The Adoption of Open-Source software's in Libraries in Digital Era: A Case Study of Pakistan

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Abstract

This study aims to explore the adoption of Open-Source Software's (OSS) in the academic libraries of Pakistan. It also focuses on the challenges encountered during the application and management of these software's in both public and private sectors academic libraries around the country. Quantitative data was collected through structured questionnaire developed and distributed online to the target population. The findings indicate that the library's adoption of OSS, such as Koha, SLIMS, GREENSTONE, and DSpace, was motivated by the need to distribute information to library users efficiently, modernize library staff workflows, and enhance user accessibility to library information resources. The OSS has been instigated specially in the cataloguing and circulation and digital library management functions of the library. The major hurdles impeding the software's full implementation include lack of planning, lack of technical expertise, and security concerns related to library software's. Study recommends that, to successfully adopt and implement any integrated library Software, proper planning and prior feasibility studies, along with proper training of the library professionals are recommended.

Keywords: Open-Source Software, Library Software Adoption, Academic Libraries, Pakistan.

Introduction

In this information age, the information has become an essential element for survival and vital as air we breathe. The advent of information technology (IT) has truly transformed the whole world into a global village and in real sense has affected every aspect of our lives (Hussain & Ahmad, 2021). The Information Technologies (IT) particularly, computer programs and software's also played a significant role in information management. This unbelievable technology of computers software's has enabled us to access, collect, organize, preserve and disseminate information from one point at library. Palmer and Choi (2014) stated that adopting new technologies is a nonstop challenge that academic libraries must agree to take. The history shows that among the institutions, libraries were quick to embrace IT during its early stages of development. Asim and Mairaj (2019) stated that the library software stands out as one of the central elements in the process of automating a library. A computer lacking software is comparable to a library without both librarian and books, rendering it incomplete and ineffective. The libraries of all types must embrace the ongoing challenge of adopting new technologies if, they want to continue serving as information providers for higher education institutions. Moreover, the use of software's for automation is very crucial to handle the explosion of information in libraries of all types (Hassan, Hamid & Shah, 2022).

Among the key technologies crucial to the functioning of libraries include the integrated library system (ILS) that manages library collections and services. Whereas, the digital library is responsible for organizing and maintaining digital assets like institutional repositories. There are several commercial options available for these systems, the growing need for technology coupled with limited budgets has sparked a mounting interest in OSS within academic libraries. Unlike proprietary software, OSS is characterized by developers' permission to create derivatives from the original software, free distribution and modifiable source code (Choi & Pruett, 2015). In other words, the open-source software refers to computer software with source code that is accessible under a license or arrangement, such as the public domain, allowing users to study, modify, and enhance the software. Furthermore, it grants the freedom to redistribute the software in its original or modified form. OSS is commonly developed in a joint venture within a public context. It represents a prominent model of open-source development and is often likened to user-generated content (Randhawa, 2008).

It is a fact that the information professionals are operating in a more complex yet fascinating environment. Their ability of providing effective services depends on leveraging open and concealed digital resources on the internet, which poses a challenging task for library professionals. Modern libraries continually strive to innovate and offer a diverse range of services to users with the aid of information and communication technology (ICT) applications. OSS has gained widespread popularity in current times, with libraries around the world extensively adopting it. Academic libraries are increasingly turning to Open Source Software (OSS) to cut costs, break free from vendor lock-in, and most significantly, offer users tailored technology solutions. While existing research primarily focuses on well-known OSS products through case studies and anecdotal evidence, this research provides more comprehensive and widely applicable insights for US academic libraries considering OSS adoption, based on an online survey reported by Choi, & Pruett, (2019).

According to Rafiq (2009), OSS refers to computer software whose source code is available under a license that permits users to use, modify, improve, and distribute the software, either in its modified or unmodified form. The access to a program's source code empowers developers to enhance and fix any aspects of the software that may not be functioning optimally. Reddy and Aswath (2015) are of the opinion that currently, numerous open-source computer applications are available to libraries for tasks such as library automation, management of library websites, knowledge management, and digital library administration. They also said that open-source software has gained popularity within the library environment, leading to a significant migration of libraries embracing the open-source software movement. They also found that a vast range of open-source software and applications, each with unique features and functionalities, are available for automating library tasks and operations. Examples of library software include Dspace, GSDL, e-Prints, Koha, Joomla, ABCD, Drupal, NewGenlib, and many more, all facilitating efficient and continuous information services to library clients.

