

## **Open Source Software (OSS) for Management of Library and Information Services: An Overview**

**Aswini Kumar Ray**

Assistant Librarian  
ITER, Siksha 'O' Anusandhan University,  
Bhubaneswar  
Odisha – 751030  
e-mail: aswiniray4@gmail.com

**Dr. D.B. Ramesh**

Chief Librarian  
Siksha 'O' Anusandhan University  
Bhubaneswar  
Odisha – 751030  
e-mail: dolababuramesh@soauniversity.ac.in

### **ABSTRACT**

*Rapid advances in technology have significantly turned libraries nature from palm leaves to open source systems. Now adoption of new technologies has become a most essential factor for the libraries to stay active as an information provider. Today all most all day-to-day activities of the library are completed through the open source technology. These technologies include the digital library, integrated library systems, content management systems, OPAC, citation management, etc. Library professionals are now effectively using this software to provide innovative services to their valued users without having high budget. This paper describes the basic features of the most popular and leading open source software used in the library for different purposes. Here author also discuss about the advantages and limitations of open source software.*

**Keywords:** Open Source Software, OSS, CMS, ILMS, Institutional Repository, Citation Management Software

### **Introduction**

From the last one decade the Open Source Software (OSS) has been spread rapidly in the whole software world. Now, OSS is also being used in the library domain. Due to the advancement of technology, library faces many challenges of integrating traditional and emerging formats. The rapid growth of the OSS and explosion of the web technology has provided huge opportunities for the library professionals. OSS are now easily available for download with their source code free of cost which provide an opportunity to save money as well as removing dependency on proprietary software. However, OSS is the good alternatives of expensive proprietary software that is free from vendor lock-in and gives the permission to modify the source code according to the user's requirement. In this context it is necessary to study the major categories of library software along with brief discussion on the widely used open source library software. Here we provide most helpful information about the OSS for libraries of different functions along with brief description of its feature.

## **Objective of the study**

The main objectives of the study are:

- Study the advantages and limitations of OSS.
- Discuss different areas in a library that may have the potential to implement OSS.
- Briefly discuss about the popular OSS that are used in the library.

## **Review of Literature**

Randhawa, S. (2008) describes the ability and advantages of open source software to serve in the library environment. Here author also highlights major open source software for library<sup>14</sup>. Wei, Z. (2011) explores the general description including license of OSS in the field of digital library. Here author also gives a short note of Greenstone, Dspace and Eprints software<sup>10</sup>.

Salve, A., Lihitkar, S.R. and Lihitkar, R. (2012) describe that with the dwindling budget and vendor's closed access attitude in dealing with commercial software made libraries to go for open source software as an alternative. Here author highlighted on the features of some popular software packages of Content Management Systems, Digital Library and Integrated Library Management Software<sup>2</sup>.

Palmer, A. and Choi, N. (2013) employs a descriptive literature review. Here author pay attention to the open source repository, OPAC (Online Public Access Catalogue) software, and (ILMS) integrated library management system<sup>9</sup>.

Hanumappa, A., Dora, M. and Navik, V. (2014) explore the OSS that used in the libraries of India and review the existing library automation i.e. ILMS (Integrated Library Management System) and DL (Digital Library) software. Here they also state that, the presence of OSS like Koha and NewGenLib in the ILMS category and Dspace, Greenstone and Eprints in the DL software category in Indian context<sup>3</sup>.

Velmurugan, C. and Radhakrishnan, N. (2015) explains about the features and advantages of open source software for libraries. According to author libraries are able to comprehend several advantages by using open source software. They also told that, open source software not only used widely for lower cost than commercial software, but it has also lower realization and maintenance cost. Here author briefly explain the features and advantages of some open source Integrated Library Management Software (ILMS) such as Evergreen, Koha, NewGenLib, OpenBiblio and PMB<sup>17</sup>.

Dave, J.L. and Lalwani, S.L. (2016) describes the importance and adoption of OSS for the libraries. Here author also provide a brief note of some popular OSS used frequently in the library<sup>11</sup>.

