THE ADOPTION OF FREE AND OPEN SOURCE LIBRARY MANAGEMENT SYSTEMS IN HIGHER EDUCATION INSTITUTIONS IN ZAMBIA

By

Tuesday Bwalya

This thesis is submitted in partial fulfilment for the award of the Degree of Doctor of Philosophy in Library and Information Science

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LUSAKA

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DECLARATION

I, Tuesday Bwalya hereby declare that this thesis represents my own work that has been done after registration for the Degree of Doctor of Philosophy (PhD) in Library and Information Science at the University of Zambia (UNZA). This thesis has not been previously submitted to any other institution of learning for an award of any academic qualification. Further, I wish to declare that sources of information for this thesis have been acknowledged and that for data collection, I obtained approval and consent from both higher education institutions (HEIs) and respondents. Ethical clearance was also obtained from UNZA Humanities and Social Sciences Research Ethics Committee.

Student's name: ……

Signature: ..…….

Date: ……

APPROVAL

This thesis of Tuesday Bwalya is hereby approved as fulfilling the requirements for the degree of Doctor of Philosophy in Library and Information Science of the University of Zambia.

Name	Signature	Date
_____	_____	_____
Examiner 1		
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Examiner 2		
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Examiner 3		
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DEDICATION

This thesis is dedicated to my mother, Teresa Mukuka, who, without formal education encouraged me at a tender age to like school. When I was in primary school, she always threatened me with negative social sanctions whenever I missed school. To her, I just want to say thank you for putting me on the path of knowledge at a tender age, and never will I disappoint you.

ABSTRACT

Globally, many libraries have turned to free and open source library management systems (FOSLMS) for their library automation needs. Prohibitive costs of commercial library management systems and dwindling financial support have compelled libraries to embrace FOSLMS. In Zambia, some libraries in higher education institutions (HEIs) have adopted FOSLMS for library automation. This study, therefore, thought to establish how widespread was the adoption of FOSLMS among libraries in the higher education sector in Zambia. It also aimed at determining the most used FOSLMS in higher education libraries and factors influencing the adoption of FOSLMS in HEIs in Zambia. Further, this study sought to establish the possible benefits and challenges of using FOSLMS by libraries in HEIs in Zambia. Anchored on the positivism philosophy, the study was descriptive quantitative in design and employed a survey research strategy. A complete census of all 154 HEIs in Zambia with functioning libraries was conducted. In this regard, a person in charge of the library in the higher education institution participated in the study. A questionnaire was used to collect data and 142 HEIs answered the questionnaire. The findings of the study have shown that the adoption of FOSLMS in HEIs is widespread. In this regard, 42 (78%) libraries out of the 54 libraries that have automated their operations were using FOSLMS. It has also been established that Koha is the most used FOSLMS in library automation by HEIs in Zambia, as 41 (97.6%) libraries have automated their operations using Koha. This finding supports other findings of various studies in Malawi, Nigeria, Kenya, Uganda, and Ethiopia where Koha was found to be the most used FOSLMS in library automation. The principal driver for the adoption of FOSLMS in HEIs is the lower cost of adoption. Furthermore, the Chi-square test of independence using a 0.05 level of significance shows a strong relationship between adoption of FOSLMS and variables such as management support, ease of use, and social influence with the p-value of 0.000. In addition, the study established that the adoption of FOSLSMS has resulted in efficient and effective provision of library services. Other benefits accrued to libraries in HEIs that have adopted FOSLMS include the provision of online library services and control over bibliographic records. The study also established that many libraries face challenges using FOSLMS. These include having difficulties in using FOSLMS, lack of technical support, failure to update and upgrade FOSLMS and unreliable Internet connectivity.

Given the findings above, the study recommends that ministries responsible for HEIs should lobby the Zambian government to formulate a policy to promote the use of FOSS. Government should also ensure that library automation becomes mandatory among HEIs. Further, the government should begin allowing librarians from private HEIs to apply for international training scholarships in library automation it receives from cooperating partners. To HEIs management, it has been recommended that internet service provision be improved and that serving library workers should be retrained on how to use FOSLMS installed in their libraries. For other stakeholders in librarianship in Zambia such as the Library Association of Zambia (LIAZ) and Library Science Schools, it has been recommended that more publicity on the existence of other FOSLMS be undertaken and that more training workshops on the use of Koha and other FOSLMS be continuously conducted. For Library Science Schools that do not have modules on FOSLMS, they should revise their curricula to incorporate FOSLMS. To ensure the successful adoption and implementation of FOSLMS in HEIs in Zambia, a model has been developed detailing the major drivers of FOSLMS adoption. More importantly, the model identifies adoption environmental factors that need to be in place for the successful adoption of FOSLMS. This model will serve as a guide to libraries not only in the higher sector but also in other sectors that wish to automate their libraries using FOSLMS

Keywords:
Adoption, Free and Open Source Library Management Systems, Library Automation, Libraries, Higher Education Institutions, Zambia

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ACRONYMONS

ABCD	Automatisación de Bibliotécasy Centros de Documentación'
ANH	Academia Nacional de la Historia
API	Application Programming Interface
API	Application Programming Interface
BIREME	Biblioteca Regional de Medicina
CSS	Cascading Style Sheet
CCF	Common Communication Format (CCF)
COMESA	Common Market for Eastern and Southern Africa
CD	Compact Disc
CDS/ISIS	Computerised Documentation Services/Integrated Set of Information Systems
CMS	Content Management System
CMS	Content Management System
DANARAH	Danny and Rahab
DoD	Department of Defense
DELNET	Developing Library Network
DOC	Document
EIFL	Electronic Information for Libraries
ETHIOKOHA	Ethiopia Koha
EUPL	European Union Public License
FIUBA	Facultad de Ingeniería de la Universidad de Buenos Aires
FOSLMS	Free and Open Source Library Management System (s)
FOSS	Free and Open Source Software
FOSSFA	Free and Open Source Software Foundation for Africa
GPLS	Georgia Public Library Service
GPL	GNU General Public License
GNU	GNU Not UNIX
GOI	Government of India
HEI	Higher Education Institution
HEIs	Higher Education Institutions
HTML	Hyper Text Markup Language
ICTs	Information and Communication Technologies

ILS	Integrated Library System
ISO	International Organization for Standardization
AGRIS	International System for Agricultural Science and Technology
KDE	K Desktop Environment
KIPA	Korea IT Industry Promotion Agency
Kuali OLE	Kuali Open Library Environment
LIS	Library and Information Science
MARC	Machine Readable Cataloging
MGT	Management
MariaDB	Maria Database
ML	Markup Language
MESVTEE	Ministry of Education Science Vocational Training and Early Childhood Education
MySQL	My Structured Query Language
NEIS	National Education Information System
NRCFOSS	National Resource Centre for Free and Open Source Software
NGO	Non-Governmental Organisation
OPAC	Online Public Access Catalogue
OAI-PMH	Open Archives Initiative Protocol for Metadata Harvesting
OLE	Open Library Environment
OSOR.eu	Open Source Observatory and Repository for European Public Administration
OSS	Open Source Software
PMB	PhpMyBib
PDF	Portable Document Format
PostgreSQL	Postgre Structured Query Language
PPT	Power Point
PHP	Preprocessor Hypertext Language
PTFS	Progressive Technology Federal Systems
PINES	Public Information Network for Electronic Services
PINES	Public Information Network for Electronic Services
RAM	Random Access Memory
RDA	Resource Description and Access
RTF	Rich Text Format

SDI	Selective Dissemination of Information
SLIMS	Senayan Library Management system
SQL	Structured Query Language
UTAUT2	Unified Theory of Acceptance and Use of Technology Two
UNESCO	United Nations Educational, Scientific and Cultural Organization
URU	Search/Retrieve via URL
USD	United States Dollars
UNICODE	Universal Character Encoding
UNIMARC	Universal Machine Readable Catalogue
URL	Universal Resources Locator
UCLA	University of California, Los Angeles
VLIROUS	Flemish Inter-University Council
Web OPAC	Web Online Public Access Catalogue
XLS	Excel Spreadsheet
XML	Extensible Markup Language
ZIBSIP	Zambia Institute of Business Studies and Industrial Practice

CHAPTER 1: INTRODUCTION

1.0 Overview of the Chapter

This chapter covers among other things, background of the study, context of the study, statement of the problem, purpose of the study, study objectives, research questions, delimitation and limitations of the study. It also covers definition of concepts, and ethical considerations.

