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Open Source Software for Library and Information Centres: A Study

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Dr. Gautam Kumar Sarma

Abstract

Open source software is also called Free/Libre or Open Source Software (FLOSS) as particularly in Europe. But, the most widely used term seems to be open source software. The Open source movement was started by Richard Stallman in 1983 but the term "Open Source" was given by Christine Peterson in 1997. Today there are very useful OSS starting from the different Linux Operating Systems, Apache Web Server, MySQL and PostgreSQL RDBMS in general to library- specific softwares like, Integrated Library System (ILS) such as Koha, Evergreen, NewenLib, etc. and Digital Library Software such as DSpace, Eprints, Fedora, GSDL, etc. No doubt, the hardware costs have to be borne by the libraries concerned but the availability of efficient OSS has considerably cut down the software costs. The quality of open source software in the field of LIS is rising day by day, because they go through an informal review process by a strong user community and LIS specialists. Open source Digital Library Software, Learning Management System and Content Management System have already dominated over commercial software. The major advantage of open source software is interoperability. This paper highlighted some of the important issues related to the use of open source software in Library and information Centres in modern era.

Keywords: Open Source Software, Library and information Centre, Integrated Library System, Digital Library Software, Learning Management System, Content Management System, Journal Management System

1. Introduction :

A computer has two basic parts-hardware and software. Software refers to programs installed into the hardware of a computer in order to perform certain functions. Computers work only in response to instructions provided externally. Usually, instructions to perform some intended tasks are organised into a program using a programming language, which is submitted to a computer. The computer interprets and executes these instructions and provides response to the user accordingly. A set of program intended to provide user with a set of interrelated functionalities is known as a software package. It is a bridge between the human and the machine.

Merriam Webster Dictionary defines software as "the entire set of programs, procedures, and related documentation associated with a system and especially a computer system." (<http://www.merriam-webster.com/dictionary/software>). To develop a software package, a programmer writes a program in a particular programming language. This form of the program is called the source program, or more generically, the source code. The source code is the only format that is readable by humans. If an individual can access the source code of a software package, then that person can copy the code, make some changes and also develop similar kinds of software. Depending upon the nature of the source code, the software packages can be divided into two distinct categories- closed source or proprietary software and open source software.

Closed Source or Proprietary Software: With closed source or proprietary software, the source code is not shared by the developers with the public to look at or make changes. Most companies, which sell their software for money, make it closed source to make it harder for people to change it or copy it for free. Closed source or proprietary software packages are licensed under exclusive legal right of the copyright holder with the intent that the licensee is given the right to use the software only under certain conditions, but restricted from other uses, such as modification, sharing, studying, redistribution, or reverse engineering.

Open Source Software: Open source software is completely opposite to closed source or proprietary software. The creators of open source software usually make their source code available to the users as it is or with the facility of modifications. This type of software does not require a vendor lock. Open source software is often developed in a public, collaborative manner.

From the monetary point of view along with the source code, the software can be subdivided again into following categories-

Freeware: Some people and companies who give their software for free do not show the source code, they are known as freeware. Freeware are the purely closed source or proprietary software.

Free Software: Free software is computer software that gives users the freedom to run the software for any purpose as well as to study, research, modify and distribute the original software and the adapted versions. Free software is primarily a matter of liberty, not price. Free software is also distinct from freeware, which is simply a category of proprietary software, which does not require payment for its use.

Commercial Software: Commercial software, also known as payware, is a computer software that is produced for sale or that serves commercial purposes. Commercial packages can be proprietary software or open source software.

2. Definition of Open Source Software :

According to Open Source Initiative, open source software is "software that can be freely used, changed, and shared (in modified or unmodified form) by anyone" (<http://opensource.org>).

The Open Source Initiative (OSI) is a California based public benefit corporation, founded in 1998. The Open Source Initiative (OSI) is a non-profit corporation with global scope formed to educate about and advocate for the benefits of open source and to build bridges among different constituencies in the open source community. According to Open Source Definition (OSD), ten criteria must be met in order for a software distribution to be considered open source:

- a) Free Redistribution- The license must allow end users to redistribute the software, even as part of a larger software package and may not charge royalties for this right.
- b) Source Code- The distribution must make the source code freely available to developers.
- c) Derived Works- The license must permit modifications to be made to the software for redistribution under the same license.
- d) Integrity of the Author's Source Code- The license may require that modified distributions be renamed, or that modifications be made via patch files rather than modifying the source code.
- e) No Discrimination against Persons or Groups- The license must not discriminate against any person or group of persons.
- f) No Discrimination against Fields of Endeavor-This includes commercial or controversial endeavors.
- g) Distribution of License- The same license must be passed on to others when the program is redistributed.
- h) License Must Not Be Specific to a Product- A program may be extracted from a larger distribution and used under the same license.
- i) License Must Not Restrict Other Software- The license cannot prescribe the terms of other software with which it is distributed.
- j) License Must Be Technology-Neutral- The license cannot restrict the use of the program to any individual interface or platform.