Oyelude, A.A. and Kesselman, M.A. (2016) concentrates on reviewing articles on OSS published on 2016 and available on the internet. He has reviewed the literature on the commonly used open source software in libraries<sup>13</sup>.

Khode, S. And Chandel, S.S. (2016) describes about the OSS for different library functions, advantages and its implementation to the library. Here author also briefly discuss about different library functions where OSS is used frequently i.e. Integrated Library Management,

Repository/Digital Library, Content Management Systems, OPAC, Archival Record Manager and Editor, E – Learning Management System, etc<sup>6</sup>.

Upasani, O.S. (2016) state that modern libraries need to stay technologically active to provide different value added services to their research community. Libraries need to hold library management systems and digital technologies as smart tool for providing advanced services to their users. According to the author libraries should collaborate with computer experts to become technologically sounder in using OSS. Here author also provides an overview of the benefits, limitations and availability of different open source library management systems in Indian context<sup>7</sup>.

Vijayakumar, S. And Babu, V.R. (2016) state that now libraries are completely dependent on ICT (Information and Communications Technology) for providing various services to the users. Here author also provide different benefits and drawbacks of open source software. In their study, they finally discuss about three major categories of library software i.e. ILMS, DL, and Content Management System (CMS)<sup>5</sup>.

### Open Source Software

The term “free software” was coined by Richard Stallman, a member of MIT in 1970. In 1998, the term “free software” was replaced by group of individuals includes Larry Augustin, Todd Anderson, John Hall, Christine Peterson, Sam Ockman and Eric S. Raymond to OSS, which is more comfortable and less ambiguous for the corporate world<sup>17</sup>. From that day most of the software developers are producing their software with an OSS license, so that anybody can understand how it works. The main aim of the open source product is to be simpler for accessible, understandable, editable and duplicable. Simply an OSS is computer software that makes its source code available with a public license in which the copyright holder gives the rights to study, edit and distribute the software to anybody and for any purpose. Mainly OSS is developed in a collaborative public manner and its source code written in a programming language that to be compiled in to a binary format to run on a computer, which carrying out the tasks outlined in the source code. All the OSS is copyright protected and distributed under license terms and conditions to ensure that the source code is always available. The most popular open source license is GPL i.e. GNU Public License. Value of any OSS is measured in terms of its simplicity and connectivity. The taxonomy of Software is illustrated as given below fig-1

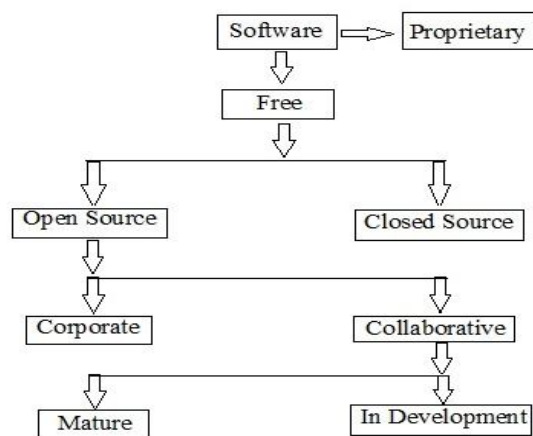


Fig. 1: Software Taxonomy

According to the Free Software Foundation (FSF), the Free Software should provide freedom to:

- Study how the software works
- Run the software for any purpose
- Improve the software
- Redistribute the original or modified version of the software

The implementation of OSS provides many advantages and opportunities to all the sectors including libraries. OSS can be the right solution for long term use with several significant benefits but still there are some possible limitations. Researchers and software experts have identified several advantages and disadvantages on OSS. The major advantages and disadvantages of OSS are listed below.

### **Advantages of OSS**

*Freedom to use:* Anyone can download, modify the source code to change or upgrade and redistribute the software without any restriction. It can also be incorporated in to another program to perform new functions.

*Software Cost:* Generally OSS requires no licensing fees. It also never charges any maintenance fees. Expenditure may require only for documentation and support.