1.1 Background of the Study

Libraries, like many other institutions, experienced quantum jump in their operations with the introduction of information and communication technologies (ICTs) in the 1960s. Since the early 1970s, libraries have used computer systems to automate their operations in order to improve service delivery. Deployment of library automation systems promotes the utilisation of information services and improves the quality and effectiveness of library services (Kumar, 2016). Further, library automation extends library services even to remote users. Library automation systems are not necessarily exciting technologies, but they are also workhorse applications that support the complex tasks of acquiring, describing, and providing access to materials and services (Marshall Breeding, 2019). Library automation systems have added a new dimension to library operations and are expanding the sphere of operations of many libraries (Balasubramanian, 2011). Automation systems have ushered libraries into a new dispensation in which operations and services have been automated using both integrated library systems (ILS) and non-integrated library systems, with a view to providing library services closer to the doorsteps of the users.

In the early 1960s, the use of library automation systems in libraries was mainly confined to big libraries, such as academic and research libraries, which could afford both the cost of hardware and software (Kochtanek & Matthews, 2002). The use of library automation systems was a preserve of wealthier libraries, mainly those in developed countries that could afford proprietary library automation systems. This, however, has changed due to the omnipresence of free and open source library management systems (FOSLMS) such as Koha, Evergreen, ABCD, NewGenLib and OpenBiblio. The availability of open and free library management systems has given impetus to libraries, especially in developing countries such as Zambia, to automate their operations in order to bring about efficiency and improved service delivery.

The birth of FOSLMS has come as a blessing to many libraries that for many years have lamentably failed to procure proprietary library management systems because of prohibitive prices. Nagia (2012) observes that many libraries do not have huge amounts of money to burn; and any funds they have, usually go to purchasing additional information resources. Libraries that receive some funding are over-burdened with operational costs as they spend two-thirds of their budgets on among other things, personnel. Many libraries have more demands than resources (Singh & Sanaman, 2012). Lack of financial resources is more acute in developing countries where libraries receive less or no funding from their parent organisations. In these countries, libraries are constrained to purchase, and meet user fees for proprietary library management systems. Free and open source library management systems (FOSLMS) cost much less than the commercial library management systems (CLMS), hence, providing a realistic solution to the already bankrupt libraries (Adera, 2013; Joseph & Namjoo, 2013). FOSLMS provide a valuable alternative to proprietary systems. Characterised by the absence of licence and user fees, FOSLMS have come to liberate libraries from library software vendors and have provided a window of hope for the cash-strapped libraries to automate their operations. FOSLMS have truly strengthened the capacity of many libraries in service provision especially in developing countries.

Many libraries from developing countries are providing online library services using FOSLMS, as many library management systems are increasingly welded at the seams with other services, such as access to online databases (Kochtanek & Matthews, 2002). Libraries can now put their services online, link library users to external information resources and effectively engage in library co-operation through the use of the Internet and the Web. This is a giant leap in the libraries' quest to provide quicker and reliable services to their users. Indeed, FOSLMS have come to fulfill one of the *Five Laws of Library Science* propounded by Ranganathan: the law of serving the user's time, as many libraries are automating their services and putting them online thereby providing easy and remote access to all library services.

The use of FOSLMS in automating the operations of libraries is now a global phenomenon. Many libraries in different countries have adopted FOSLMS. In some countries, the adoption footprints of FOSLMS are well documented. In India, Kumar (2016) observes that 47 percent of libraries in India adopted FOSLMS from 2012-2014 compared to the 37 percent adoption rate in 2009-2011. Marshall Breeding (2019) reveals that FOSLMS implementations currently represent about 14%

of installations in the United States of America (USA) and 6% of academic libraries have automated their operations using FOSLMS. Further, Marshall Breeding observes that the adoption of FOSLMS in the USA is dominated by small to midsized libraries; very few larger libraries have adopted FOSLMS. In China, the use of FOSLMS in library automation is not pronounced. According to Jabeen, Qinjian, Jabeen and Yihan (2018) much of Chinese research and academic libraries depend on commercial software, not FOSLMS. Ponelis and Adoma (2017) observe that 61.5 percent of academic libraries in Uganda have adopted FOSLMS. The adoption of FOSLMS is also widespread in Kenya as Adera (2013) observes that there was a 50-50 distribution of libraries that had adopted open source and commercial library management systems. In Malawi, Chaputula and Kanyundo (2019) discovered that 84.2 percent of libraries in higher education institutions were automated, and 81.3 percent of them were using a free and open source library system called Koha.

1.2 Context of the Study

As indicated in the introduction, the coming of FOSLMS has excited many libraries, especially those in developing countries that were unable to purchase proprietary turnkey library management systems to automate their operations. As Mutula (2012) observes, for many years, libraries in sub-Saharan Africa remained the laggards as regards automation and modernisation of library operations due to among other factors, budgetary constraints and high cost of ICT facilities. This picture has however begun to change with the coming of free and open source software. The birth of FOSLMS has provided a window of hope for many social sector organisations such as libraries in Africa to automate their operations.

In an effort to speed up the process of automation in social sector organisations such as libraries in sub-Saharan Africa, local and regional bodies such as the Common Market for Eastern and Southern Africa (COMESA) are encouraging member states to adopt and use free and open source software. Common Market for Eastern and Southern Africa recently embarked on a programme to promote the use of free and open source software (FOSS) not only to make ICTs more accessible but also to provide goods and services in the region at a relatively lower cost (COMESA, 2009).

On the other hand, there have been efforts at national level in different countries in the COMESA region to promote the use of free and open source software in social sectors such as information centres and libraries. For instance, the National Assembly in Uganda has made it a policy to use

free and open source software to manage its data centres. Similarly, the Zimbabwean National Assembly in 2008 replaced Windows operating systems on all the computers with *Ubuntu*, a free and open source operating system. The Malawian National Assembly is contemplating migrating to free and open source software (COMESA, 2009).

In Zambia, the Balancing Act (2014) observed that the social sector in Zambia had lagged behind in adopting ICTs to deliver services in various communities efficiently. It however anticipated the situation to change with the coming of free and open source software. Further, the Balancing Act reported that developed countries such as Sweden, were keen to support the development of open source software in Zambia as the spirit of open source reinforces a virtuous circle of learning and sharing information (Kabissa, 2009). The Government of Zambia also acknowledges the fact that open source software is a recommended alternative to proprietary software for use in community access projects because it is available without licence fees.

Like many libraries in developing countries, Zambian higher education institutional libraries failed to automate their operations (Lungu & Mwamba, 2010). Library automation in this sector had been largely limited to a few university libraries, the University of Zambia and Copperbelt University libraries. For instance, the University of Zambia began the automation of its library in 1996 using Dynix; a proprietary library management system which was donor-funded (Mwacalimba, 1996). However, in the late 1990s, the library automation landscape in Zambia began to change with the coming of a free library system called Computerised Documentation Services/Integrated Set of Information Systems (CDS/ISIS) which was sponsored by UNESCO. Computerised Documentation Services/Integrated Set of Information Systems was widely used in the late 1980s and 1990s by libraries in sub-Saharan African countries such as Zambia (Mutula, 2012). The dawn of the 2000 decade saw the birth of the robust FOSMLS such as Koha, Evergreen, ABCD and OpenBilio. The new generation of FOSLMS is integrated and available for download from the Internet. The birth of FOSLMS, such as Koha has further provided opportunities and choices for higher education institutional libraries in Zambia to automate their operations.