Figure 1: Open Source Logo



Hence, the open source software refers to software for which the source code is freely available for public to view, amend, and adapt. The principle of open source software is that when many programmers read, redistribute, and modify the source code, there are more people to spot bugs and provide fixes.

Kavanagh (2004) explained open source software as "software that must be distributed with source code included or easily available, such by free download from the internet. The source code should be in the same form that a programmer would actually use to maintain it; not for instance or intermediate code form" (p.1).

Typically, open source software is created and maintained by an international team of developers who have no institutional and national boundaries. As such, open source software cannot be appropriated by one large proprietary vendor. However, the degree of support provided by virtual communities of users and developers may not be as well organized as that provided by commercial vendors.

3. History of Open Source Software :

In the 1950s, the first modern business computers were introduced which were practically some large calculating machines, running custom programs written in binary code, later assembler language. In the 1960s, commercial mainframes were introduced by several companies including IBM. These were custom programmed for applications, usually in COBOL or FORTRAN. Prior to the 1970s, software packages were, essentially by default, open or free.

3.1 The Beginning Stage of Open Source Software

In late 1970s and early 1980s, two different groups were establishing the roots of the current open source software movement-

- a) On the US East coast, Richard Stallman, formerly a programmer at the MIT AI Lab, resigned, and launched the GNU Project and the Free Software Foundation. The ultimate goal of the GNU Project was to build a free operating system.

- b) On the US West coast, the Computer Science Research Group (CSRG) of the University of California at Berkeley was improving the Unix system, and building lots of applications which quickly become "BSD Unix". These efforts were funded mainly by DARPA contracts, and a dense network of Unix hackers around the world helped to debug, maintain and improve the system.

During the 1980s and early 1990s, open source software continued its development, initially in several relatively isolated groups. During 1991-1992, the whole landscape of open source software and of software development in general, was ready to change. Two very exciting events were taking place, although in different communities-

- a) In California, Bill Jolitz developed an unencumbered version of BSD Unix. Bill called his work 386BSD, and it quickly became appreciated within the BSD and UNIX communities. It included not only a kernel, but also many utilities, making a complete operating system.
- b) In Finland, Linus Torvalds, a student of computer science, developed the first versions of the Linux kernel. Soon, many people were collaborating to make that kernel more and more usable, and adding many utilities to complete GNU/Linux, a real operating system.

3.2 The Development Stage of Open Source Software

In 1993, both GNU/Linux and 386BSD were reasonably stable platforms. Since then, 386BSD has evolved into a family of BSD based operating systems (NetBSD, FreeBSD, and OpenBSD), while the Linux kernel is healthy evolving and being used in many GNU/Linux distributions (Debian, Red Hat, Suse, Mandrake, and many more).

During the 1990s, many open source projects have produced a good quantity of useful software. Some examples are-

- a) In 1987, Larry Wall released PERL 1.0 scripting/programming language. Its current release is version 5.20.1.
- b) In 1990, Guido van Rossum released Python programming language. Its current release is version 3.4.2.

- c) In 1994, Rasmus Lerdorf released PHP/FI web scripting/programming language. Its current release is PHP 5.4.37.
- d) In 1995, the Apache web server program was released and quickly became the most widely used web server product (which it remains today). Its current release is 2.4.12.
- e) In the mid 1990's, MySQL and PostgreSQL relational database management software were released.
- f) Also in the mid-1990's Andrew Tridgell released Samba, a set of utilities which allows UNIX, Linux machines to use the same network communication protocol as Microsoft Windows.
- g) In January 1998, Netscape released the source code for its browser under an open source license, beginning the Mozilla project. Its current release is 35.0.1.

While many of these packages originally ran exclusively on Linux platform, most have been ported to other operating systems, including Windows and Mac. The other significant development was the involvement of commercial interests in the open source movement. Corporations such as IBM and Oracle have ported software to the Linux platform.

4. Issues Involved with Open Source Software :

Open source software is basically found in the public domain. SourceForge (<http://sourceforge.net>) is a web-based source code repository, which provides over 430,000 open source projects and all of these open source projects and serves more than 4,800,000 downloads per day (<http://sourceforge.net/about>). SourceForge offers free access to hosting and tools for developers of free/open-source software. Some similar projects in the public domain are- GitHub (<https://github.com>), Tigris.org (www.tigris.org), BountySource (www.bountysource.com), JavaForge (www.javaforge.com), Gitorious (<https://gitorious.org>), etc.