*License Management:* OSS can be downloaded and installed as many times and many locations respectively. It never track, count or monitor for license compliance

*Support:* Like proprietary solutions, open source also have superior support system. Where, open source support is freely available by the different community. Now most of the companies are providing free as well as paid support to the open source. The help and support system of OSS are available worldwide through different forums and mails.

*Free from vendor Lock-in:* Users of open source software are completely independent to customize software according to the requirement.

*Quality of Software:* Popularity and progress of research indicates that OSS is powerful. Through the peer review process the open source software is designed and source code is unveiled for the whole world.

### **Disadvantages of OSS**

*Continuous Development:* There is no such guaranty on OSS for continuous development. Any community may stop the support or development of particular OSS at any time for any reason.

*Software Version:* We cannot find any final version of OSS. Every version of OSS has some modifications, which sometimes creates problem in data migration from one version to other.

*Online Support:* Online support may take more time than commercial software.

*Formal Training:* Formal support and training of OSS are poor in comparison to the commercial software.

*Technical Knowledge:* One cannot install and maintain OSS without having technical knowledge.

*User Manual:* Documentation manuals of OSS are not very simple.

### **OSS for Libraries**

Over the last decade, there has been increasing interest in the potential of OSS in the library sectors regarding the cost and performance of proprietary software products. In 1998, open source trend came in to libraries and libraries started making use of these OSS products for different functions carried out in libraries. Basically OSS tools are helping libraries to overcome problems of high budget allocations for buying commercial solutions. Lot of research is going on in using OSS based applications which are useful in libraries. In recent years, there has been a rapid growth in the number of applications that are available for libraries to design multilingual website, automate library catalogue, MARC edit, digitization, citation management, etc. Now let us have a brief description of some popular software related to above said work is given below which is very useful in library services.

### **Content Management Systems (CMS) for Web Publishing**

The main function of CMS is to store, organize files, and provide controlled access to their data. The process of CMS is to acquire or create content, manage the content and publish the content. Web-based CMS support all the phases of content management from creation to dissemination. Now-a-days open source CMS is considered as the best tool for creating website and blog. Hence, open source CMS are being used in the libraries as a powerful tool for managing web content for its extensibility and flexibility. A brief technical overview of most popular and leading open source CMS that are used in the libraries, described below.

**Drupal** is one of the web publishing options that allow a single or group of users to simply publish and organize a wide variety of content on a website. It is developed by Dries Buytaert, a Dutch university student. Drupal runs on Windows, Linux and Mac OS; it uses Apache as web server, MySQL as database and PHP as scripting language. It also supports WAMP, LAMP and XAMPP technology. It has the ability for administration control option like apply access rules, denies the site access and also helps to manage throttling and caching. Some of the salient features of Drupal are as follows.

- Multi-site option facilitates to create more than one website using one instance of Drupal installation.
- Multi user participation feature helps involvement of many users to create the content.
- It provides an option to the administrator for giving authentication to the users.
- It creates roles and permissions for the users.
- It has the option to maintain user profile after successful registration.
- It supports multi level menu system.
- It provides a strong community support.
- Customization through Theme is also available.
- It has also some additional options like advanced search, forums, comments, and polls.

**Joomla** arrived from the popular open source Mambo CMS in 2005 as a fork. The name Joomla is not a real word. It is the phonetic spelling of a Swahili word Joomla, which means “all together” or as a “whole”. The Joomla logo has also the same meaning as the name. In

logo, adding the circles to each “J” yield the representation of people and the multiple colors in for different races, peoples and cultures. Since 2005, Joomla has gone from success to success and achieved many awards as top rank. Now Joomla become the most popular and active open source CMS in comparison to others. Joomla supports all the technology and operating systems similar to Drupal. The salient features of Joomla are as follows.

