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Open Source Software Adoption in Libraries – A Literature Review Study

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ABSTRACT

Purpose:

The present study is a literature review and its analysis part of a larger research work i.e. “Issues and Challenges of Using Open Source Software in Private Business Management Education Institutions Libraries of Noida & Ghaziabad Region”. Authors through this study have tried to identify the already published research work related to Open Source Software from different perspectives emphasizing of Indian context in particular.

Design/Methodology/Approach:

This is a literature review study and hence methodology adopted is to consult all possible sources of literature and particularly secondary literature including papers published in journals, magazines, conferences’ proceedings, websites and/or blogs articles. Dissertations, theses and books published related to the topic are all included in the literature review to have comprehensive view of the research already conducted related to the subject. Analysis of existing literature is done to understand key findings and areas for future research.

Findings:

Authors analyzed that a lot of work has been done related to origin, history and details of open source software, various types of open source software used in libraries. Lot of literature is available on open source software used for library management and for developing digital libraries, however, very less work has been done by researchers to study any correlation between open source software adoption and gender and age of the librarians.

Research implications:

The present study would serve as a comprehensive background study on open source software use in libraries and provide new thrust areas for budding researchers that they can work upon.

KEYWORDS: Open Source Software, OSS, OSS Adoption in Libraries, Literature Review

INTRODUCTION

Information technology is currently governing all aspects of life. Particularly after the ongoing pandemic of COVID-19 virus spread, use of information technology (IT) tools and techniques has been immensely increased even in the common man's life. Information technology usage is so much now that even family gatherings, functions, birth celebration and condolences meetings are too even conducted online. This was not a scenario always. Prior to 1985, particularly in developing countries like India, almost all operations were manual. It was first time in 1985, when mass scale Computerization and automation of processes started in India and rest is history.

Libraries, as fifth law of library science rightly calls, in their true sense are growing organisms and are always at forefront of adopting and adapting to new skills, new technologies, new resources and providing new and innovative services. Hence, when computerization started in India, libraries very quickly adopted the new system, learnt skills to use computers for their needs and in many libraries automation of libraries and their processes started on a very large scale.

It was 1990's decade when many library automation software providers emerged who helped in setting up automation processes in libraries. A great number of libraries got computerized using services of these proprietary software providers.

The cost of Software, licensing terms and AMC services were however remained a core concern as libraries were entirely dependent upon software provider services for any change or additional services. Without AMC there were no chances for any troubleshooting as source code was not provided to libraries and remained with software providers.

Problem was even more acute for medium and small libraries as budget & manpower constraints were always a barrier for them to undertake automation and to continue AMCs. Gaining skills set was another concern. Problem was even more serious among library professionals working in private sector particularly in smaller organizations where all management support, money and manpower were missing. Such concerns were there in other parts of the world and also in other fields too and not just related to libraries. In fact, libraries were just a very small segment among all sectors that were facing hardships with proprietary software vendors due to their monopoly and tough conditions with little flexibility.

Initiatives started particularly in Western part of the world to end monopoly of proprietary software vendors and resulted in growth and development of Open Source Software. Open source is an approach to software development and intellectual property in which program code is available to all participants and can be modified by any of them

Open Source Software gained momentum with establishment of Free Software Foundation (FSF) in 1985 by Richard M. Stallman. FSF developed the General Public License (GPL) that is often called "Copyleft" to allow programmers to release the software with its source code. In 1991,

Linus Torvalds released version 0.1 of the Linux Kernel as an operating system, an alternative to Windows, the proprietary system of Microsoft.

In the mid- 1990s, after public release of Netscape's browser source code the Open Source Initiative (OSI) came into existence as an alternative institution to Free Software Foundation (FSF) and provide proper conditions for any software to be termed as Open Source.

A lot of development on open source software in all fields including to be used for library management has taken place since then and is continuing as now it is open source community driven work and not just dependent upon any individual or organization.