In a bid to accelerate the process of library automation in higher education institutions (HEIs) in Zambia, many organisations both local and international, have been offering training to higher education institutional librarians on how to use FOSLMS to implement library automation. These

include the Flemish Inter-University Council (VLIR-UOS), a Belgium-based organisation, which since 1991 has been offering three months' scholarships to librarians from HEIs in developing countries, on how to automate their libraries using FOSLMS such as WINISIS, JISIS and now ABCD. Since 2000, VLIR-UOS through international training programmes called *Stimulate* and *Lib@web* has trained more than 12 librarians from HEIs in Zambia (VLIR-UOS, 2010; VLIR-UOS, 2015). Further, the Indian Government through its Indian Technical and Economic Cooperation (ITEC) for many years has been offering training to librarians from HEIs in developing countries on how to use FOSLMS such as Koha to automate library operations. The International Network for the Availability of Scientific Publications (INASP) has also been training some librarians from HEIs in Zambia on how to use FOSLMS to automate their libraries. In this regard, some college and university libraries staff has been trained by INASP.

At national level, the Ministry of Education and Flemish Association for Development Cooperation and Technical Assistance (VVOB) have since 2008 been promoting the use of FOSLMS such as Koha in automating libraries in HEIs in Zambia. In this regard, librarians from all the twelve (12) colleges of education received training from VVOB and the Ministry of Education, Science, Vocational Training and Early Education (MESVTEE) on the use of Koha to automate their library operations (MESVTEE and VVOB, 2013). Further, the Department of Library and Information Science at the University of Zambia has since 2000 been teaching some selected FOSLMS to undergraduate Library and Information Science students in order to speed up the process of library automation in Zambia.

It was against this background that a comprehensive study was conducted to accurately describe how widespread was the use of FOSLMS in library automation in HEIs in Zambia. Further, conducting a study made it possible to document the possible opportunities and benefits, and challenges FOSLMS present to higher educational libraries in Zambia that have adopted them.

1.3 Statement of the Problem

As articulated in the introduction, the deployment of FOSLMS in library automation in Zambia started in the late 1990s (Mutula, 2012). CDS/ISIS was the first developed open source library system to be used in automation by libraries (Kumar, 2016). Since the early 2000s, better FOSLMS such as Koha, OpenBiblio, ABCD, and Evergreen have been developed and are available on the

Internet. The availability of such FOSLMS in Zambia has made it possible even for the financially-challenged libraries to think of automating their operations (Lungu & Mwamba, 2010). To increase library automation in HEIs in Zambia, the Zambian government and its cooperating partners have invested a lot of money and time in the training of librarians from higher education institutions in Zambia on how to automate their libraries FOSLMS (MESVTEE & VVOB, 2013).

Many studies have been conducted on the adoption footprints of FOSLMS in several countries such as India, USA, China, Nigeria, Kenya, Uganda, and Malawi (Kumar, 2016; Marshall Breeding, 2019; Jabeen, Qinjian, Jabeen and Yihan, 2018; Ponelis and Adoma, 2017; Adera, 2013; Chaputula and Kanyundo, 2019). Some of these studies have attempted to describe the adoption of FOSLMS by libraries from various sectors. These studies looked at a broader spectrum of libraries as regards the adaption of FOSLMS; they did not specifically look at the adoption of FOSLMS in the higher education sector. These various studies also failed to identify the major benefits accrued to libraries because of the adoption of FOSLMS. For example, a study by Lungu and Mwamba (2010) on the challenges of implementing online library database management systems in developing countries focused only on the challenges of adopting free and open source software (FOSS) in Zambia. The study highlighted the possible challenges associated with the adoption of FOSS. It did not comprehensively tackle all issues surrounding the adoption of FOSLMS in Zambia such as the adoption levels and factors influencing FOSLMS adoption in Zambia. Furthermore, the study by Lungu and Mwamba also took a generic approach by looking at all types of libraries in Zambia. It was therefore important that a contextualised nationwide study be conducted in all HEIs in Zambia to accurately measure the adoption of the level of FOSLMS, the benefits, and factors driving FOSLMS adoption; and the possible challenges of using FOSLMS.

1.4 Purpose of the Study

The deployment of FOSLMS in library automation has gained ground, especially in developing countries such as Zambia. The study sought to describe the adoption levels of FOSLMS in HEIs by establishing the number of libraries in HEIs that have automated their operations using FOSLMS. Furthermore, this study sought to establish the most used FOSLMS in HEIs if at all, there is significant adoption of FOSLMS in HEIs in Zambia.

According to Borhani (2016), there are many factors that influence the adoption of any technology. In this regard, the study also sought to establish factors that are influencing the adoption of FOSLMS in HEIs. This answers questions regarding the drivers of the adoption of FOSLMS in library automation in the higher education sector in Zambia.

The study also sought to establish the potential benefits accrued to libraries in HEIs that have adopted FOSLMS in HEIs. There are many benefits associated with the adoption and use of free and open source software which include reduced costs associated with the adoption and use of software (Mutula & Kalaote, 2010). It was therefore critical to establish the real benefits emanating from the adoption of FOSLMS by libraries in HEIs in Zambia.

Studies by Lungu and Mwamba (2010), Chaputula and Kanyundo (2019), and others show that the adoption and use of free and open source library management systems are not without challenges. It was the purpose of this study to identify the possible challenges libraries in HEIs that have adopted FOSLMS face. This helps to provide practical solutions to address the challenges libraries in HEIs face in their use of FOSLMS.

1.5 Objectives of the Study

The main objectives of this research were threefold: investigate the adoption footprints of FOSLMS in libraries in HEIs, determining opportunities FOSLMS have presented to libraries, and identifying challenges faced by libraries in the use of FOSLMS in HEIs in Zambia. In so doing, the study specifically sought to:

(i) establish the extent to which libraries in HEIs have adopted FOSLMS,
(ii) establish the most adopted FOSLMS in HEIs,
(iii) determine factors that influence the adoption of FOSLMS in HEIs,
(iv) establish the benefits accrued to libraries in HEIs for adopting FOSLMS,
(v) identify challenges libraries in HEIs face in their adoption of FOSLMS,
(vi) develop a model for successful adoption of FOSLMS in HEIs in Zambia.

1.6 Research Questions

i. How widespread is the adoption of FOSLMS in HEIs?
ii. What is the most adopted FOSLMS in HEIs?
iii. What factors influence the adoption of FOSLMS in HEIs?
iv. What are the benefits accrued to HEIs libraries that have adopted FOSLMS?
v. What challenges HEIs libraries face in their adoption of FOSLMS?
vi. What model could explain the successful adoption of FOSLMS in HEIs in Zambia?

1.7 Significance of the Study

Libraries in various countries have been adopting FOSLMS as they seek to automate their operations. The adoption footprints of FOSLMS in HEIs libraries and other sectors in many countries are well documented. For example, in countries such as Nigeria (Egunjobi and Awoyemi, 2012), Kenya (Adera, 2013), Uganda (Ponelis and Adoma, 2017), and Malawai (Chaputula and Kanyundo, 2019), a number of studies have been conducted to create literature and knowledge on the deployment of FOSLMS not only in the higher education sector but also other sectors. There is literature and knowledge on the deployment of FOSLMS. This, however, is not the case with Zambia; there has never been research conducted to measure the adoption footprints of FOSLMS in HEIs libraries in the country. The study by Lungu and Mwamba (2010) attempted to highlight only the possible challenges of adopting FOSS in Zambia. In this regard, there was a need to conduct a nationwide study to ascertain the number of libraries in HEIs that have automated their operations using FOSLMS. This study, therefore, acts as a baseline study for other future studies on the adoption of FOSLMS in HEIs Zambia and contributes to the creation of knowledge on FOSLMS deployment in library automation in Zambia.

Since the late 1990s, various local and international organisations have been training librarians on the use of FOSLMS in library automation, and that the Zambian government and its partners such as VVOB have been providing the necessary ICT infrastructure such as computer hardware to some HEIs libraries to accelerate library automation. However, there has never been research conducted to measure the adoption footprints of FOSLMS in HEIs libraries in Zambia. In this regard, this study provides feedback not only to the Government of the Republic of Zambia but also to its cooperating partners on whether their financial and other resources have been well spent.