- *Front End and Back End:* The Front End is the visibility of the website and Back End is meant for administration layer, where configuration, maintenance, new content creation, etc. are done by the administrator.
- *Configuration Settings:* These settings are applicable to the entire website control.
- *Access Rights:* This feature provides a hierarchy of authorities for an effective and secure administration.
- *Content:* Different types of content can be appended in the website by depending on the structure of the website. Where content may be simple text, a picture, music, table, graph, etc.
- *Templates:* These provides editable visual format in which contents are embedded beautifully.
- *Extensions:* A CMS should have the feature of expandability for future requirements in the form of components such as database manager, online form, etc.
- Apart from that Joomla has also some core features such as multilingual, easy updates, well supported, media manager, banner management, content management, nested categorization, tagging, integrated help system, frontend editing, menu manager, content versioning, syndication and newsfeed management, powerful extensibility, and Extensive Access Control List for all your access control needs.

**WordPress** was originally established as tool for bloggers. But WordPress has evolved significantly and changed in to a fully fledged Content Management Systems, which allow creating, editing and managing the website from a central interface. WordPress supports PHP as programming language and MySQL or MariaDB as database. The basic features of WordPress are as follows.

- Web-based administration
- Fresh content
- Commenting features
- Easy to get started
- Share the workload
- Flexible and extensible
- Remote updating
- Custom Taxonomies
- XML-RPC interface
- Themes for beautification
- Intelligent text formatting

Another main advantage of WordPress is the plug-ins. WordPress plug-ins is written in the PHP language and integrates seamlessly with WordPress. WordPress plug-ins mainly used to handle each and every aspects of website like creation, organization, and search engine optimization. Functionality of the user interface can be improved through this plug-ins. One can download thousands of free plug-ins from the official WordPress plug-in directory.

## **Integrated Library Management System (ILMS)**

ILMS is the major pre requisites to manage the modern libraries and information centers. Library automation is a process of utilizing information and communications technology facility to perform housekeeping operations of the libraries; those are traditionally executed manually like - acquisition, cataloguing, circulation, serial control, etc. There are a good number of open source software are available for automating above said functions of the library. A brief technical overview of most popular and leading open source ILMS are presented below.

**Koha** is the first open source software for ILMS, and developed by Katipo Communications Ltd in 1999. It was first installed at Horowhenua Library Trust of New Zealand in 2000. A dedicated team of library technology staff and software providers from around the world as OSS are now maintaining Koha. The name Koha derived from a word “Maori” with a complex meaning having to do with gifts brought by visitors. Koha is written in Perl language. It runs on Linux, UNIX and Mac, OpenBSD and FreeBSD. For installation of Koha some additional software are required i.e. Apache for web server, programming language Perl and MySQL for database. Koha has received many awards from its release such as 3M award for innovation in Libraries and TUANZ Interactive Award, Community/Not for Profit category in 2000, winner of the Trophees du Libre, Software for public administration category in Soissons, France in 2003 and joint winner of the Computerworld Excellence Award for the use of IT in a non-profit Organization in Auckland, New Zealand in 2004. Current stable version of Koha 3.22.12 released on 24<sup>th</sup> October 2016. Basic features of Koha are as follows:

- Web based interface
- Customizable web based Online Public Access Catalogue
- It supports MARC 21 and UNIMARC for professional cataloguing
- It uses Z39.50 protocol
- Multilingual and multi-user support
- Circulation i.e. issue and return of library books
- Advanced Acquisition and full Catalogue system for library stock management
- Print Barcode
- Generate reports
- Reservation facility of library books
- Manage database of library users
- Supports RSS feed
- Export and import records, ISO 2709
- Management of Serials, etc.

**ABCD** (Automation of liBRaries and Centres of Documentation) is developed by BIREME (WHO, Brazil) in a joint collaboration with the Flemish Interuniversity Council of Belgium<sup>16</sup>. ABCD is a menu driven software package that provides help instruction at every step. ABCD software used ISIS database technology of UNESCO, ISIS formatting language, ISIS Script, CISIS, ISIS NBP, Groovy and Jetty, Java Script, PHP, Apache, MySQL and YAZ. This software is also compatible with GNU license accepted programming language such as PHP, Java, JavaScript, Python, etc. ABCD 2.0 is written in PHP v.5 and IsisScript. Basic features of ABCD software are as follows:

- Fully web based
- Runs on both Windows and Linux platform

- Supports Z39.50 facility
- For the bibliographic databases it is compatible with the technology of CDS/ISIS database
- Define, copy or edit any new database structure with existing ISIS applications like – MARC, CEPAL, UNIMARC and Dublin core
- Compatible with MARC 21
- Web based Online Public Access Catalogue facility
- The software is available in different languages such as English, French, Spanish, Portuguese, etc.
- Provides advanced serial management system
- Report generation with graphical presentation
- Freedom of database structure
- Book reserve facility also available
- In ISO 2709 format data can be imported and exported

**NewGenLib**, a fully web based ILMs was an indigenous project by Verus Solutions Pvt. Ltd in collaboration with KIIKM (Kesavan Institute of Information and Knowledge Management). From beginning NewGenLib started its career as proprietary software and its first version 1.0 was released in the month of March, 2005. On 9<sup>th</sup> January 2008, NewGenLib with version 2.1 was turned in to OSS under GPL. NewGenLib 3.1.2 is the current version. It runs on distributed computers through a network with server. It can also run on intranet without any internet connectivity, although some of the advantages of using it through the web will be lost<sup>16</sup>. It also supports open source components like PostgreSQL, Apache Tomcat, etc. Completely NewGenLib is a Java based neutral software. Basic features of NewGenLib software are as follows:

- Operating system independent. It runs on Windows as well as on Linux.
- Uses open source component
- Web OPAC is self instructed interface and informative
- All modules such as acquisitions, serials management, cataloguing, circulation, etc. are completely web based
- NewGenLib supports international standards like AACR 2, MARC 21, UNICODE, SRU/W, Z39.50, MARC – XML, OAI-PMH and Dublin core
- Unicode 3.0 complaint for data entry, storage, retrieval in any language
- Also supports (i18n) Internationalized application
- RFID integration
- Ability to support other languages
- Use XML based OpenOffice templates
- It has the ability to attach digital objects like image files, PDF or MS Word, video clips, sound, etc. to catalogue records
- It is scalable, manageable and efficient
- It provide support to NewGenLib users in online via remote desktop technologies

### **Institutional Repository (IR)/DL**

It is a new technique for gathering, organizing, disseminating and preserving intellectual output of the members of an institution in digital form (Chang, 2003). With its latest role play as digital archives of these intellectual assets, the repository opens itself to the need of multifarious researchers and students of various disciplines in that institution. The end users outside of the institution are equally benefitted by this innovative technique (Johnson, 2002).



In 2003, Clifford A. Lynch explains that the necessity of an effective institutional repository represents cooperation among librarians, information scientists, archive and record managers, faculty members, administrator and policy makers of the institution. All institutional repositories hold the similar mission to disseminate the scholarly output to the end users. The success of an IR depends upon the quality of its content and service it supplies. A brief technical overview of most popular and leading open source DL/IR software are described below:

**GSDL** was developed in 1995 by the New Zealand Digital Library Project at the University of Waikato. UNESCO; Human Info NGO, Belgium; NCSI, Bangalore; UCT, Cape Town; Dakar, Senegal; Almaty, Kazakhstan and an individual are the distributor and promotion partner of GSDL<sup>1</sup>. The downloads available from the download page i.e <http://www.greenstone.org/download> are hosted by Sourceforge. GSDL runs on Windows, Linux and MacOS platform. GSDL can be installed on Desktops, Laptops and Servers with the help of Java and Apache web server. For core installation one may require some additional software such as ImageMagick, Ghostscript and Tomcat web server. GSDL accepts almost all kind of document formats. In GSDL, Plug-ins are available for all kinds of documents like PDF, Word, Postscript, HTML, RTF, Latex, Plain text, Excel, PPT, email, GIF, JPEG, TIFF, mp3, MPEG, MIDI, etc. Suitable Plug-ins can be added if the document format is not included. Basic Features of GSDL are as follows.