Because of the availability in the public domain, anyone can use most of the open source software in any way without getting anyone

else's permission. Yet, open source software is copyrighted, which is known as open source license.

4.1 Licensing

The key fact that makes open source software different from proprietary software is its license. As copyright material, software is almost always licensed. Open source software is unique in that it is always released under a license that has been certified to meet the criteria of the Open Source Definition.

Early in the history of the open source movement, there were a small number of projects covered by the small number of licenses that met the criteria of the Open Source Definition (OSD). These licenses included the GNU General Public License, the BSD license (old and new varieties), the MIT license, the Mozilla Public License, and a few others.

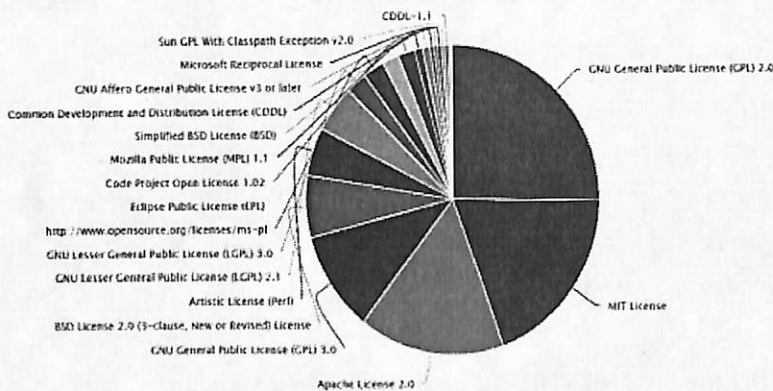
Over the years, the Open Source Initiative (OSI) received hundreds of licenses, discussed all of them, and approved approximately 75 (<https://opensource.org/licenses/alphabetical>). This explosion of choice in licensing reflected both the interest in open source as well as the many particular ways in which people wanted to create and or manage their open source software. Unfortunately, while all of these licenses provide the freedom to read, modify, and share source code, many of the licenses were legally incompatible with other free and open source licenses, seriously constraining the ways in which developers could innovate by combining rather than merely extending open source software.

The following Open Source Initiative (OSI) approved licenses are popular, widely used, or have strong communities:

- a) Apache License 2.0
- b) BSD 3-Clause "New" or "Revised" license
- c) BSD 2-Clause "Simplified" or "FreeBSD" license
- d) GNU General Public License (GPL)

- e) GNU Library or "Lesser" General Public License (LGPL)
- f) MIT license
- g) Mozilla Public License 2.0
- h) Common Development and Distribution License
- i) Eclipse Public License

**Figure 2: Most commonly used licenses in open source projects
(www.blackducksoftware.com)**



4.2 Advantages of Open Source Software

- a) **View, change and redistribute source code-** Anybody can read the source code provided they have the requisite know how to use technology. Anybody can contribute by modifying the code by adding the new features and correcting the errors.
- b) **Allow integration between products-** With open source, because source codes are available, the users can always make things work together by examining these codes. With proprietary systems, the users are dependent on the code owner to make changes. The

users basically buy products from different companies and keep them operating for years. Integration is a hard problem that users must deal with. Open standards and source code are essential parts from which the solutions to integration can be constructed.

- c) **Lower costs-** Open source solutions generally require no licensing fees. The logical extension is no maintenance fees. The only expenditures are for media, documentation, and support, if required.
- d) **No vendor lock-** Frustration with vendor lock-in is a reality for all IT managers. In addition to ongoing license fees, there is lack of portability and the inability to customize software to meet specific needs. Open source exists as a declaration of freedom of choice.
- e) **Open source has a large pool of skilled professionals-** Open source support is freely available and accessible through the online community via the Internet. And on the other hand, many tech companies are now supporting open source with free online and multiple levels of paid support.

4.3 Disadvantages of Open Source Software

- a) **Lack of personalised support-** Unlike proprietary software, open source software packages do not come with phone support or personalised e-mail support. However, there are some commercial service providers who can provide support by taking money. Open source software does not come with a warranty, as there is no single company backing the product.
- b) **Speed of change-** The modification or updating of the versions of open source software is an ongoing process in the open source world, which can make it difficult to adjust for the users sometimes.
- c) **No vendor responsibility-** With no vendor responsibility for the software, support for the open source software applications can

vary and often depend on the user/developer's community's commitment to the project.

- d) Customization- Open source software may not offer the level of customization as it is being done in case of commercial software.
- e) Forking code- Because of the openness of the source code for all, forking happens in case of open source software, when developers take a copy of source code from one software package and start independent development on it, creating a distinct and separate piece of software.