Further, the findings of the study could positively affect the training of librarians in Zambia as regards the use of FOSLMS in Zambia as some of the challenges identified in the deployment of FOSLMS hinge on the lack of skills. The findings provoke the need for reforms in the training of librarians in FOLSMS in library schools in Zambia as curricula have to be reformed to include modules on FOLSMS and other missing technical skills. Furthermore, the findings of the study could enable the Library and Information Association of Zambia (LIAZ), a body for librarians in Zambia, to know the skills gaps among its members as regards the use of FOSLMS. This will enable LIAZ to development appropriate interventions for the professional development of its members in the country.

Furthermore, the study has unveiled challenges being faced by libraries in HEIs in Zambia as regards the use of FOSLMS. It is indisputable that project implementation, such as library automation is not devoid of challenges (Lungu & Mwamba, 2010) and Chaputula & Kanyundo, 2019). Unless a study was conducted, challenges being faced by libraries using FOSLMS would not be known. Challenges that have been revealed, with practical solutions on smooth deployment of FOSLMS, will be passed on to the Government, cooperating partners, and library schools in Zambia.

1.8 Delimitations of the Study

This study was not conducted among special, public and school libraries. Further, HEIs without libraries were excluded from the study; the study covered only libraries in HEIs with functioning libraries. The surveyed HEIs were universities and colleges of education. Other HEIs surveyed were nursing schools, institutes, business and technical colleges. The other delimitation is that the study focused on the adoption of FOSLMS by HEIs in Zambia, not proprietary or commercial library management systems.

1.9 Definition of Key Concepts

In this study, the following terms have been used to denote the following:

(i) Free and open source software (FOSS): software that is publicly available for use at no cost and its source code is available for others to modify (Rankin, 2014).

(ii) Free and open source library management system: software that is freely available for use by libraries to collect, process, store, and distribute information to support decision-

making on all the activities of libraries such as circulation, acquisition and cataloguing (Deshmukh, 2016).

(iii) **Higher education institution (HEI)**: is any organisation providing higher, post-secondary, tertiary or third-level education (IGI Global, 2017). This entails any learning institution either public or private established to award degree, diploma and certificate qualifications to its graduates. In this study, HEIs include universities, academies, colleges, nursing schools, institutes, business, and technical colleges.

1.10 Ethical Considerations

The researcher sought to conduct the study with maximum observance of ethical issues. In this regard, the researcher ensured that permission was obtained from HEIs authorities that took part in the study, before a questionnaire was delivered to the respondents. Further, participation in this study by respondents was based on informed consent and voluntarism. This entails that participants were made aware of the study's objectives through a respondent cover letter that was attached to the questionnaire; they had the latitude to accept or refuse to take part in the study. Furthermore, respondents were not made to write on the questionnaires their real names, with a view to ensuring maximum anonymity of their responses. Similarly, data collected in this study was not communicated to unauthorised persons and that it was used only for the purpose of this study. This was to ensure high level of confidentiality. The researcher guaranteed that participants/respondents in this study were not subjected to any harm, as the study was non- experimental; their safety in participating in this study was assured. Lastly, interpretation, presentation and communication of data collected from this study was done in an honest manner; it was not doctored to suit the opinion of the researcher.

1.11 Summary of Chapter 1

Research has established that libraries have embraced ICTs to automate their operations using library management systems in order to improve service delivery. Globally, library automation was initially done using commercial library management systems, which have now proved expensive. Therefore, many libraries have turned to FOSLMS. Zambian libraries have equally turned to FOSLMS. Libraries in Zambia especially those in HEIs have been receiving training from both international and local organisations on how to automate their operations using FOSLMS. Furthermore, the then Ministry of Education in partnership with VVOB have trained

librarians in HEIs and provided computer hardware to colleges of education with a view to accelerating the process of library automation in HEIs. It was expected that many libraries in HEIs would have automated their operations using FOSLMS, considering the amount of training and computer hardware support rendered to them by international organisations and the Ministry of Education. It was however not known how widespread was the adoption and use of FOSLMS in HEIs in Zambia. Opportunities and challenges presented to libraries by FOSLMS were also not known. There was need therefore to carry out a study to determine how widespread was the use of FOSLMS in HEIs, and learn about the opportunities and challenges FOSLMS presented to libraries in HEIs in Zambia. In terms of scope, the study only covered libraries in HEIs such as universities, colleges, nursing schools, business and vocational colleges and not any other types of libraries. Further, the study focused on FOSLMS and not commercial library management systems (CLMS).

CHAPTER 2: LITERATURE REVIEW

2.0 Overview of the Chapter

This chapter presents the literature review of the study. Among the areas covered under this chapter include the concept of free and open source software (FOSS), history of FOSS, reasons for adopting FOSS, global adoption of FOSS, history of free and open source library management systems (FOSLMS), commonly used FOSLMS, global adoption footprint of FOSLMS in higher education institutions (HEIs) and benefits and opportunities, and challenges FOSLMS present to libraries in HEIs.

2.1 Concept of Free and Open Source Software

The concept of free and open-source software (FOSS) has been defined in different ways. According to Kundu, Swain, and Biswas (2010), free and open software is used, modified, and redistributed without any permission required. FOSS refers to computer programmes that are usually available free of licence cost and have been licensed to grant users the right to use, copy, change, and distribute their source code (UNESCO, 2013). Rankin (2014) argues that free and open source software is one that is publicly available for use at no cost and its source code is available for others to modify. From these definitions, it is clear that FOSS is used without paying for licence and that the users of FOSS are at liberty to copy, share and modify the software. This implies that the adopters of FOSS have absolute freedom to use the software in any way they wished.

It is important to state that FOSS is different from freeware. As the name suggests, freeware is free to use, and it is copyrighted. All freeware has licence agreements that restrict usage or distribution of the software (Corbly, 2014). Freeware clearly does not embody the spirit of open source. Its source code is not available to the public for modification.

Free software is seen as a matter of liberty (freedom) not price; it is like freedom of speech, not free beer. According to Rankin (2014), Stallman described free software as having four characteristics (freedoms), namely:

(i) the freedom to run the programme for any purpose;
(ii) the freedom to study how the programme works and adapt it to one's needs;
(iii) the freedom to distribute copies so that one can help his or her neighbors; and

(iv) the freedom to improve the programme and release the improvements to the public so that the whole community benefits.

Årdal, Alstadsæter and Røttingen (2011) argue that the key characteristics of FOSS include free distribution, openly available source code, and permission for modification of software.

2.2 History of Free and Open Source Software

The idea of using, sharing and modifying a software freely can be traced back to the year 1911, when Henry Ford in the United States of America (USA) developed his own car engine which he allowed other people and companies to use and modify freely. This revolutionised the automobile industry as many cars with different engines emerged.

The idea of developing free computer software however did not materialise until the year 1983, when Richard Stallman, who was a researcher at Massachusetts Institute of Technology (MIT) Computer Laboratory, began a project called GNU Not UNIX (GNU) and Free Software Foundation. Stallman wanted to promote the concept of free software. According to Orloff (2009), Stallman grew skeptical of the commercial software packages that were selling at very high prices in computer stores. He advocated for the introduction of free software whose source code could be copied by computer programmers and users to modify in order to improve its performance. Stallman and other programmers released the new operating system in 1991 and named it GNU, a recursive acronym for GNU Not Unix (Orloff, 2009).

GNU operating system lacked a central component found in all operation systems called kernel. However, Linux Torvalds, who by that time was pursuing a Master's degree in Computer Science at University of Helsinki in Finland, wrote the first kernel as his project. He named the kernel Linux and released it under a free licence. Linux kernel was paired with the GNU project's development tools and OS and with the graphical windowing system called X (Rankin, 2014). This resulted in the birth of a free operating system called GNU Linux.

The concept of free software did not go well with software business companies, which questioned the morality behind such a concept, wondering why any product or software could be released without participating in the market for returns. This painted free software as being unreliable. However, this prompted Eric S. Raymond and others in consultation with Richard Stallman to develop the term open source as a more business friendly term than free software *(*Rankin, 2014*)*.