- Open source software
- Multilingual support
- Plug-ins for documents
- Searching facility
- Data compression
- Metadata extraction
- Password protection
- Administrative functions
- Structured Metadata in XML using DC
- Through internet content can be delivered
- Collections easily exported to CD/DVD
- Customizable as per the Institution's/University's need
- Based on Unicode, separate indexes can be created for different languages as well as a plug-in allows to automatic language recognition

**EPrints** was designed to create a pre-print institutional repository to help scholarly research work that was the initial goal of EPrints is concerned. But now, the scope of EPrints extends to the reprints, technical reports, conference publications and e-communication. Its website ([www.eprints.org](http://www.eprints.org))<sup>10</sup> describes OSS as “a flexible platform for building high quality, high value repositories. It is recognized as the easiest and fastest way to set up repositories of research literature, scientific data, student theses, and project reports, multimedia, teaching materials, scholarly collections, digitized records, exhibitions and performances”. EPrints is written in Perl, depends on the Apache web server and some of Perl modules. EPrints uses the MySQL database as a back-end. Additional software required for the installation of EPrints that are all open source and freely available. It was developed under GNU/Linux to run on any UNIX-like system<sup>10</sup>. As of July 2016, ROAR (Registry of Open Access Repositories) has recorded 601 implementations, making it the second most popular platform. Like DSpace, EPrints use turnkey approach and some institutions have reported that the installation process is straightforward. The administrative back end provides access to configuration options. Bazaar store of EPrints, is an interesting concept, that allow repository

managers to install extensions with a single click. To setup an IR for any institute, EPrints is an excellent choice due to its simplicity in installation and configuration process. After successful completion of the IR setup, one may upload documents and provide appropriate metadata for each record just by filling out a simple web form. The advanced features of EPrints that represent its potential as an IR are follows.

- EPrints offers plug-in technology for easier customization
- Export of data in XML formats of standard i.e. BibTex, Dublin Core
- Import from many sources, especially complying with the standard
- History module and support for preservation data export
- Easy search and browse facility
- Provides RSS feeds for entire collections and E-Mail alerts
- OAI compatible
- Temporary restrictions are easy to set during embargo periods
- Integration with SHERPA/RoMEO to check publisher policies and author rights quickly
- Auto generate CVs, publications list, etc
- Works with Bibliography Management Software

**DSpace** was developed by MIT libraries in collaboration with HP labs. It provides tools for managing digital assets. Just like EPrints, it also used for building of IR. In general, the main objective of DSpace was to manage, preserve, host and distribute the scholarly output of MIT's faculty. But later DSpace has evolved significantly and changed in to fully fledged DL software to capture, preserve, and communicate the intellectual output of an institution's faculty and research scholars through a central hub<sup>4</sup>. The latest version of DSpace is 6.0 which was released during April 2016. The collection in DSpace is organized into communities, collections and items. The communities in DSpace include a high-level organizational structure whose only purpose is to divide collections into related groups. Each community contains one or more collections, which are containers for related items. An item is a deposited object of any type like a published article, an image, audio, or video file, notes, a presentation, etc. DSpace is written in Java and runs on Linux or UNIX and Windows operating system.

The major features of DSpace are as follows:

- Lucene search engine (a part of Apache Jakarta project) and query language
- Handle system
- OAI-PMH

### **Citation Management Software**

It is also known as bibliographic software or reference software. This software has the ability to import citations from any websites and favourite databases, build and organize bibliographies, and entering many bibliographic references in to manuscripts. Citation management software also saves time of the research scholars in collecting, organizing and formatting their references for publication. The primary features of the software are to capture bibliographic information about research topics, add footnotes, create bibliographies, and manage research collections for the research scholars. It is also used to save and organize references in a personal database. By using this personal database one can create citations or

list of references according to different styles of citations. A brief technical review of most popular software is presented below.

**Zotero** was launched as a project of the Roy Rosenzweig center for History and New Media at George Mason University of United States with an extension of the Mozilla Firefox web browser on 2006. In 2011, Zotero came in a standalone version which is compatible to Safari and Google Chrome. Zotero which works on Windows, Linux and Mac operating systems. It offers two options for downloading Zotero i.e. Zotero for Firefox or Zotero standalone. Another easy option for using Zotero is that to register and create an online account on Zotero home page. Major strength of Zotero are as follows.