Continued development in open source software domain has been a topic of research interest for researchers across domains and lot of research output has been published in the form of research papers, conference proceedings, monographs, books, blog articles etc.

Current study has tried to find out and review the existing published literature regarding open source software history, growth and development, types of open source software used in libraries, leading open source software, their comparison and finding the best suitable open source software for libraries and so on.

OBJECTIVES

Identifying right kind of open source software that are even backed up with backend support, easy to adopt and use is in greatest interest of libraries

The current literature review study, a part of the research study on "Issues and Challenges of Using Open Source Software in Private Business Management Education Institutions Libraries of Noida & Ghaziabad Region" is undertaken with clear objective of finding out existing research work related to use of open source software among libraries and determine what are the thrust areas for future research in this domain. Output of this literature review will help not only in identifying both the benefits and problems associated with the usage of open source software but will also help in determining solutions to the problems faced in implementing such tools.

The current study is designed to achieve the following objectives:

- To find existing literature available on the history of open source software (OSS) and the need of OSS in the libraries.
- To find existing literature on various open source software available for use in the libraries for their various functions.
- To study the existing literature available on the advantages versus disadvantages of using open source software over Commercial Software
- To study the existing literature available on open source software in the context of Indian libraries.
- To determine the chronological development of literature on open source software for libraries
- To determine new thrust areas where either no or very little research work has been conducted related to open source software

LITERATURE REVIEW

It is essentially required to make a review of literature to determine the quantum of work done in general and to identify research work already done related to your research interest in particular. After going through various printed and online resources and after visiting various research libraries, finally, 110 previous works were identified and are included under Literature Review.

History and Development of Open Source Software

- Bretthauer, David (2001) in his paper has traced the history of open source software since 1970 to 2000.
- Morgan, Eric Lease (2002) in his classic paper has elaborated how open source software can help in providing better and effective services to users by the libraries.
- Amin, Saiful (2003) in his dissertation discussed different OSS software used for library automation and also for value added services (VAS) in libraries
- Wheeler, D (2003) work on his webpage not only provides a history of open source software development but also suggests a business model for OSS
- Crawford, Richard S (2004) papers has described useful open source software in library context while also providing brief history of OSS
- Krishnamurthy, M. (2007) in his paper” has described how in libraries across the world, trend of open access, open source and digital libraries has become new phenomena.
- Schneider, K.G. (2009) has described how in the beginning of the twenty first century everyone started discussing about use of open source software in libraries and factors behind this.
- Wikipedia (2009) provides definition, history and development of open source software

Similarity between Open Source Software and Librarianship

- Morgan, Eric Lease (2008) cites similarity between OSS and librarianship in terms of both advocating free and equal access to information, mentions that computing program are 20 % technology issue and rest 80% people issue. He also calls for including commercial institutions to support OSS.
- Muller, Tristan (2011) also find similarity between OSS and librarianship both encouraging intellectual freedom and free usage.
- Puckett, Jason (2018) describes common values between librarians and open source software community i.e. both believe in openness and free flow of information.

Types of Open Source Software

- Richardson, Howard (2001) has described a Web content filtration open source software and suggests that OSS can be adapted for any purpose as per your needs
- Keats, Derek (2008) study provides comprehensive list of free and open source software for different works of library and calls for more and more use of OSS ecosystem in all functions of library
- Balas, Janet L. (2009) has described various open source software utility useful for libraries.
- Molyneux, Robert E (2009) paper citing example of Evergreen also calls for use of OSS in libraries.