Open source had a more inclusive meaning, in that licences that were not as strict about the need to pass on modifications, would also qualify to be launched under the Open Source Initiative. However, by 2007, Commercial Open Source Software had effectively co-opted this term, leading the community to coalesce around the term free and open source software (FOSS) to bring the original visions of Stallman and Raymond back together. Others called free software as Free-Libre Open Source Software (FLOSS).

2.3 Open Source Software Foundations and Open License Models

As the development of FOSS was gaining momentum, Bruce Perens and Eric S. Raymond established an organisation called Open Source Initiative (OSI) in 1998. The purpose of the foundation was to oversee the release of open source software. All FOSS are released under open source licences. Notable open source licences include; Apache 2.0, GNU General Public Licence ('GPL') , GNU Library or 'Lesser' General Public Licence ('LGPL'), BSD 3-Clause 'New' or 'Revised' License , BSD 2-Clause 'Simplified' or 'FreeBSD' LicenceBSD, MIT, Mozilla Public Licence 2.0, IBM, and Apple, Sun ,Common Development and Distribution License and Eclipse Public License (Open Source Initiative, 2015).

There are also other foundations established to support specifically FOSS. Notable foundations include free software foundation (FSF), started by Richard Stallman in 1985 as in table1 below. Others are Apache Software Foundation, Linux Foundation, Ubuntu Foundation, and Free and Open Source Software for Africa (Opensource.com, 2015).

Table 1: Notable Free and Open Source Software Foundations

SN	Name of Foundation	Year	Purpose
1	Free Software Foundation (FSF)	1985	Promotes study, distribution, creation, and modification of computer software
2	Apache Software Foundation	1999	Supports the development of Apache
3	Linux Foundation	2000	Supports Linux Kernel and other Linux software
4	Ubuntu Foundation	2005	Promotes Linux distro called Ubuntu
5	Free and Open Source Software for Africa	2003	Spearheads the use of FOSS in Africa

(Source: Adapted from Opensource.com, 2015)

2.4 Common Free and Open Source Software

Since the launch of GNU in 1991, a number of FOSS have sprung up. Some are horizontal in nature as they are applicable to many industries (Stephen, Maeve & Army, 2007). Horizontal FOSS include Apache Server software, Linux operating systems (Ubuntu, Red Hat, Suse etc), Open Office, LibreOffice (the two Office software, work like Microsoft Office), and Mozilla Fire Fox (an Internet browser). On the other hand, vertical FOSS that only apply to specific industries exist. These include MySQL (database management systems), Koha (library management system), Dspace (institutional repository software), and xTuple (finance, sales and inventory management software). It is now conceivable to find free and open source software for commercial software. Below is the table of common FOSS software against commercial software.

Table 2: Commonly used FOSS Cross-referenced with Commercial Software

SN	Type of Software	Commercial	FOSS
1	Word processing	Microsoft Office	LibreOffice and OpenOffice
2	Web browser	Internet Explorer	Mozilla Firefox, Chrome, etc.
3	Music player	Windows Media player	VLC, MPC-HC, PotPlayer etc.
4	Server	Windows Server	Apache, Lighttpd, etc.
5	Content mgt. system	Dreamweaver	Drupal, Wordpress and Joomla
6	Library mgt. system	Liberty, SirsiDynix, etc.	Koha, Evergreen, etc.
7	Database mgt. system	Oracle	MySQL, PostgreSQL, etc.
8	Operating system	Windows, Macintosh, etc.	Linux (Ubuntu, Red Hat, etc.)

2.5 Free and Open Source Software Development Model

Free and open source software (FOSS) follow a *bazaar* development model in which many developers scattered over the globe participate in the development of the software. However, in the early stages of development, FOSS tend to follow the *cathedral* development model, commonly associated with proprietary software; cathedral involves a small group of developers working on the software. According to Josep (2010), FOSS has a five-stage life cycle. These stages are:

a) Preliminary stage: selection of a problem of interest and perform some development planning;

b) Prototype stage: closed development of a prototype software by an individual or small group of individuals;

c) *Transition stage*: open the project to the community; allowing other members of community to participate in the development of the software;

d) *Bazaar stage:* many programmers contribute to the development of prototype software by debugging and extending it together with the community; and

e) *Responsibility transfer*: transfer the responsibility of the project to a competent successor in case of loss of interest.

Figure 1: FOSS Development Model

From these stages, it is clear that FOSS like any other software, is initially conceptualised and planned by an individual or group of people. Thereafter, such an individual or group of people (which is usually small) writes the prototype software and releases it to the community for its contributions. The most unique stage in the developmental process of FOSS is the fourth stage, which allows many programmers from the community to begin contributing to the software in a *bazaar* way. Contrary to the cathedral approach employed by proprietary software where, a small group of programmers continues to develop the software, many developers of FOSS at this stage contribute to the software by writing patches and extending the software. The bazaar approach makes FOSS to be more robust than proprietary software, which is forever, developed by a small group of people. The fact that more people contribute to the development of the software could result in uncoordinated efforts and haphazard development of the software if not properly managed.

2.6 Free and Open Source Software Ecosystem

The development of FOSS is like a system with many parts that interact and work together to ensure that FOSS succeeds. There are four parts or components in the FOSS ecosystem, namely *government*, *academia*, *community* and *industry* (Nasserifar,2016). These parts contribute differently to the development of FOSS. Each sub-system contributes to FOSS the necessary resources such as funds, ideas, skills, exercise and technology, to the development and growth of

FOSS. The interaction among these four components as demonstrated below is bi-directional, indicating the mutual dependence of these sub-systems.

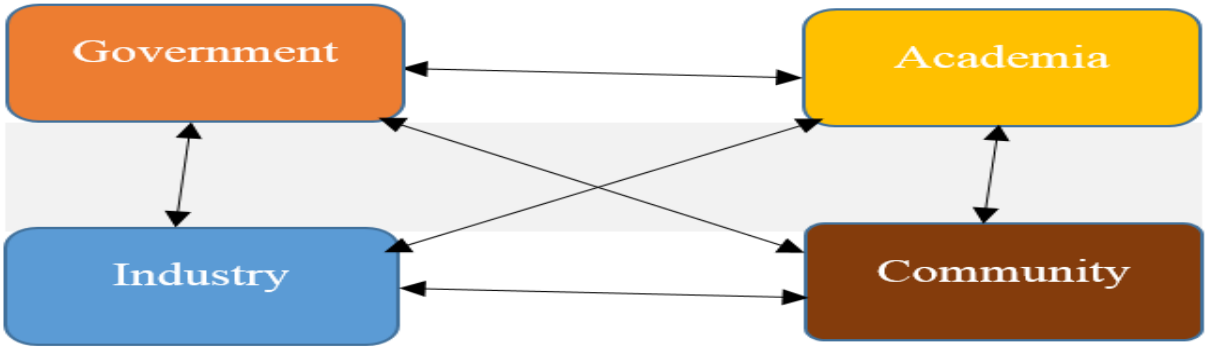

Figure 2: Ecosystem of FOSS
(*Source:* Adapted from Saini, 2013)

According to Saini (2013), countries or societies that have a strong ecosystem of FOSS have excelled in the development of FOSS as each component contributes to FOSS development. The roles of each component in the development of FOSS include:

2.6.1 Government/State

A government in ecosystem of FOSS provides funding for support and promotion of FOSS. It also formulates policies that support the use of FOSS. The government, however, depends on academia to produce trained human resource, the industry to opt for FOSS solutions, and the community to evangelise FOSS. In Brazil, the government is actively funding FOSS and putting in place policies to encourage its use (Paiva, 2009).

2.6.2 Academia

Academia evangelises the case of FOSS, generates FOSS, trains human resource and produces FOSS technologies. However, academia depends on government to extend funding and policy support. Academia also relies on the industry to absorb the FOSS human resource it generates. Further, academia depends on the community to evangelise and support FOSS.

2.6.3 Community

The community evangelises FOSS and lobbies for it. Further, it develops FOSS technologies and supports promotional efforts. The community, however, depends on government for policy support

and funding. It also depends on academia to generate trained human resource. Further, the community depends on the industry to adopt FOSS technologies and solutions.