In connection to the technological developments in Pakistan the utilization of computers in libraries have commenced during the late 1990s, with the assistance of the Pakistan Scientific and Technological Information Center (PASTIC) being recognized as the first institution to employ a computer for their union catalogue of scientific periodicals (Haider, 1998). Then Rafiq and Ameen in 2010 discovered that Information technology (IT) has significantly enhanced library services in Pakistan. They found that three libraries in Pakistan were using the Koha software, and

47.8 percent of librarians expressed interest in adopting Koha. The first instance of Koha being implemented in Pakistani libraries was in 2006, as reported by Ur Rehman, Mahmood, & Bhatti, (2012). As noted, that integrated library systems (ILS) are largely absent in Pakistani libraries; however, the usage of OSS, notably the Koha ILS, is on the rise in Pakistan. Rafiq and Ameen (2010) further revealed that, presently the OSS, particularly Koha, has gained immense popularity, primarily due to its free availability and distinguishing features, not only in developing countries like Pakistan but abroad as well such as Moruf, Sani, and Abu (2020) stated that the main reason of adoption and usage of Koha in Nigerian libraries is a result of its distinguishing features.

The attitude of librarians towards IT revolutions means a lot in the successful provision of services to library users, therefore technology adoption attitude of librarians needs to be explored (Shehzad, Tariq, & Naeem, 2021). In another study, Khan (2020) expressed that Pakistani librarian demonstrated hesitancy when it comes to embracing digital innovations, often relying on traditional practices. Such as Rafique, Subhpoto, & Idrees (2023) found that in the academic libraries of Sindh province Pakistan, majority of the services and functions were not fully automated. Ahmad & Ahmad (2017) stated that university libraries in Peshawar are using Information Technologies but not adequately. In other study, also found that developing countries like Pakistan faces many challenges with OSS documentation and support (Rafi et al., 2019). Jabeen et al. (2018) reported that plenty of interest among librarians in OSS existed, but the lack of in-house training and expertise blocked its adoption. Similarly, substandard OSS code and lack of internal trained staff was an issue for U.K. libraries (Dalling & Rafferty, 2013). However, recognizing the significance of OSS (like Koha and other library software's) as a valuable open-source software for library automation, these researchers have suggested its adoption due to practicality, user-friendliness, cost-effectiveness, and ease of maintenance. Acknowledging the importance of Koha, it becomes crucial to understand the drivers and obstacles influencing its acceptance and rejection within the Pakistani librarian community. Additionally, considering the prevailing gap in literature regarding the adoption of innovations among Pakistani librarians, there is a potential for research focusing on identifying and validating the factors that determine the intention to adopt OSS in libraries.

Similarly, in Pakistan the Pakistan Scientific and Technical Information Center (PASTIC, 2017) has played a pioneering role in introducing cloud computing to the field of library and information sciences in Pakistan. The utilization of cloud computing began with the

implementation of Pak-Cat, which served as the union catalogue for Pakistani books. This initiative was carried out as part of the larger project titled "Modernization of PASTIC National Science Reference Library with Effective Resource Sharing," dated 2-08-2017. To cater to local requirements, PASTIC customized the Koha library automation software in collaboration with Pakistani library professionals. In this regard, PASTIC organized a meeting of library professionals under the Consortium of S&T and R&D Libraries of Pakistan on October 18th, 2017, where the decision was made to proceed with the customization. At present, a total of 162 libraries in Pakistan are using the PASTIC Koha cloud. The open-source software paradigm has brought about a significant shift in the software development landscape, fundamentally changing how software is designed, developed, and disseminated. Its numerous advantages make it particularly appealing for libraries, especially those in developing countries.

