1, pp. 121-146.

Saxena, S.C. and Srivastava, R.K. (1998), "Evaluation of library software packages available in India", *DESIDOC Bulletin of Information Technology*, Vol. 18 No. 5, pp. 9-17.

Shafique, F. and Mahmood, K. (2008), "Integrated library software: a survey of Lahore", *Library Hi Tech News*, Vol. 25 No. 6, pp. 6-13.

Shalini, A. and Madhusudhan, M. (2011), "Evaluation of open source software-based OPACs of selected university libraries of east and west", *Journal of Library and Information Science*, Vol. 36 No. 1, pp. 87-113.

Singh, M. and Sanaman, G. (2012), "Open source integrated library management systems: comparative analysis of Koha and NewGenLib", *The Electronic Library*, Vol. 30 No. 6, pp. 809-832.

Sunil, M.V. and Harinarayana, N.S. (2011), "Evaluating OSILS product for Indian college libraries", *SRELS Journal of Information Management*, Vol. 48 No. 5, pp. 471-491.

Tajoli, Z., Carassiti, A., Marchitelli, A. and Valenti, F. (2011), "OSS diffusion in Italian libraries: the case of Koha by the consorzio interuniversitario Lombardo per l'elaborazione automatica (CILEA)", *OCLC Systems & Services: International Digital Library Perspectives*, Vol. 27 No. 1, pp. 45-50.

Taylor-Powell, E. (2008), "Ways to word answer choices in questionnaires", available at: www.uwex.edu/ces/4h/evaluation/documents/Waystowordanswerchoicesinquestionnaires.pdf (accessed 22 January 2016).

Trainor, C. (2009), "Open source, crowd source: harnessing the power of the people behind our libraries", *Program: Electronic Library and Information Systems*, Vol. 43 No. 3, pp. 288-298.

Vasupongayya, S., Keawneam, K., Sengloilaun, K. and Emmawat, P. (2011), "Open source library management system software: a review", *World Academy of Science, Engineering and Technology*, Vol. 77 No. 1, pp. 973-978.

VTLS (2013), *Virginia Tech Library System*, available at: www.iii.com/products/vtls-virtua (accessed 2 April 2013).

Wang, Y. and Dawes, T.A. (2012), "The next generation integrated library system: a promise fulfilled?", *Information Technology and Libraries*, Vol. 31 No. 3, pp. 76-84.

Yang, S.Q. and Hofmann, M.A. (2010), "The next generation library catalog: a comparative study of the OPACs of Koha, evergreen and voyager", *Information Technology and Libraries*, Vol. 29 No. 3, pp. 141-150.

Zou, Q. and Liu, G. (2009), "Chinese localisation of Evergreen: an open source integrated library system", *Program: Electronic Library and Information Systems*, Vol. 43 No. 1, pp. 49-61.

About the authors

Margam Madhusudhan is currently working as an Associate Professor in the Department of Library and Information Science, University of Delhi, India. He has 15 years of teaching, administration and research experience at the university level. He has published 1 book, 2 edited books, 31 international research articles in peer-reviewed journals, 20 chapters in books, 9 articles in national journals and 5 international conference papers. His current research interests include designing and evaluation of websites, e-resources, evaluation of Web-OPACs, information and communication technology applications in libraries, mobile technologies, etc. Margam Madhusudhan is the corresponding author and can be contacted at: mmadhusudhan@libinfosci.du.ac.in

Vikas Singh is currently working at Shri Ram College of Commerce, University of Delhi, New Delhi. He obtained his MLISc and MPhil (Library Science) degrees from the University of Delhi and Post Graduate Diploma in Library Networking from Indira Gandhi National Open University (IGNOU), New Delhi. He has around four years of professional and research experience. He has also presented papers in conference/seminar and published some papers in national and international journals. His specialized fields are library management software, subject gateways, social networking sites and library security measures.