2.6.4 Industry

The industry uses FOSS technologies and solutions. The industry also develops and provides FOSS technologies and solutions. Furthermore, it funds FOSS promotion (Nasserifar, 2016). It however depends on government for policy support. It also depends on academia to train human resource. Further, it relies on the community to evangelise and support FOSS.

2.7 Reasons for Adopting Free and Open Source Software

There are a number of reasons that have necessitated the adoption and use of FOSS in many countries. According to Egypt FOSS (2016), the reasons for adoption of FOSS are many and grouped into three, as follows:

2.7.1 Strategic

Many countries have adopted FOSS for strategic reasons; they consider FOSS as key to achieving national priorities. These priorities and interests include developing local capacity and industry. Given the fact that FOSS grants the user, the freedom to modify the software code, many countries (especially developing countries) consider FOSS as having potential to build the local people's capacity to learn and develop their own software (Sahay, 2019).

Other strategic reasons for adopting FOSS are for enhancement of national security. Countries are increasingly interested in software that is secure, a software that will not compromise national security. There is empirical evidence showing that FOSS provides minimal risks to national security as it is less vulnerable compared to commercial software. According to Gourley (2009), the number of raw vulnerability reports is much less in FOSS. This is because open source software is always available for review and developed in most cases in an open, public, and collaborative manner. This however has changed, as more FOSS is becoming vulnerable to attacks. For example, in 2019, Android and Debian Linux were ranked the most vulnerable software (CVE Details, 2020).

Avoidance of copyright infringements is one of the strategic benefits of adapting FOSS. The vendors of software often claim that state institutions and citizens of a given country have pirated

their software. This constitutes a breach of agreement, which may result in costly legal suits against a country. Since FOSS offers unlimited freedoms, which include freedom to copy and distribute the software, many countries have turned to it to avoid copyright infringements (Islam, 2014).

2.7.2 Economic

In developing countries, proprietary software and related services are part of imported goods and services. They are imported at a high cost; billions of USD dollars are paid for proprietary software resulting in the depletion of many countries' foreign reserves, and worsening the balance of payments of many developing countries, resulting in economic instability of these countries (Arslan, 2014). In this regard, FOSS is key in reducing the cost associated with procurement of software as the use of it results in these countries spending less than they could spend on commercial software. Wong and Sayo (2004) compared the cost of using a commercial software Windows operating system with Linux (Red Hat distro) in some companies in Kuala Lumpur, Malaysia, and established that there were massive savings earned by companies that have adopted d FOSS; the savings were over 99 per cent as table 3 shows.

Table 3: Comparison of the costs of Proprietary and FOSS Operating Systems

SN		Windows	Linux (Red Hat)	Savings
1	Company A: 50 users	$87,988	$80	$87,908
2	Company B: 100 users	$136,734	$80	$136,654
3	Company C: 250 users	$282,974	$80	$282,894

(Source: Adapted from Wong and Sayo, 2004)

2.7.3 Social

The promoters of FOSS consider the development of it as provision of a service to humanity (Free Software Foundation, 2020). The fact that FOSS is used without restrictions and no licence fees, underdeveloped communities and people are able to have access to computer software, which can improve their work and way of life. The proponents of FOSS also consider it a social good that enables increased access to information by people.

It is important to underscore the fact that many governments have been spurred to adopt FOSS because of their desire to maintain their sovereignty. Governments such as China wish to avoid dependence on foreign technology and FOSS is the option. These governments seek to build local software that will meet their needs, and will be available free in their countries (Business Software

Alliance, 2007). According to COMESA (2009), one major reason advanced by governments in the adoption of FOSS is low cost of ownership of software. The regional body for Eastern and Southern African countries postulates that member states such as Mauritius, are looking at reducing the cost of ownership of software and that FOSS is well placed to enable them achieve that. Other reasons cited by COMESA includes the freedoms associated with FOSS and the secure nature of it. As indicated above, FOSS gives users latitudes to do so many things with the software, which include modifying it to suit the local needs. Further, FOSS is said to be secure owing to the fact that it is developed in a Bazaar style, where many developers contribute to the software as opposed to Cathedral approach, where a handful of developers work on software. The fact that FOSS is a community resource and that many programmers or developers look at the source codes, any lapse in the software could easily be identified and fixed. This makes FOSS more secure than proprietary software. Other scholars such as Saini (2013) argue that FOSS helps countries avoid using unlicensed (pirated) software. This ultimately enables countries to avoid copyright infringement on commercial software owners.

2.8 Free and Open Source Software Adoption Policies

In a bid to expedite the adoption and use of FOSS, some federal, national, state and local governments have formulated and implemented FOSS polices. According to the Centre for Strategic and International Studies (2010), there are three types of FOSS policies namely:

2.8.1 Mandatory

As the name suggests, mandatory FOSS policy makes it compulsory for any government institution or department to use FOSS; no use of commercial software is entertained. This is the most extreme and compelling FOSS policy. Few countries have adopted it, which includes Brazil. In 2003, the Brazilian Government made it mandatory for all Federal government departments to use FOSS. In this regard, 300,000 government computers using Microsoft's Windows operating system were to migrate to Linux, open source operating system (Birkinbine, 2016).

2.8.2 Preferential

In preferential FOSS policy, FOSS is preferred to commercial software. This implies that if a government unit or department is about to procure software, preference must be given to FOSS. This is a moderate FOSS adoption policy. Many countries have adopted this policy which includes

India, which in 2014 made FOSS to be given preference when procurement of software to use in government departments (Government of India, 2014). Other countries that have adopted this type of policy include South Africa and Tanzania.

2.8.3 Advisory

Under this policy direction, the use of FOSS is not mandatory or preferred but that government departments have the latitude to consider and use FOSS if deemed good and cost-effective. This is a lukewarm policy towards FOSS adoption. Many countries have adopted this type of policy. These include Denmark, Hong Kong and Ghana (Centre for Strategic and International Studies, 2010).

2.9 Global Adoption and Use of Free and Open Source Software

In life, people always tend to question something given to them freely. They suspect maybe it could not indeed be free; maybe it could be 'poison quoted with sugar' or maybe it is useless. This is the predicament of FOSS. Many people, organisations and countries do not believe that they could have good software freely available to them, and that they can use, share and modify it to meet their local needs. However, the negative perception about FOSS has begun to decline as more people, organisations and countries are realising that FOSS are genuine products and that they have both social and economic benefits to society. In this regard, they are switching to FOSS from proprietary software. In some countries, this switch to FOSS is backed by policies. It is however, imperative to mention that FOSS prioritisation as reflected by public policy initiatives varies from continent to continent and from country to country. In this regard, some continents such as Europe have more FOSS policy initiatives as compared to other continents as highlighted below in table 4.

Table 4: FOSS Policy Initiatives by World Regions from 2000–2009

SN	Continent/Region Name	Number of FOSS Policy Initiatives
1	Europe	163
2	Asia	81
3	South America	57
4	North America	37
5	Africa	9
6	Middle East	7

(Source: Center for Strategic and International Studies, 2010)

The above statistics about FOSS policy initiatives were taken 11 years ago but they are still valid as there have been negligible dynamics on regions' FOSS policies as Europe still leads the rest of the continents. As regards to the most users of FOSS globally, Takhteye and Hilts (2010) report that North America as a continent is leading followed by Europe. North America is also a world leader in the number of people contributing to the development of FOSS (Takhteye & Hilts, 2010). Africa is trailing behind in these areas as shown in table 5 below.

Table 5: Github Participation by Region (%)

SN	Continent/ Region	Users	Contributors	Contributions
1	North America	42.9	43.0	47.5
2	Europe (W/N)	25.7	27.4	27.3
3	Europe(E/S)	10.6	10.5	8.4
4	Asia	10.2	9.0	8.6
5	Latin America	6.4	5.5	3.6
6	Australia	3.6	3.9	4.1
7	Africa	0.6	0.6	0.5

(Source: Adapted from Takhteye and Hilts, 2010)

As articulated earlier, within these continents and regions, there are disparities in the adoption and support of FOSS.