- West, Jessamyn (2009) paper provides list of ten additional useful OSS for libraries in addition to usual OSS library automation software for developing RSS feeds, filtering contents, E-mail, e-mail antivirus, web statistics, image editing, audio editing, wikis, HTML editing and accounting.
- Engard, Nicole C (2010) book elaborates on various open source software for libraries.
- Tajoli, Zeno, et al. (2010) paper shows how Koha has emerged as a leader among OSS library automation software.
- Espiau-Bechetoille, Camille, et al. (2011) also suggest fulfilling collective expectations by Koha in terms of Union Catalogue etc.
- Vasupongayya, Sangsuree, Kittisak, Keawneam, Sengloilaun, Kittipong, Emmawat, Patt (2011) have compared different open source software with respect to satisfying different functionalities of library system and also provide system requirement, environment of different OSS and language used in their development.
- Velmurugan, C & Kannan, M. (2012) have discussed various features of leading digital library software used in India and provided a list of different open source software for different functional areas of library.
- Randhawa, Sukhwinder (2013) paper has described features of leading open source software like Koha, NewGenlib, Evergreen, SENAYAN, ABCD, and BiblioteQ.
- Breeding, Marshal (2016) in his paper has discussed various open source software including Koha, ABCD, Evergreen and the latest Folio as supported by Ebsco Publishing and has made a comparison of all leading software.
- Ray, Aswini Kumar and Ramesh, D.B. (2017) have described features of leading open source software for libraries.

Proprietary versus Free and/or Open Source Software

- Ghosh, Rishab A, et al. (2002) in their study have provided comparative analysis between open source, free software and proprietary software developers, their economic models, their motivational factors etc. and how people associate any positive feature with OSS and negative features with proprietary software
- Tong, Tan Wooi (2004) in a UNDP report has defined free and open source software and differentiated them. While free software is more towards freedom, Open source talks more about advantages. Reports mentions that open source software may not always imply free software
- Riewe, Linda M (2008) study compares OSS and proprietary Integrated Library Systems (ILS) and concludes that OSS are cost effective and calls for smoother installation and better documentation for OSS
- Watson, Richard T, et al. (2008) study accepts that OSS is altering the competitive landscape within the software industry but cautions that proprietary software developers will also come out with newer strategies to counter OSS and this paper suggests that eventually line between these two models will blur
- Colford, Scot (2009) paper differentiates between Free and Open Source software and calls for cost benefit analysis before finalizing if free/OSS or commercial software is to be used.
- Schneider, KG (2009) paper mentions that proprietary software is still market leaders but use of OSS in libraries is growing.

- Vance, Ashlee (2009) study finds that OSS as a business model is still illusive and only proprietary software model is viable and sustainable
- Stallman, Richard (2010) also clarifies that fee software means freedom of choice and not necessarily free cost and also differentiate between OSS and Free software. According to him, open source is a development methodology whereas free software is a social movement
- Wheeler, David A (2011) finds that calling “Commercial” as an antonym for FLOSS is not correct as developing FLOSS also require costing and FLOSS licenses and projects also clearly approve of commercial support; and official definitions of “commercial item” in US Government definition include FLOSS too. In fact, there are two kinds of commercial software: proprietary and FLOSS.
- Pruett, Joseph and Choi, Namjoo (2013) in their work have made descriptive study about various features and licensing conditions etc. of both proprietary and open source software system.

Open Source Software for Digital Library Development

- Prudlo, Marion (2005) has discussed use of open source software tools in e-archiving or building digital repositories.
- Naik, Umesha, Shivalingaiah, D. (2006) study has made a comparison among three digital library open source software used in India i.e. Greenstone DSpace, and Ganesha.
- Bradley, Kevin; Lei, Jurrans and Blackall, Chris (2007) advocates UNESCO participation and help in developing a single open source repository using international standards for digital archiving using affordable OSS tools, technology and training.
- Pirounakis, George and Nikolaidou, Mara (2009) book has compared five OSS for digital library usage providing different environment under which each one of them will be useful.
- Biswas, Goutam and Paul, Dibyendu (2010) paper calls that OSS is more about empowerment for less privileged libraries and for bridging the digital divide and while comparing Greenstone versus Dspace concludes that Dspace is a much better option.
- Madhu, K.N. and Kumar, Lakshana (2011) in their paper have also discussed various OSS used for digital library development describing a number of digital libraries in India developed with help of open source software.
- Wei, Zhaohui (2011) paper has provided different factors that need to be compared while choosing any open source software.
- Trambo, Shahkar, Humma, Shafi, S.M., Gul, Sumeer (2012) in their work have made a comparative study of three leading digital library software.
- Hanumappa, Anilkumar, Dora, Mallikarjun and Navik, Viral (2013) in their study have explored various OSS useful for Indian libraries for library management and for digital library development
- Raghunadha Reddy, T. and Kumar, K. (2013) research study discusses features of leading open source library management software.
- Cherukodan, Surendran and Humayoon Kabir, S. (2013) have described why DSpace is the most chosen and implemented software for digital library creation in India.