While the use of Open Source Software (OSS) is on the rise in Pakistan, proprietary software remains dominant; however, the open-source movement has made significant strides in various industries, including government, education, and libraries, gaining considerable momentum and influence. Challenges such as the availability of technical expertise, resistance to change and limited awareness about open-source alternatives may have influenced the pace of adoption in certain sectors however, this research is intended to investigate the present scenario regarding the adoption of OSS in the libraries of higher education throughout Pakistan.

Research Objectives

Most basic objective of adopting OSS in libraries is to enhance overall efficiency and quality of library services. The below are some of the relevant objectives associated with the current topic of the study:

1. To ascertain the commonly used open-source software in libraries of Pakistan.
2. To gain knowledge about the reasons for the adoption of OSS, specific modules of OSS, OSS suitability to libraries, the level of satisfaction from OSS by the library staff and the impact of software's on the library functions, and challenges being faced in the implementation of OSS.

Research Questions

The following questions are outlined to reach the set objectives.

1. Which types of library software's are they using?
2. What are the causes behind the implementation of OSS in libraries?

3. How suitable is the open-source software for your library's needs?
4. Which module(s) of the open-source software are the most beneficial to your library community?
5. How much customizable are the open-source software’s to meet your library's specific needs?
6. How satisfied are they with the OSS they are currently using?
7. Are there any challenges encountered in the adoption and implementation of the OSS?
8. What recommendations would you provide to other libraries contemplating the implementation of OSS solutions?

Significance of the Study

The financial challenges arising from the COVID-19 pandemic have resulted in budgetary limitations for organizations, including libraries. Consequently, there has been a notable increase in the use of open-source software (OSS) in libraries to effectively manage budget constraints. By utilizing OSS, libraries can prioritize crucial areas such as collection development, staff training, and enhancement of user services. The flexibility and customization options provided by OSS allow libraries to tailor software to their specific requirements, creating an individualized and efficient environment that seamlessly integrates with existing infrastructure and operational processes. The collaborative nature of OSS promotes cooperation among libraries and organizations, enabling the exchange of ideas, software development contributions, and the utilization of collective expertise to improve software solutions. Adopting OSS provides libraries with autonomy from specific vendors, granting them greater control over their technology infrastructure. Furthermore, OSS emphasizes security and reliability, benefiting from community scrutiny and adherence to open standards, thereby promoting interoperability and preventing reliance on proprietary formats. By embracing OSS, libraries can encourage innovation and adaptability, stay abreast of technological advancements, and effectively respond to evolving user expectations. While challenges may arise during OSS adoption, understanding and addressing these challenges allows libraries to develop effective strategies for successful adoption. Proper planning, stakeholder engagement, staff training, and ongoing support are crucial factors in maximizing the benefits of OSS in library environments. Overall, the adoption of OSS in libraries provides a cost-effective solution to optimize budget allocation, foster collaboration, and promote

innovation, thereby enhancing services, improving user experience, and positioning libraries at the forefront of technological advancements in the evolving library landscape.

Method employed in this study

The quantitative design using an online survey was considered appropriate for the study. The target population was comprised of all the librarians employed in public and private sectors universities and colleges, across four provinces of Pakistan. The instrument designed with the help of previous literature was used to gather data online from the respondents through purposive sampling technique. The sample included all those librarians who were using OSS in their libraries. The questionnaire was distributed using SurveyMonkey, an open-source tool that provides visually appealing templates for creating both structured and unstructured questionnaires. Respondents were able to access the questionnaire conveniently through a simple link. The decision to employ an online questionnaire is driven by the goal of reaching a wider audience of potential respondents. The questionnaire consisted of two sections, addressing various aspects including demographic information, and the adoption of OSS including the reasons of adoption, module beneficial ness to library community, satisfaction levels with the OSS, challenges encountered when using OSS, and recommendations regarding OSS adoption etc. To ensure the validity of the draft questionnaire, two experts in the field of library and information science reviewed and approved it for the research. In July 2023, the questionnaire was distributed online to librarians working in colleges and universities through multiple platforms such as WhatsApp, Facebook, Twitter (Now X), email, and SMS along with the request that library professionals using OSS in their libraries should respond. Ultimately, 251 questionnaires were returned by respondents from diverse locations across Pakistan. The data was coded and fed in SPSS software for analysis.