2.9.1 Europe

Europe is among continents that have actively participated in the development, adoption and use of FOSS. Many successful projects in FOSS can be traced back to Europe. For instance, the project to write Linux Kernel started in Finland. Furthermore, famous contents management systems such as TYPO3 and Drupal started in Germany and Belgium, respectively. European society and governments have been supportive of FOSS. Their regional body, the European Commission (EU) has also been instrumental in the development, adoption and use of FOSS, among member countries. This is evidenced by the European Commission's decision to begin using FOSS at its offices in Brussels, Belgium. The European Commission in 2000 defined a strategy concerning the internal use of FOSS and recommended the use of Apache to power its servers in Brussels (European Commission, 2013). Further, between 2007 and 2011, the European Commission established and approved the European Union Public Licence (EUPL), which formed the basis for the development of various FOSS foundations such as the Open Source Observatory and

Repository for European public administration (European Commission, 2013). The OSOR.eu has coordinated and promoted the development of FOSS in public sector in Europe.

However, the adoption and use of FOSS in European countries is heterogeneous. According to Cenatic (2010), the penetration and use of FOSS in Europe vary from country to country with Western European countries doing exceptionally well than their Eastern counterparts. Germany, France and Spain are leading in the adoption of FOSS in Europe. These three governments have been heavily involved in the development and promotion of FOSS in Europe. For example, Germany launched policies aimed at promoting FOSS in public institutions while France has centralised the promotion and implementation of FOSS in public organisations (OSEPA, 2011). In Spain, the promotion and implementation of FOSS is left to individual autonomous governments but central government has provided guidelines.

Other European countries that are striving to promote FOSS include Sweden. According to Bouras, Kokkinos and Tseliou (2012), 50 per cent of local authorities in Sweden use FOSS. The United Kindom (UK) is not doing well in the promotion and use of FOSS because it has a lukewarm policy on FOSS. Its FOSS policy states that government would actively and fairly consider open source solutions alongside with proprietary ones in making procurement decisions (United Kingdom Cabinet Office, 2012). The government in UK does not compel state institutions to use FOSS but just encourages the use of FOSS; its FOSS policy is advisory in nature. This is the reason why the UK does not rank well in the adoption and use of FOSS because the state has not taken an active role in promoting FOSS.

2.9.2 North America

North America is credited for initiating the FOSS movement; the first FOSS movement started in North America, in the United States of America (USA) by Richard Stallman. North America remains the biggest contributor to the growth of FOSS in the world. Many successful FOSS projects domicile in the USA. These include Red Hat, Apache and Evergreen. The Cenatic Foundation (2010) observes that the USA contributes a large-percentage of FOSS initiates and projects in Northern America than Canada and other countries. North America suffers from lack of firm national commitment to the promotion of FOSS (Cenatic Foundation, 2010). There are no national policies like in some European countries to promote and use FOSS in public institutions.

However, some individual States and public institutions promote and use FOSS. For instance, in the USA, Texas and Oregon states have passed laws to promote FOSS. Further, the White House has migrated its website contents to Drupal from a commercial content management system. By 2003, the Department of Defence (DoD) was reported to be using more than 115 FOSS in its operations (The MITRE Corporation, 2003)). Further, the DoD has been actively supporting and promoting the use of Alfresco, a records management system which has a community version. The private sector in the USA has been extensively using FOSS in its operations too. According to the Cenatic Foundation (2010), 41 per cent of private companies in the USA use FOSS. The commonly used FOSS are Apache (43%), Tomcat (31.5%) and MySQL (30.7%).

2.9.3 South America

In Latin America, Brazil stands out from the rest of the countries in the region as regards the development and use of FOSS. Brazil competes favourably with India and China in the development and use of FOSS (Cenatic Foundation, 2010). The ecosystem of FOSS in Brazil is healthy with major stakeholders such as government, academia and industry playing their roles. Federal and State governments in Brazil have been actively participating in the ecosystem of FOSS by implementing laws that favour the growth and use of FOSS. For instance, many cities and 27 states have passed laws to encourage the adoption and use of FOSS, mainly to build up computer infrastructure (Richter, Zo & Maruschke, 2009). Further, the Brazilian Government has been initiating FOSS projects ranging from inventory systems to agricultural networks. Major examples include CACIC (inventory systems), CONTRA (access control system), SISAU, SACI LIVRE (administration for institutional contents) and Agrolivre (Agriculture network). Brazil has been also preaching FOSS by encouraging government departments and units to use FOSS. For example, the Ministry of Education has adopted Linux Debian with its education application packages from K Desktop Environment (KDE) (Richter, Zo & Maruschke, 2009). Bank of Brazil adopted Linux servers in 2001. Further, the current voting system in Brazil runs on Linux servers (Paiva, 2009).

The private sector in Brazil has been active in the ecosystem of FOSS. According to Richter, Zo and Maruschke (2009), 73 per cent of private companies in Brazil use FOSS. This is because FOSS is deemed cheaper than proprietary software. One of the major users of FOSS in the private sector in Brazil is Casas Bahia (a large retail chain) which uses SUSE Linux Enterprise server. Other

private sector players have migrated from commercial software to FOSS. For instance, companies have migrated from Oracle to MySQL and PostgreSQL.

Universities in Brazil have contributed significantly to the development of FOSS. Many computer and ICTs learning institutions in Brazil encourage their students to develop programmes and applications in FOSS programmes such as JAVA, PHP and Python, and release their programmes under general public licence. In addition, HEIs in Brazil evangelise the concept of open access not only to software but also to scholarly communications (open access journals). According to UNESCO (2014), Brazil is the only country in the world with 97 per cent of scholarly works (journals) published under open access philosophy.

2.9.4 Asia

According to the Centre for Strategic and International Studies (2010), Asia in 2008 had 70 FOSS approved and proposed initiatives. Asia is home to numerous FOSS projects that include Asianux, jointly developed by Red Flag Software of China, Miracle Linux of Japan, Haansoft of South Korea and other Asian countries (Saini, 2013). In Asia, China is leading not only on the economic front but also in the development and use of FOSS. The Chinese Government has taken deliberate steps to support the development and popularisation of FOSS by prohibiting the use of foreign commercial software in government departments. This has spurred the growth of FOSS in China. Further, the Chinese Government supports Red Flag Linux (Chinese Distribution of GNU/Linux) with a view to creating its local technology and discouraging software piracy (Johnson, 2008). Many government departments at national, provincial and local levels in China use Red Flag Linux. These include the Ministry of Statistics, China Post and China Academy of Sciences.

India is not far behind in technology advancement. It has grown to be a technology giant in the world, with large software and hardware companies shifting their operations to India. Like many other governments in the world, the government of India (GoI) in 2015 launched an ambitious project of turning India into a digital country; government began implementing e-governance. In this regard, the Indian Government considers FOSS as a means to actualise the concept of digital India. In the bid to support the growth of FOSS, the Indian Government in 2015 announced a policy for adopting FOSS, making it mandatory to consider such software along with proprietary software in order to lower the cost of software (The Economic Times, 2016). Under this policy,

Central and State departments ought to give preference to FOSS in the procurement of software as India seeks to implement e-government systems (Ministry of Communication and Technology, 2016). It is imperative to mention that prior to this policy launch India has been home to many FOSS projects. These include BOSS (an Indian version of GNU/Linux), Koha, Dspace, Creative Computing@ School (an Education e-journal). Even before the implementation of FOSS policy in India, some Central and State, departments began migrating to FOSS and saved a lot of money in Dollar terms. For example, Kerala State replaced Windows Software with FOSS on 50,000 desktops in schools across the State and saved nearly 10.2 Million USD. The private sector in India has also been migrating to FOSS. For instance, the New India Assurance Company with IT infrastructure of 1,500 severs and 7,000 desktops migrated to FOSS and saved USD 16.67 million (Opensourcecom, 2016).