- Handa, Sumeet Kumar and Bhatt, Kishor (2017) paper discusses history of OSS and features of leading open source software in libraries.
- Gurikar, Rushmanasab and Hadagali, Gururaj S. (2021) in their work has undertaken a study of 209 libraries and found out that DSpace and EPrints are two of the most widely used in Institutional repository software in India.

Advantages of Using OSS in Libraries

- Daffaro, Carlo, et al. (2000) advocate adoption of open source software by countries to have competitive advantage.
- Tennant, Roy (2000) looks into low costs of developing digital library software by their developers due to availability of source code of similar open source software cautioning that open source is not an alternative for all types of libraries
- Chawner, Brenda (2004) has described benefits of OSS and also listed factors associated with adoption of OSS in any organization
- Corrado, Edward M (2005) have explained meaning and benefits of Open Source, Open Access and Open Standards and for libraries how these will provide easier and more comprehensive access to scholarly research to their patrons
- Evans, Roger (2005) describes how public libraries can save costs by using open source software
- Mishra, Sanjay (2005) has also described competitive benefits that an educational institution can get by adopting open source software
- Singh, Ibohal; Devi, Madhuri and Singh, P Sanjaoba (2008) calling for ‘Anywhere Accessible Library’ stress on role of OSS by providing greater freedom with lower costs
- Yuan, Li; MacNeil, Sheila and Kraan, Wilbert (2008) paper is also about Open Education Resources (OER) using OSS which may help in removing society’ boundaries and in promoting life-long learning
- Chudnov, Daniel (2009) in his classic paper claims that OSS/free software is not just about saving costs but more about freedom to use, to study how the software works, to modify the software as per needs and to copy and share copies of the software
- Devaney (2009) identifies costs and flexibility as two main factors for use of OSS
- GNU Project – Free Software Foundation (2010) provides a business model for Free Software as a user is free to run the program, change the program, and redistribute the program with or without charges
- Giri, Rabishankar and Sengar, DS (2011) also find OSS as more future oriented and more easily amenable for customization at much lower costs.
- Herbert, Eric (2011) suggests that using OSS implies that money saved on software may be diverted for other useful library activities

Disadvantages of Using OSS in Libraries

- Chudnov, Daniel (1999) in his study finds that due to lower critical mass of libraries, producing commercial software is not a viable business hence open source software (OSS), a community driven imitative have high chances of success.
- Balas, Janet L (2004) in her work advises to be careful while planning and executing any open source software work as failure will be both embarrassing and expensive.

- Abram, Stephen (2009) work is highly critical of Open source software (OSS) development and use in libraries and calls using OSS as “stupidest strategies ever undertaken” and OSS in libraries is developed as per library staff desire and not as per institutional policies or end-user needs
- Foote, Amanda (2010) paper dispels the myth that OSS are free and calls for measuring costs in terms of human, time, and monetary costs while shifting to OSS. According to this paper OSS provides freedom to change software into anything and everything a library desires but it’s not free
- Njoku, Ifeoma S. (2017) in his paper has highlighted factors that are causing hindrance in adoption of open source software in Nigeria.