Finding

Response Rate

The instrument was distributed online in July 2023 through WhatsApp, face book and other social media to reach the sample that was geographically spread over the research site as well as to get a good response rate. A total of 251 responses were received that is a fair response for the analysis of the situation regarding the adoption of OSS in Pakistan.

Background Information

The data in table 1 shows that more than half of the libraries 54% are medium in size, some 26% libraries are large in size and only 20% libraries are small. When respondents were asked

about the familiarity with OSS, data shows that, 2% respondents expressed that they are not familiar with OSS, 34% are somewhat familiar, and 64% are familiar and very familiar.

The responses regarding the number of professional staff involved in operating OSS show that majority 118(47%) of the libraries using OSS are having more than 6 professional staff whereas, in 75(30%) libraries there are 4-6 professionals working and about 58(23%) libraries the professional staff was up to 3 members.

So, for the types of software are concerned no library was using commercial software, majority 128(51%) of the respondents are using free software, 70(28%) are using Open Source software and only 53(21%) have adopted home developed software's. Similarly, when the subjects are asked whether they are trained to use software's or not. A large majority143 (57%) said that they are partially trained and 45(18%) state that they are fully trained. Surprisingly, 63(25%) mentioned that they are using software's without training.

It is very encouraging that a large majority of the respondents are familiar with OSS and most of the libraries adopted OSS are medium or large in size. Small libraries are rarely adopted OSS. Similarly, majority of the libraries using OSS are having staff not less than 3.

Table1

Background Information

Variables	Categories	Frequency	Percentage
Size of Library	Small Libraries	50	20%
	Medium Libraries	136	54%
	Large Libraries	65	26%
Familiarity with OSS	Not Familiar	5	2%
	Somewhat Familiar	86	34%
	Familiar	100	40%
	Very Familiar	60	24%
Professional Staff involved in using OSS	1-3	58	23%
	4-6	75	30%
	More than 6	118	47%
Type of Software use in library	Commercial	0	0%

	Home Developed	53	21%
	Free	128	51%
	Open Source	70	28%
Staff training	Not trained	63	25%
	Partially trained	143	57%
	Fully trained	45	18%

Adoption of Open-Source Software

Types of OSS adopted in Libraries

The detail about the different OSS used in the libraries shows that majority 151(60%) of the libraries are using Koha, followed by SLIMS that is used by 33(13%) and 24 (10%) libraries using GREENSTON and 13(5 %) DSpace. However, 30 (12%) libraries in Pakistan using other software's.

It shows that Koha, SLIMS and GREENSTONE are the highly used software's as compared to DSpace and In-House software's.

Table 2

The Types of OSS used in Libraries

S. No	Open Source Library Software	Frequency	Percentage
1	Koha	151	60%
2	SLIMS	33	13%
3	GREENSTONE	24	10%
4	DSpace	13	5%
7	Other	30	12%
	Total	251	100%

Reasons for the Adoption of OSS

The table 3 shows the answers regarding the reasons for the adoption of OSS. It reveals that cost saving, customization and security are the major reason with highest mean score, 4.34,

4.01 and 3.54 respectively. The other minor reasons for the selection and adoption of OSS are community support mean=3.23 and compatibility with existing systems mean=3.01. The analysis of data in table below shows that they adopt library software mainly for its cost saving and customization facilities rather than other reasons.

Table 3

Reason of the adoption of OSS

S. No	Reason for the adoption of OSS	Mean	SD
1	Cost saving	4.34	.017
2	Security	3.54	.321
3	Community support	3.23	.389
4	Customization	4.01	.132
5	Compatibility with existing systems	3.01	.574

The suitability of OSS for library's Need

In order to know the opinions of the respondents' regarding the suitability of OSS for their libraries are displayed in table 4. The respondents expressed that OSS are suitable due to its features like open source code having highest mean score, 4.55 and the variety of modules having the second highest mean score 4.01 along with easy installation and customization mean=4.00. The other suitability is OSS features and functions mean=3.90 and easy understanding mean=3.24.