5. Open Source Software Applications :

Open source software projects are built and maintained by a network of volunteer programmers. One of the most successful open-source products is the Linux operating system, an open-source Unix-like operating system. Linux was originally conceived by Linus Torvols in the late '80's because he wanted to run a UNIX-sort of operating system on Intel-based computer. Linux is becoming increasingly popular with many information technology (IT) professionals as an alternative to Windows-based server applications or proprietary versions of UNIX.

The Apache Project is one of the more notable (www.apache.org). Apache is a World Wide Web (HTTP) server. It started out its life in the mid '90's as NCSA's (National Centre for Supercomputing Applications) httpd application, the Web server beneath the first graphical Web browser.

MySQL is a popular relational database application. It is very often used to support database-driven websites. It adheres to the SQL standard while adding a number of features of its own (as does Oracle and other database vendors). MySQL is known for its speed and stability. The canonical address for MySQL is www.mysql.org.

There have been many successful open source projects e.g., PostgreSQL, OpenOffice, Lucene search engine, etc. Mozilla Firefox is a

very popular web browser. Android is also a popular open source operating system for mobile devices.

Datamation, the first print magazine in the field of computer technology, in January 2015 has compiled those software packages into one ultimate open source software list. The list spotlights 1,211 noteworthy open source projects that have been featured on Datamation's website (<http://www.datamation.com/open-source/open-source-software-list-2015-ultimate-list-1.html>). Few examples of open source software from the list are-

Table 1: Some examples of open source software

Software Types	Name of OSS (Selective)
Anti-Virus	ClamAV, Clam Sentinel, ClamTk, ClamWin Free Antivirus, P3Scan, Rootkit Hunter
Blogging Browsers	B2evolution, Ghost, LifeType, WordPress, Chromium, Dooble, Firefox, Qt Web Browser, SRWare Iron, Tor Browser
Wikis	DokuWiki, FOSWiki, MediaWiki, TikiWiki, TWiki, XWiki Apache Drill, BlinkDB, Cassandra, CouchDB, Firebird, FlockDB, HBase, Hibari, Hive, Hustle, Hypertable,

Databases	Infinispan, InfluxDB, Kexi, LucidDB, MongoDB, MySQL, Neo4j, OrientDB, Poderopedia, PostgreSQL, Riak, Realm, Redis, Terrastore, Tokudb/TokuMX, VoltDB, WebScaleSQL
E-mail	Evolution, Thunderbird with Lightning, Zmail
Graphics Editors/ Animation Tools	Alchemy, Art of Illusion, Blender, CinePaint, Dia, Gimp, Gmsh, GPaint, GraX2, Inkscape, K-3D, Krita, LaTeXDraw, Luminance HDR, MyPaint, Pixelitor, Pinta, sK1, svg-edit, Synfig Studio, Wings 3D
Mail Servers	Citade, Exim, Postfix, Scalix, Sendmail, SOGo, Zimbra
Middleware	JBoss
Network Management	Kale, OpenNMS, Zenoss
Office Productivity	AbiWord, Calligra (Formerly known as KOffice), Gnumeric, Impress.js, LibreOffice, LyX, NeoOffice, OpenOffice, Reveal.js, WriteType, X-00o4Kids
Operating Systems	Android, Arch Linux, Bio-Linux, Bodhi Linux, CentOS, Chromium, Contiki, CoreOS, Debian, Skolelinux, Edubuntu, Elementary OS, Fedora, Firefox OS, Frugalware, Gentoo, GoboLinux, Illumos, IprediaOS, Joli OS, Korara, Knoppix, Liberté Linux, Linux Lite, Linux Mint, Lubuntu, Mandriva, Manjaro, Matriux, MEPIS, Nanolinux, Netrunner, NetSecl, OpenMandriva, openSUSE, PC-BSD, PCLinuxOS, Peppermint, PinguyOS, Point Linux, PwnPi, Raspbian, Red Hat, RLSD, Robolinux, Sabayon, Salix OS, Scientific Linux, SELinux, Slackware, StartOS, Spark, SUSE Linux, Ubuntu, Xubuntu, Zorin OS

Programming Languages	Dart, ECL, Go, Harlan, Java, Perl, PHP, Python, R, Ruby, Terra
Social Networking	BuddyPress, Diaspora, LiveStreet, Pligg, Storyltr
Web Servers	Apache HTTP Server, AppServ, EasyPHP, Nginx, XAMPP

6. Open Source Software for Library and Information Centres :

Library and information centres and open source software have a common philosophy i.e. "community first". Chudnov (1999) stated that the library community is largely made up of not-for-profit, publicly funded agencies, which hardly command a major voice in today's high tech information industry. As such, there is not an enormous market niche for software vendors to fill our small demand for systems.