Advantages and Disadvantages - Both of Using OSS in Libraries

- Altman, Micah (2001) discusses advantages and disadvantages of using open source software in libraries suggesting that open source standards and protocols used in the library will always be open to examination and further development.
- Hein, Gary (2004) calls for a clear cost-benefit analysis before any library takes a call on adopting OSS and calls for full involvement of library staff in OSS implementation citing benefits versus risks of OSS
- UK Government Parliamentary Office of Science and Technology (POST) (2005) documents listed advantages and disadvantages and examines factors affecting uptake of OSS
- Witten, Ian H (2009) raises the sustainability issue in OSS describing how Greenstone is a sustainable digital library OSS
- Zargaryan, Tigran (2009) while providing pros and cons of OSS highlights how OSS is able to provide affordable community access points, build new business initiatives and so on
- Sumer, F.R., Hangsing, P. and Prasad, A.D. (2017) in their paper have discussed how discusses advantages versus disadvantages of using Open Source Software in libraries.
- Pund, Mukesh A. (2010) in his presentation has made a comparative study about use of open source software for libraries.
- Khode, Subhash and Chandel, Sunil Singh (2016) in their study have discussed benefits of adopting open source software as well as challenges in implementing OSS in libraries.

Licensing Issues of Open Source Software

- Lee, Steve H (1999) has discussed licensing issues of OSS and suggests that open source software licenses, in general, are legally enforceable and it is necessary to avoid stealing of community work by greedy commercial software developers by legally enforcing these licenses.
- Stinebruner, Scott A; Humphrey, Thomas W and Davis, John P (2002) have discussed about licensing issues in open source software versus proprietary software while describing the risks associated with OSS

- AlMarzouq, Mohammad, et al. (2005) provide three core approaches for looking into Free and Open source software (F/OSS) i.e. software, the community and the license mentioning that F/OSS is changing the way companies acquire software
- Breeding, Marshall (2007) calls for transparency in library automation so that librarians are well aware about the organization or source from which they plan to acquire OSS for automation
- D'Antoni, Susan (2008) in the UNESCO study on open educational resources (OER) advocates for using open source software in developing OERs so as to have easy copyright and licensing terms
- Singh, Sanjay Kumar and Deka, Prasanta Kumar (2008) study also calls for adoption of OSS in automation of libraries in Assam due to cost aspects and easy licensing conditions

OSS Community or Experts Participation in OSS Implementation

- A dissertation report by Clarke, Kevi, S. (2000) examines if the library community must extend its support for open source software development discussing pros and cons for doing the same.
- Balas, Janet L (2005) calls for taking help of support services and not to think that open source software means doing everything by yourself.
- Banerjee, Kyle (2005) has strongly advised to try open source software mentioning that being community driven initiative, it would be easier to get help in case of any issue. He has listed several advantages of using open source software
- Buchanan, Kym and Krasnoff, Basha (2005) calls librarians to join OSS communities along with their IT team people to understand nuances of OSS and to save time and money by installing open source software
- Hasan, Nabi (2009) cites the community backing as the main reason for OSS success in libraries
- Kaur, Kiran and Yip Ping, Chia (2009) paper on open access initiatives in libraries calls for wider contribution from community to develop open source and open access institutional repository
- Breeding, Marshall (2010) study finds that libraries using self-support services were having more satisfaction with OSS than who are using external help
- Fakhlina, Resty, Jayanti, Saputra, and Dwi Fajar (2019) in their paper have highlighted how open source software communities are helping development of libraries in Indonesia.