Table 4

How did you evaluate the suitability of open source software for your library's needs?

S. No	Reason for the suitability of OSS	Mean	SD
1	Suitable due to easy installation and customization	4.00	.491
2	Suitable due to ease of understanding	3.24	.987
3	Suitable due to its features and functions	3.90	.299
4	Suitable due to open-source code	4.55	.021
5	Suitable due to variety of modules	4.01	.566

Which module(s) of the OSS have been most beneficial to your library community?

In order to determine the modules which are more beneficial for the library community, the study participants rated the below mentioned modules in their softwares. The data in table 5 shows that library professionals are of the opinion that the following modules of OSS like, Cataloguing (mean=4.02), Circulation/Patron management (mean=4.00) and Digital Library Management (mean=3.99) the most beneficial to their community. However, some modules like, OPAC mean=3.89, Search mean=3.79, Book reservation mean= 3.78, Acquisition mean=3.76 are less beneficial to the library patrons. In addition, they stated that, OSS module i.e. Inter-library loan mean=2.97 has the lowest advantage for the library users.

The findings shows that all modules of OSS are beneficial with different mean scores but, among these cataloguing, circulation and digital library management are very important than serial management, acquisition and inter-library loan.

Table 5

Module(s) of the open-source software most beneficial to you and your library community

S. No	Modules of OSS	Mean	SD
1	Cataloguing	4.02	.256
2	Circulation/Patron Management	4.00	.176
3	Acquisition	3.76	.567
4	Serial Management	3.00	1.236
5	OPAC	3.89	.984
6	Inter-Library loan	2.97	1.280
7	Book reservation	3.78	.988
8	Digital Library Management	3.99	.098
9	Discovery/Search	3.79	.356
10	Institutional Repository	3.56	.289

The extent of customization of your OSS to meet your library's specific needs

The respondents were asked to express their view about the customizability of their OSS used in their library. The details in table 6 reveals that more than half of the respondents 136(54.18%) agreed that their software's are highly customizable. Another larger group of the respondents 92(36.65%) said that their software's are moderately customizable. But, a reasonable number 23(9.16%) mentioned that their software's are customizable. Thus, it is good that the larger

group expressed that they have adopted OSS which are highly or moderately customizable which can be used to meet the specific need of the community.

Table 6

The extent of customization in Open Source Software (OSS) to meet library's specific needs

S. No	The Ability of customization in your OSS	Frequency	Percentage
1.	Not customizable	23	9.16%
2.	Moderately customizable	92	36.65%
3.	Highly customizable	136	54.18%
	Total	251	100%

Scale: *1-3, 1 Not customizable and 3 Highly customizable.*

How satisfied are they with the adoption of Open Source Software?

The adoption of OSS in libraries affects the respondent's level of satisfaction The tabulated data in table 7 shows that, the library professionals are satisfied with the highest mean score=4.56 and highly satisfied with the second highest mean score, 3.65. However, they are very dissatisfied or dissatisfied with the lowest mean scores as, 2.67 and 2.01.

Here, it is important to note that some of the respondents give no opinion regarding the satisfaction

Table 7

Respondents level of satisfaction with the adoption of OSS

S. No	Respondent's satisfaction level with the adoption of OSS	Mean	SD
1	Very Dissatisfied	2.67	1.230
2	Dissatisfied	2.01	1.034
3	Neutral	3.56	.990
4	Satisfied	4.56	.011
5	Highly satisfied	3.65	.988

Scale: *1-5, with 1 being l very dissatisfied and 5 highly satisfied.*

The challenges faced by the librarians in the adoption and implementation of OSS

So, for the challenges faced by the librarians in adopting OSS are concerned? The respondents' answers have been displayed in table 8. It discovers that, the most important challenges in adopting OSS are; Lack of technical expertise mean score=4.76 followed by two challenges, lack of planning and security concerns having same mean scores=3.99 are considered as important by the respondents. The rest of the challenges mentioned by the respondents like, Compatibility issues with the existing systems mean=3.02, lack of internet mean=2.10 and lack of Hardware mean=2.13 are considered less important by the study participants.