- Zotero can also be run as an offline database and it does not require constant internet access to function
- In Zotero references can be shared easily with colleagues or other researchers
- It is also capable to capture citations from other websites such as Google Scholar, PubMed, Amazon.com and other webpages of journals, where DOI, PMID and ISBN are displayed
- It also has the ability to extract metadata from a PDF file
- Zotero users are also able to annotate webpages
- Zotero creates a bibliography easily, when the user selects references and drag them in to a word processor
- Zotero supports Microsoft Word and other open office
- Zotero can import Bibtex, RDF, RIS and MODS data formats
- A web translator facility is also available in Zotero to scan a website to determine the desired resource type
- Zotero is constantly improving its functions by the help of largest community network
- Finally, it synchronizes and backup saved research library in to its website i.e. [www.zotero.org](http://www.zotero.org)

## **Conclusion**

So, it seems that there are most powerful OSS solutions are available to serve different functions of the library. Mainly money can be saved by using these OSS in the libraries and this money can be used for the other purposes such as purchase of books, journals, etc. These above described OSS are constantly being updated, changed, and customized according to the libraries requirement. Few years ago, only the technically sound users were dare to use the OSS, but now novice and non-technical users are also trying and using the OSS with the help of different training workshops, online support, manuals and from the other library professionals. Today, the library professionals of India have well aware and intentions to implement OSS in libraries. Therefore, the OSS for libraries is rapidly gaining its popularity among the library professionals. So, we hope this article provides some fundamental information about the features of the most popular OSS for libraries.

## **References**

1. Henley, Mark, and Richard Kemp. "Open source software: an introduction." *Computer Law & Security Review* 24.1 (2008): 77-85.
2. Salve, Anand, Shalini R. Lihitkar, and Ramdas Lihitkar. "Open source software as tools for libraries: an overview." *DESIDOC Journal of Library & Information Technology* 32.5 (2012).

3. Hanumappa, Anilkumar, Mallikarjun Dora, and Viral Navik. "Open source software solutions in Indian libraries." *Library Hi Tech* 32.3 (2014): 409-422.
4. Vimal Kumar, V. "Selection and management of open source software in libraries." (2007): 1-5.
5. Vijayakumar, S., and V. Ramesh Babu. "The open sources software and Its Impact for libraries in digital environmental." *International Research Journal of Multidisciplinary Studies* 2.8 (2016).
6. Khode, Subhash, and Sunil Singh Chandel. "Use of Open Source Software for Libraries: Opportunities and Challenges." *International Journal of Information Dissemination & Technology* 6.3 (2016).
7. Upasani, Ojaswini Subodh. "Advantages and Limitations of Open Source Software for Library Management System Functions: The Experience of Libraries in India." *The Serials Librarian* 71.2 (2016): 121-130.
8. Rafiq, Muhammad. "LIS community's perceptions towards open source software adoption in libraries." *The International Information & Library Review* 41.3 (2009): 137-145.
9. Palmer, Aaron, and Namjoo Choi. "The current state of library open source software research: a descriptive literature review and classification." *Library Hi Tech* 32.1 (2014): 11-27.
10. Wei, Zhaohui. "Research on the Application of Open Source Software in Digital Library." *Procedia Engineering* 15 (2011): 1662-1667.
11. Dave, Jigar L., and Suresh L. Lalwani. "Open Source Software and Libraries." *Indian Journal of Applied Research* 6.5 (2016).
12. Pyati, Ajit. "A critical theoretical model for library-led technological development: A case of open source software and libraries." *Proceedings of the American Society for Information Science and Technology* 43.1 (2006): 1-4.
13. Oyelude, Adetoun A. "Open Source Software for Library Systems-2." *Library Hi Tech News* 33.9 (2016).
14. Randhawa, Sukhwinder. "Open source software and libraries." (2008).
15. Fitzgerald, Brian, et al. *Adopting open source software: A practical guide*. The MIT Press, 2011.
16. Velmurugan, C. and N. Radhakrishnan. "Libraries from palm leaves to open source: an introduction". *Automation & Digitization Software of Library: open source & commercial*, edited by Mange Ram, Y.K. Publishers, 2015. 70-80.