Measuring Effectiveness of Open Source Software

- Berg, Karin van den (2005) has provided an evaluation tool to find the right software package to meet the user's needs based upon Functionality, Community, Release Activity and Longevity.
- Dion Hoe-Lian Goh et al. (2006) in their paper have provided a useful instrument to measure usefulness of different open source digital library software.
- Breeding, Marshall (2009) questions if OSS is a viable alternative of proprietary software evaluating on four parameters i.e. market acceptance, support options, product development and functionality and risk factors and concludes in affirmation

- and also suggests that OSS emergence has resulted in commercial vendors also introducing new openness in their closed-source products
- Wheeler, David A (2009) has provided evaluation procedure and tools to evaluate software especially F/OSS

Gender Bias in Open Source Software Development

- Krieger, Bernhard and Leach, James (2006) has studies gender bias in development of open source software giving reasons why open source software field is still not popular among females.
- Powell, Whitney E and Hunsinger, D Scott (2010) has discussed gender bias issue in OSS field in their study

Barriers and Motivation for Open Source Software Adoption

- Xu, Bo (2006) in his paper discusses incentives or motivational factors to increase participation of community in open source development and suggests that relational social factors act as a great motivator for community participation in OSS projects and its development.
- Tennant, Roy (2007) papers suggests change is inevitable and by choosing OSS, libraries will be able to save costs both on software part but also on hardware using hardware architecture that allow scaling up as per needs.
- Caldwell, Tracey (2007) paper asks some important questions related to fixing responsibility in selecting, cost aspect, maintenance, support while calling for active participation of library community in OSS development
- Amaral, Megan (2008) papers calls for important role librarians can play in establishing digital repositories using open source software and help in free flow of information world over.
- Li, Yan; Tan, Chuan-Hoo and Xu, Heng (2011) investigate the motivational factors for adopters' usage of OSS and non-adopters' intention to adopt OSS.
- Blowers, Helene (2012) in her paper has described how FOSS4LIB can help in planning and decision making about open source software adoption.
- Dalling, John and Rafferty, Pauline (2013) paper reflects attitude of UK higher education libraries towards open source software adoption and why are they unwilling to migrate to open source software.
- Choi, Namjoo and Pruett, Joseph A. (2019) in their paper have described factors that act as barriers and motivators for OSS adoption among US academic libraries.

Open Source Implementation - Case Studies

- Mahmood, Khalid (2009) paper is about use of OSS in Pakistani libraries.
- Bahuman, Chaitra; Bahuman, Anil; and Nair, Siddharth (2010) paper is study on successful implementation of OSS in an agricultural library.
- Chouhan, Lal Bahadur (2010) in his dissertation study has made a comparative study of adoption of OSS in four libraries of India.
- Shibu, KM (2011) study mentions how due to OSS and open access initiative cultural heritage literature of India has reached to different parts of world due to low cost of creating repositories. Study also suggest a business model for OSS i.e. service-oriented support services rather than earning from selling software license.

- Surendran Cherukodan G. Santhosh Kumar, S. Humayoon Kabir (2011) have contributed a case study of OSS implementation in CUSAT library in India that provide usage statistics also of the digital library developed using OSS.
- Vimal Kumar, V. (2011) in his paper presented at a conference gave examples of best practices adopted by different Library and Information Centres.

Future Development in Open Source Software Domain

- Little, Melissa M (2009) paper proposes about next phase of OSS where how to use OSS needs to be publicized rather than Why OSS!
- Walls, Ian (2011) while also finding Koha as market leader suggests areas of improvement for Koha particularly in electronic resources management.

ANALYSIS AND FINDINGS

Before choosing a particular open source software and adopting the same, it is essential to first ascertain the requirements of library, availability of manpower and technology aids and also the budget for library activities expansion other than the management inclination towards such an effort. A library needs to ascertain various questions like if self-experimentation or hiring an expert's service for installing, data transfer and customization of software is a better approach. Library needs to look into both opportunities and challenges while adopting and implementing Open Source Software.

Experience of other libraries may be crucial while determining if one has to go for adopting open source software or other form of software and if open source software is to be adopted then which software will best suit the library requirements. Literature review on the subject not only helps in knowing experience of other libraries but help in reaching a decision based upon experiences of other libraries. It also helps in knowing and finding solutions to the barriers that may cause hindrance in adoption and implementation of open source software in libraries.