Open source software is seen as a solution in the age of global meltdown because many libraries experience with commercial library management software that is slow to evolve and expensive to upgrade. Open source systems cost nothing or very low cost to use, whether they have one or one thousand users. Rather than spending lots of money on commercially licensed software and also for their maintenance, such funds might be reallocated for training, hiring, or support needs, areas where libraries tend toward chronic shortfalls.

There are number of open source library applications which fulfil the specific needs of the users within the library. Open source software can be applied successfully in housekeeping operations of libraries, building digital libraries and institutional repositories, e-learning, designing library webpage and portals, etc. Therefore, the areas where library and information centres can see the implementation of open source software are-

- a) Integrated Library System
- b) Digital Library
- c) Learning Management System
- d) Content Management System
- e) Journal Management System, etc.

6.1 Integrated Library System

Integrated Library System (ILS) is a system where all tracks of a library operation such as items, bill, paid, and also patrons' record are kept. By this software, we can operate all the library operation easily. In Integrated Library System, there are two interfaces one is patron and another one is library staff. In this system, the operation of a user/member/patron and staff of library is different. A user can search a book, view a book list available in library, can issue a book, renew a book, can hold a book, can print issue list, can edit his/her information (patron information). However, a staff can store bibliographic (book, CD, DVD, journal etc) record actually library materials record in database, can create patron in database, order a book, purchase a book. Acquisition, cataloguing, some functions under serial control, management all are operated by the staff of a library.

In the last few years, we have seen the development of a number of ILS products in the open source world. Avanti, Emlida, Evergreen, Koha, Newgenlib, OpenBiblio, OPALS-NA, PhpMyBibli, PhpMyLibrary, etc. are some examples of open source ILS packages. Among all these packages, some packages are available freely in the web, and release updated versions regularly. Update and modification have become stagnant in case of some packages like Avanti, Emlida, PhpMyLibrary, etc. It is not uncommon for open source software projects to last only for a few years and falter, either because of lack of ongoing patronage or lack of take-up. This is certainly evident in the case of ILS open source projects (Balnaves, 2013). Again, OPALS-NA charges money for the package, though it is not for the license fee, hence OPALS-NA is not freely downloadable from the web. So, few open sources ILS are discussed here on the basis of availability on their own website with no cost. The list is attached as **Table 1** in the **Annexure** and one of the basic criteria of their selection is their current releases.

Koha is the first open source ILS widely used all over the world. It was developed by Katipo Communications for the Horowhenua Library

Trust in New Zealand. Evergreen was developed by the Georgia Public Library Service for Public Information Network for Electronic Services (PINES) in United States and become popular in United States and Canada. PhpMyBibli was developed in French with the initiative of Public Library of Agneaux; it is now maintained by PMB Services (a French Company). Openbiblio was created by Dave Stevens, currently the software is under the guide ship of OpenBiblio development team and the maintainer is Hans van der Weij. On the other hand, NewGenLib is the only indigenous open source software in this field developed by Verus Solutions Pvt Ltd, powered by Kesavan Institute of Information and Knowledge Management in Hyderabad, India.

In updateness, Evergreen and Koha are leading the table with the latest release in 2015. All the open source ILS are designed for Linux platform, but some releases Windows and Mac versions too. Apache web server is used by all packages and RDBMS used is either MySQL or PostgreSQL. Perl, PHP and Java are the three main programming languages and the platform used in writing the source codes for the packages, though some packages use some additional programming language like JavaScript, Python, C, XML, and XHTML, etc.

Most of the open source ILS acquired GNU General Public License, but PhpMyBibli is licensed under CECILL License retaining compatibility with the GNU General Public License. MARC has been the predominant influence in schema design and every package is Z39.50 compliant.

6.2 Digital Library

The creation and maintenance of digital libraries has become vital with the growing amount of information available in the digital format. Building digital libraries needs a fair amount of knowledge of information management tools such as databases, web technology, information retrieval, user interface, etc. The usability of hosted resources is as

important as the quality of information presented. There are a number of open source software packages to be used for building digital libraries and institution repositories. DSpace, E-Print, Fedora, Greenstone, Invenio, etc. are popular open source package in this field listed in the **Annexure (Table 2)**. These open source solutions provide better control for system administrator with additional power in the hands of users and authors.

DSpace was developed, as a joint effort between developers from MIT and HP Labs and now a day the software is under stewardship of DuraSpace. The Fedora is also a project supported by the DuraSpace, earlier to that the software was developed by researchers at Cornell University. EPrints was developed in University of Southampton; on the other hand, Greenstone was developed at University of Waikato, as New Zealand Digital Library Project in collaboration with UNESCO and Human Info NGO. Invenio, formerly named as CDSware, was developed by the CERN Document Server Software Consortium.