Findings showed that lack of technical expertise is the biggest problem in the adoption and implementation of OSS.

Table 8

The Challenges faced by the participants in the adoption and implementation of OSS

S. No	Challenges faced in the implementation of OSS	Mean	SD
1	Lack of planning	3.99	.763
2	Lack of technical expertise	4.76	.001
3	Compatibility issues with the existing systems	3.02	0.999
4	Security concerns	3.99	.277
5	Lack of Internet	2.10	1.231
6	Lack of Hardware	2.13	1.171

Scale: *1-5, with 1 being low and 5 being high.*

Would you recommend the adoption of OSS to other libraries in Pakistan?

In response to this question, about 221 respondents said that yes, they would recommend other libraries to adopt the OSS because of the following reasons.

1. Open-Source Software (OSS) are user friendly as mentioned by 199
2. Open-Source Software (OSS) are customizable as mentioned by 168
3. Open-Source Software (OSS) are providing Cloud as mentioned by 155

Remarkably some 30 respondents gave no answer regarding the recommendation of adopting OSS in libraries.

Limitation and delimitation of the study

One of the limitations of the study is that researchers is not able to find the exact number of libraries using OSS which could be used for data collection. However, it is decided to distribute

the instruments online and wait for three months in order to get maximum response. After the specified time 251 responses were received, data was fed in the SPSS for further analysis. Similarly, the study is delimited to the academic libraries (College and Universities libraries) both in private and public sector. It does not include data from the Public, Special or National libraries.

Conclusions and Recommendations

The study investigated the adoption of Open-Source Software (OSS) in libraries in Pakistan, revealing a significant shift towards OSS adoption. A majority of libraries (54%) are medium in size, and most librarians (64%) are familiar with OSS, with Koha, SLIMS, and GREENSTONE being the most commonly used OSS. The reasons for adopting OSS include cost savings, customization, security, and community support, indicating a growing recognition of OSS as a viable alternative to proprietary software.

Despite the challenges faced by librarians in adopting OSS, including lack of technical expertise, the majority of respondents (221) would recommend OSS to other libraries in Pakistan due to their user-friendly nature, customizability, and cloud-based services. The study concludes that OSS have the potential to revolutionize library services in Pakistan, and libraries should invest in training and technical support to fully harness the benefits of OSS. The study recommends prioritizing OSS adoption in libraries to enhance library services and promote digital literacy in Pakistan, aligning with the global trend of embracing open-source technology in libraries.

In light of the data analyzed and findings drawn, following recommendations are extracted for future applications.

1. As a smaller number of small libraries are adopting OSS as compared to medium and large libraries. Therefore, authors recommend all sizes of libraries to adopt the OSS to improve library services and to enjoy the cost saving in developing country like Pakistan where there are economic challenges faced by the academic institutions.
2. As Koha, the highly used and followed by SLIMS, GREENSTONE and DSpace software's, therefore, training programs regarding these software's should be arranged by the LIS schools and Library Association to highlight these software's among library professionals.
3. The library software's are mainly adopted for its cost saving and customization facilities therefore, this research strongly recommends that LIS curricula has some courses on programming which can enable the system librarians to install, customize, use and maintain

the software's and hardware. Learning these skills and techniques librarian should be able to overcome the technical challenges related to OSS.

4. As this study found that librarians are very much sure that OSS are suitable because of open-source code, variety of its modules and due to its easy installation. But, at the same time they expressed that the cataloguing, circulation and digital library management modules are more beneficial to library users and in addition they also stated that lack of planning and technical expertise and security concerns are the main hindrances in the way of OSS adoption. Therefore, the researchers suggest that to enhance the knowledge of librarians related to OSS trainings, workshops and conferences should be organized on different levels.
5. Respondents revealed that they are satisfied or highly satisfied with OSS because of its user-friendly interface, customizability therefore, they recommend other libraries in the country to adopt Open-Source Software's. Keeping in view the satisfaction of the respondents with the OSS this study also recommends the adoption of OSS but, after proper planning and prior feasibility study.

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