Literature review clearly throws a light on the previous research areas where enough work is already done and also reflects what the areas where there is still scope for further research. From analysis of the current literature review study (Table 1), it is clear that enough work is done on history and development, advantages, disadvantages, digital library open source software, OSS community support, proprietary versus open source software, different types of OSS for libraries available in the market, licensing, barriers and motivation factors etc. However, there is still scope to find out gender impact on adoption of open source software. Similarly, no study is conducted so far for determining age impact on adoption of open source software. One can also undertake research on the issue of self-versus- professional help in implementing open source software.

Table 1 – Bifurcation of Existing Literature in Major Sub-Headings

| S. No. | Heading | Published Papers Available and Reviewed |
|---------------|---|--|
| 1 | History and Development of Open Source Software | 08 |

| | | |
|----|--|----|
| 2 | Similarity between Open Source Software and Librarianship | 03 |
| 3 | Types of Open Source Software | 13 |
| 4 | Proprietary versus Free and/or Open Source Software | 11 |
| 5 | Open Source Software for Digital Library Development | 13 |
| 6 | Advantages of Using OSS in Libraries | 13 |
| 7 | Disadvantages of Using OSS in Libraries | 05 |
| 8 | Advantages and Disadvantages - Both of Using OSS in Lib | 08 |
| 9 | Licensing Issues of Open Source Software | 06 |
| 10 | OSS Community or Experts Participation in OSS Implementation | 08 |
| 11 | Measuring Effectiveness of Open Source Software | 04 |
| 12 | Gender Bias in Open Source Software Development | 02 |
| 13 | Barriers and Motivation for Open Source Software Adoption | 08 |
| 14 | Open Source Implementation - Case Studies | 06 |
| 15 | Future Development in Open Source Software Domain | 02 |

Table 2 of the study clearly indicates that lot of research on open source software has been conducted between 2004 to 2011. This was the actual period when many new open source software for libraries came in to existence or the earlier existing software had added new features to better suit library requirements. However, as can be seen from the Table 2, interest of researchers has not died down but gain picking up in the subject and still researchers are looking at the new facets of open source software use in libraries.

Table 2 – Bifurcation of Existing Literature Year Wise

| S. No. | Year | Published Papers Available and Reviewed |
|--------|------|---|
| 1 | 1999 | 2 |
| 2 | 2000 | 3 |
| 3 | 2001 | 3 |
| 4 | 2002 | 3 |
| 5 | 2003 | 2 |
| 6 | 2004 | 5 |
| 7 | 2005 | 10 |
| 8 | 2006 | 4 |
| 9 | 2007 | 5 |
| 10 | 2008 | 9 |
| 11 | 2009 | 21 |
| 12 | 2010 | 12 |
| 13 | 2011 | 12 |
| 14 | 2012 | 3 |
| 15 | 2013 | 5 |
| 16 | 2014 | 0 |
| 17 | 2015 | 1 |
| 18 | 2016 | 2 |

| | | |
|----|------|---|
| 19 | 2017 | 4 |
| 20 | 2018 | 1 |
| 21 | 2019 | 2 |
| 22 | 2020 | 0 |
| 23 | 2021 | 1 |

RESEARCH IMPLICATIONS AND FUTURE DIRECTIONS

Bifurcation of literature clearly indicates that in spite of lot of research work already done in the open source software area, there are still grey areas that can be taken up for future research. Research can be conducted if age and gender of librarian has any impact on adoption of open source software. Features of open source software in IT dominated and particularly android running world can be another area of research. There are practically no studies available to check subject domain specific libraries and adoption of open source software and similarly no study has been made for private versus public libraries adoption of open source software.

Similarly, not much work has been done regarding use of professional services provider in implementation and maintenance of OSS in libraries, hence, this is a gap area which requires to be looked into the current study

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