Except Invenio, other packages can also install in Windows platform besides Linux. DSpace, Fedora and Greenstone can also install in Mac platform too. Apache web server is used by all the discussed packages, and as back end database, the packages use MySQL or PostgreSQL or oracle respectively. Greenstone uses GNU Database Manager back end database. Java, Perl, XML and Python are the four main programming languages and platform used in writing the source codes for the packages.

Most of the Digital Library Software package acquired GNU General Public License, but DSpace is licensed under BSD License and Fedora is licensed under Apache License. All the packages are compliant with the Open Archives Initiative Protocol for Metadata Harvesting (OAI-PMH) and supports Dublin Core Metadata Standards and Unicode. Invenio supports MARC 21, which is not common in other Digital Library Software.

6.3 Learning Management System

Learning Management System software are used for delivering, tracking and managing training and education; for example, tracking attendance, time on task, and student progress. Educators can post announcements, grade assignments, check on course activity, and participate in class discussions. Students can submit their work, read and respond to discussion questions, and take quizzes. Learning Management System Software may allow teachers, administrators, students, and permitted additional parties to track various metrics. There are huge numbers of Learning Management System Software available today. So, making the decision on which platform to choose can be quite overwhelming. Some open source software packages which support learning management are listed in the **Annexure (Table 3)** as follows- ATutor, Chamilo, Claroline, eFront, ILIAS, Moodle, OpenOLAT, Sakai, etc.

Moodle, the highest-ranked Learning Management System Software, was developed by Martin Dougiamas, a programmer who became frustrated with the LMS used at Curtin University and designed his own system (Wright, 2014). CollectMyThoughts is a crowd-sourced website/rating service that keeps Sakai and Moodle in the top 5 highest-rated Learning Management System Software along with other three commercial packages (<http://www.collectmythoughts.com/the-current-top-5-highest-rated-learning-management-systems-lms/>). Sakai was developed by the University of Michigan, Indiana University, MIT and Stanford University. ATutor was developed in University of Toronto. Chamilo is considered a fork of Dokeos, another discontinued Learning Management System Software and now the software is developing under the stewardship of Chamilo Association. Claroline was developed with the initiative of Catholic University of Louvain, which is now controlled by Claroline Consortium. eFront was developed as a research prototype funded by the Greek government, later Epignosis Ltd took responsibility for its development.

ILIAS software is controlled by ILIAS open source e-Learning e.V. OpenOLAT was developed by the University of Zurich.

Most of the Learning Management System Software packages acquired GNU General Public License, but OpenOLAT is licensed under Apache License, eFront is licensed under Common Public Attribution License (CPAL), and Sakai is licensed under Educational Community License. All the packages are platform independent i.e. can install in Windows, Linux and Mac platform too. Apache web server is used by all the discussed packages, and as back end database, MySQL is still found dominant. PHP and Java are the two main programming languages and platform used in writing the source codes for the packages.

6.4 Content Management System

Content Management System (CMS) is a system used to manage the content of a web site. Typically, a Content Management System consists of two elements: the Content Management Application (CMA), and the Content Delivery Application (CDA). The Content Management Application element allows the content manager or author, who may not know a standard markup language (e.g. HTML), to manage the creation, modification, and removal of content from a Web site without needing the expertise of a Webmaster. The Content Delivery Application element uses and compiles that information to update the Web site. The features of a CMS system vary, but most include Web-based publishing, format management, revision control, and indexing, search, and retrieval. Some open source software packages which support content management are listed in the **Annexure (Table 4)** as follows- Drupal, Joomla, Omeka, OpenCMS, PimCore, Plone, WebGUI, WordPress, etc.

Among the list, according to web technology tracker W3Techs, WordPress, Joomla and Drupal are the most popular open source Content Management System packages used worldwide (<http://w3techs.com>). Drupal was originally written by Dries Buytaert, and now the software is maintained and developed by a community of over 1,000,000 users and developers. Joomla was the result of a fork of Mambo, later Joomla.

developers created an organization called Open Source Matters (OSM) which now look after the Joomla project. WordPress was born as the official successor of b2/cafelog, a discontinued blogging tool and now WordPress Foundation is the supporting agency for the development of the software.

Most of the open source Content Management System packages acquired GNU General Public License, but OpenCMS is licensed under GNU Lesser General Public License and Pimcore is licensed under BSD License. Except Omeka, all the packages are platform independent i.e. can install in Windows, Linux and Mac platform too. Omeka supports Linux platform only. Apache web server is used by most of the discussed packages and as back end database MySQL is found dominant. PHP, Java Perl, XML and Python are the main programming languages and platform used in writing the source codes for the packages.

6.5 Journal Management System

Open source Journal Management System are software used for publishing and managing freely available journals worldwide for the purpose of making open access publishing which is a viable for journals, as open access can increase the journal's readership as well as its contribution to the public good on a global scale. Some open source software packages that support journal management and publishing are listed in the **Annexure (Table 5)** as follows - Open Journal System (OJS), Ambra, OpenACS, etc.

Open Journal Systems (OJS) is the most popular application developed by the Public Knowledge Project currently being used by more than 2000 online journals, in over 57 countries (http://openoasis.org/index.php?option=com_content&view=article&id=353&Itemid=379). Ambra is an innovative open source platform for publishing open access research publications developed by Public Library of Science (PLOS). OpenACS is a toolkit for building scalable, community-oriented web

applications originally developed side-by-side with the ArsDigita Community System (ACS), a product of ArsDigita Corporation. OpenACS is now maintained by the OpenACS Community.

Open Journal Systems (OJS) and OpenACS acquired GNU General Public License; on the other hand, Ambra is licensed under Apache License. Except Ambra, other packages are platform independent. Ambra supports Linux platform only. Apache web server is used by Open Journal Systems and Ambra; and OpenACS uses AOLserver as web server. As back end database MySQL is used by Open Journal Systems and Ambra; and OpenACS uses PostgreSQL. PHP, Java and Ajax are the main programming languages and platform used in writing the source codes for the packages.

7. Conclusion :

There are many open source software in the domain of different library activities and the number is enormously growing. Many projects are discontinued due to different problems, because to run such projects there should be an organized community support. DSpace, Koha, Moodle, Drupal, Joomla, WordPress, etc. have emerged as strong open source software packages for its large community support which are working globally. There is no way a single vendor of software will be able to gather and support all the programmers that a well-managed open source software project can support (Morgan, 2009). The users of such software also need some expertise in the areas of computing; as such software packages are not readymade in nature. OSS presents important opportunities for libraries- though in most ventures, opportunity is also a synonym for risk (Schneider, 2009).

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Annexure

There are a lot of open source software packages for library and information centres, but here only those packages are listed which are found online through their own website and which are still releasing updated versions. Again, enterprise open source software packages are excluded from the list as they charge money.

Table 1: Integrated Library System

Software & Web Address	Developer	Licence	Latest Release	Server (O/S) for current release	Associated Software	Standard Supported
Evergreen (http://evergreen-ils.org)	Georgia Public Library Service	GNU GPL	3.2.2 in November 2018	Linux	Apache, PostgreSQL, Perl, C	MARC21, Dublin Core, RDA, MODS, ISO 2709, Z39.50, OAI-PMH, SRU/SRW, OpenURL, SIP, NCIP, Unicode
Koha (http://koha-community.org)	Horowhenua Library Trust	GNU GPL	18.11 in November 2018	Linux	Apache, MySQL, Perl	MARC21, UNIMARC, MARCXML, FRBR, ISBD, Dublin Core, METS, RDA, MODS, ISO 2709, Z39.50, OAI-PMH, SRU/SRW, OpenURL, SIP, NCIP, Unicode
NewGenLib (www.verussolutions.biz)	KIIMP & Verus Solution	GNU GPL	3.1.2 in May 2015	Linux and Windows	Apache, PostgreSQL, Java	MARC21, MARCXML, ISBD, Dublin Core, MODS, ISO 2709, Z39.50, OAI-PMH, SRU/SRW, SIP, NCIP, Unicode
OpenBiblio (http://obiblio.sourceforge.net)	OpenBiblio Development Team	GNU GPL	0.7.2 in August 2014	Linux, Windows and Mac	Apache, MySQL, PHP	MARC21, MARCXML, Z39.50, SRU/SRW, Unicode
PhpMyBibil (www.pmbservices.fr)	PMB Services	GNU GPL & CECILL Licence	5.0.5 in April, 2018	Linux, Windows and Mac	Apache, MySQL, PHP	UNIMARC, MARCXML, FRBR, ISBD, RDA, Z39.50, OAI-PMH, SRU/SRW, SIP, NCIP, Unicode

Table 2: Digital Library

Software & Web Address	Developer	License	Latest Release	Server (O/S) for current release	Web Server & RDBMS	Written in	Standard Supported
DSpace (www.dspace.org)	MIT and HP, now DuraSpace	BSD License	6.3 in June, 2018	Linux, Windows & Mac	Apache & PostgreSQL/Oracle	Java & XML	OAI-PMH, METS, Dublin Core, SWORD, Unicode
EPrints (www.eprints.org)	University of Southampton	GNU GPL	3.4.0 in March, 2018	Linux & Windows	Apache & MySQL	Perl & XML	OAI-PMH, METS, Dublin Core, SWORD, Unicode
Fedora (http://fedora.repository.org)	Cornell University, now DuraSpace	Apache License	4.7.5 in February, 2018	Linux, Windows & Mac	Apache & MySQL/PostgreSQL/Oracle	Java & XML	OAI-PMH, RDF, METS, Dublin Core, SWORD, Unicode
Greenstone (www.greenstone.org)	University of Waikato, UNESCO & Human Info NGO	GNU GPL	3.0.8 in May, 2017	Linux, Windows & Mac	Apache & GNU Database Manager	Perl, C++ & Java	OAI-PMH, METS, Dublin Core, NGLS, AGLS, DLS, GMS, RFC1807, Unicode
Invenio (http://invenio-software.org)	CERN, an European Organization for Nuclear Research	GNU GPL	3.0.0 in June, 2018	Linux	Apache & MySQL	Python	OAI-PMH, MARC 21, Dublin Core, Unicode

Table 3: Learning Management System

Software & Web Address	Developer	License	Latest Release	Server (O/S) for current release	Web Server & RDBMS	Written in
ATutor (www.atutor.ca)	ATRC, University of Toronto	GNU GPL	2.2.4 in June, 2018	Cross platform	Apache and MySQL	PHP
Chamilo (https://chamilo.org)	Chamilo Association	GNU GPL	1.11.8 in August, 2018	Cross platform	Apache and MySQL	PHP
Claroline (www.claroline.net)	Initiated by Catholic University of Louvain, now controlled by Claroline Consortium	GNU GPL	1.12.0 in Sep, 2014	Cross platform	Apache and MySQL	PHP
eFront (www.efrontlearning.net/open-source)	Epignosis Ltd	CPAL	3.6.15.5 in May, 2015	Cross platform	Apache and MySQL	PHP
ILIAS (www.ilias.de)	ILIAS open source e-Learning e.V.	GNU GPL	5.3.10 in October, 2018	Cross platform	Apache and MySQL/Oracle/PostgreSQL/MariaDB	PHP
Moodle (https://moodle.org)	Martin Dougiamas, and Moodle Community	GNU GPL	3.6 in December, 2018	Cross platform	Apache and MariaDB/MySQL/PostgreSQL/MSSQL2008/Oracle	PHP
Open OLAT (www.openolat.com)	University of Zurich	Apache License	12.5 in June, 2018	Cross platform	Apache and MySQL/PostgreSQL	Java
Sakai (www.sakaiproject.org)	University of Michigan, Indiana University, MIT and Stanford University	Educational Community License	11.4 in June, 2017	Cross platform	Apache and MySQL/Oracle	Java

Table 4: Content Management System

Software & Web Address	Developer	License	Latest Release	Server (O/S) for current release	Web Server & RDBMS	Written In
Drupal (https://drupal.org)	Dries Buytaert	GNU GPL	8.6.3 in November, 2018	Cross platform	Apache/MS IIS/Nginx and MySQL/MariaDB//PostgreSQL/SQLite	PHP
Joomla (www.joomla.org)	Open Source Matters (OSM)	GNU GPL	3.9.1 in November, 2018	Cross platform	Apache/MS IIS/Nginx and MySQL/PostgreSQL/MS SQL Server	PHP
Omeka (http://omeka.org)	George Mason University.	GNU GPL	2.6.1 in May, 2018	Linux	Apache and MySQL	PHP
OpenCMS (www.opencms.org)	Alkacon Software and the OpenCMS Community	GNU LGPL	10.5.4 in May, 2018	Cross platform	Apache and MySQL	Java, XML
Pimcore (www.pimcore.org)	Pimcore GmbH company	BSD Licence	5.5.4 in November, 2018	Cross platform	Apache/ Nginx and MySQL	PHP
Plone (https://plone.org)	Plone Foundation	GNU GPL	5.1 in May, 2018	Cross platform	Zope Web Application & ZODB	Python
WebGUI (www.webgui.org)	Plain Black Corporation	GNU GPL	7.10.30 in January, 2016	Cross platform	Apache and MySQL	Perl
WordPress (https://wordpress.org)	WordPress Foundation	GNU GPL	4.9.8 in August, 2018	Cross platform	Apache and MySQL	PHP

Table 5: Journal Management System

Software & Web Address	Developer	License	Latest Release	Server (O/S) for current release	Web Server & RDBMS	Written in
Open Journal Systems (https://pkp.sfu.ca/ojs)	Public Knowledge Project	GNU GPL	3.1.1-4 in September, 2018	Cross platform	Apache/Microsoft IIS and MySQL/PostgreSQL	PHP
Ambra (www.ambraproject.org)	PLOS (Public Library of Science)	Apache License	3.3.1 in September, 2018	Linux	Apache and MySQL	Java
OpenACS (http://openacs.org)	OpenACS Community	GNU GPL	5.9.1 in August, 2017	Cross platform	AOLserver and PostgreSQL/Oracle	Ajax