South Korea is also doubling its efforts in promoting FOSS. In 2003, the South Korean Government announced that it would replace proprietary software on government computers and servers with Open Source Software by 2000. In 2004, the government allocated USD 19 million to replace Windows Operating Systems and Office productivity suites in government bodies with Open Source programmes. Many government departments in South Korea have adopted FOSS such as Linux. The switch to FOSS has made South Korea to save USD 300 million per year (Kshetri & Schiopu, 2007). The Korea IT Industry Promotion Agency (KIPA) is spearheading the development and use of FOSS in South Korea. It has been supporting the development and use of local FOSS such as Linux. For example, an educational information system called the National Education Information System (NEIS) that is used by schools in South Korea to manage students' information was developed with financial support from KIPA. Further, KIPA is promoting the use of FOSS in universities such as Gangwon University.

Japan has lagged a bit behind in the promotion and use of FOSS. However, it is catching up quickly because the government has committed itself to promoting FOSS. In 2007, the Central government of Japan announced the prioritisation of FOSS in the procurement of software. This is a move meant to stop dependence on Microsoft, thus, reducing costs associated with software procurement in the country (Centre for Strategic and International Studies, 2010).

2.9.5 Africa

Africa is lagging behind in the development and use of FOSS. According to the Cenatic Foundation (2010), Africa is struggling to participate in the use and development of FOSS. This situation is partly attributed to the lack of public promotion policies and high rate of illegitimate software use. In this regard, very few countries on the continent have FOSS policies as table 6 depicts.

Table 6: Some African Countries with FOSS Policy Initiatives

SN	Country	FOSS Policy Existence	Year Policy Adopted	Policy Type
1	Angola	No policy but ICTs policy recommends use of FOSS	N/A	N/A
2	Benin	No policy but encourages use of FOSS	N/A	N/A
3	Djibouti	No policy but plans to research on FOSS	N/A	N/A
4	Kenya	No policy but paper on FOSS is in progress	N/A	N/A
5	Senegal	No policy but experimenting with FOSS	N/A	N/A
6	South Africa	Available	2007	Preference
7	Tanzania	Available	2003	Preference
8	Uganda	No policy but strong use of FOSS in academia	N/A	N/A
9	Zambia	No policy but ICTs policy recommends use of FOSS	N/A	N/A

(Source: Adapted from Centre for Strategic and International Studies, 2010)

Furthermore, lack of general awareness of FOSS on the continent of Africa hampers the adoption of FOSS (United Nations University, 2011). Other factors that hinder the adoption of FOSS in Africa include lack of advocacy and poor Internet connectivity. In a bid to coordinate the development and adoption of FOSS on the continent of Africa, in 2003, a foundation called Free and Open Source Software Foundation for Africa (FOSSFA) was formed under the auspices of the African Union. After its formation, FOSSFA has been focusing on three areas, namely; open source in government, open source in health and open source in education.

African countries are slowly turning to FOSS as a measure of reducing the cost of running their governments. South Africa (SA) stands out on the continent of Africa with a commendable Open Source Software (OSS) index close to the world average (Karume & Mbugua, 2012). The South African Government and non-governmental organisations such as the Shuttleworth Foundation support FOSS. South Africa is home to some important FOSS projects such as *Ubuntu* (a popular version of Linux). The use of FOSS is backed by the FOSS policy launched in 2007. In South

Africa, the policy recommends consideration of FOSS in the procurement of software in government departments; the policy is not compulsory but preferential in nature. Immediately after the South African Cabinet approved the FOSS policy, the government announced that it would replace proprietary software with FOSS, with a view among other things, lowering the administration costs and enhancing local IT skills Karume & Mbugua, 2012)

Since the launch of the FOSS policy in South Africa, many organisations both public and private have switched to FOSS. For instance, the South African Social Security Agency (SASSA) deployed Multi-station Linux desktops to address budget and infrastructure constraints in 50 rural sites. Further, First National Bank switched more than 12,000 desktop computers to Linux by 2007 (SANGONet, 2016). Despite the South African Government committing to outlaw the use of commercial software in 2007 and replace it with FOSS, many government departments today still use commercial software. For instance, Cpbotha (2014) observes that in 2007, the South African Government officially approved the OpenDocument format. However, MS Office use is still rife, and the Government still encourages people to use Microsoft's own XML formats. Cpbotha further argues that the South African Government continues to send millions of Rands to Microsoft Company every year for the use of Windows operating systems and MS Office suite. According to Kamau and Namuye (2012), South Africa's expenditure on proprietary software licences amounted to SAR 6 billion annually, which is channeled to foreign companies such as Microsoft.

Tanzania is another country on the continent that launched its ICT policy in 2003, in which the government of the Republic of Tanzanian pledged to embrace FOSS. Like South Africa, Tanzania's FOSS policy is preferential in nature; this implies that FOSS is preferred to commercial software in government departments. Although documentation on how Tanzania uses FOSS is difficult to come by, the country is actively using FOSS as evidenced by the establishment of FOSSFA Tanzania Chapter. According to Twaakyondo (2012), many banks and government departments in Tanzania use Linux as their server software. Furthermore, the Local Government Human Resources Information System (LGHRIS) and the District Health Information Software (DHIS) are good examples of systems that run on Linux, Apache, MySQL and PHP Open source technologies (Twaakyondo, 2012). Tanzania is home to various FOSS projects, which include among others, the student academic registration information system (SARIS).

2.10 The Adoption of Free and Open Source Library Management Systems in Higher Education Institutions

As captured in the introduction, libraries in HEIs such as universities and colleges have long been using ICTs, in particular library management systems to automate their housekeeping activities in order to improve service delivery to their users. According to Hussain (2013), the following factors necessitated library automation:

(a) explosion of knowledge resulting in numerous specialisations and flow of almost non-stop information;
(b) inability of users to explore unlimited literature;
(c) wastage of enormous precious time in handling routine and repetitive library operations;
(d) inability of libraries to acquire all the published information resources; and
(e) facilitation of easy, fast and reliable sharing of resources between libraries, cutting across space and time.

Prior to the 1970s, all the housekeeping activities in libraries were performed manually. Furthermore, information resources were in print format, and access to such library services was centralised. Users were supposed to be physically in a library building to receive a service. Today, users can access a variety of information and scholarly journals online (Arhtar, 2013). With the implementation of library management systems, library users can access library services remotely in the comfort of their homes and offices. They (library users) can borrow and renew library resources remotely. Further, library users can reserve the materials electronically, and request for information resources from other libraries that co-operate with their library online. On the other hand, librarians can provide reference library services online. These and other services of a library have been automated and are accessible online through the Internet and Intranet. It is worth mentioning that library automation in many of the institutions of learning has been dominated by the use of proprietary or commercial library management systems, which have been proved not to be sustainable to many academic libraries; hence libraries switching to FOSLMS.

2.10.1 History of Free and Open Source Library Management Systems

The history of FOSLMS can be traced back to the exponential increase in the prices of computer software witnessed in the late 1970s and 1980s. According to Kochtanek and Matthews (2002), in the 1970s and 1980s, the price of computer hardware dramatically fell but the price of software

rose exponentially. During this period, computer vendors began collecting an average of 12 per cent from the sales of their hardware, while software sales accounted for not less than 47 per cent of their total revenues. The sharp increase in the price of software such as library management systems resulted in many academic libraries struggling to pay for such software, hence, starting looking for alternatives and free and open library management systems appealed to them. As already stated in the introduction of the literature review, the concept of developing free and open source software began in 1980s, with UNESCO releasing the first free library management software called Computerised Information Service/Integrated Scientific Information System (CDS/ISIS) in 1985 (Nowicki, 2001). The CDS/ISIS for many years remained free software but not open source because its source code was not available for distribution. In addition, the CDS/ISIS was not an integrated library management system but was the only library management system that existed until late 1999, when versatile and integrated FOSLMS began to emerge. According to Londhe and Patil (2015), in 1999, a number of free and open source software for libraries were developed, which, included Koha, MyLibrary, Open and LOCKSS. Since then, many more FOSLMS have been developed and the library sector has never been the same.

*2.10.2 **Commonly used FOSLMS***

The library management systems market is inundated with many FOSLMS. According to Muruli and Kumar (2014), the most popular FOSLMS are Evergreen, Koha, NewGenLib, OpenBiblio, ABCD and PMB. Table 7 below lists alphabetically, some of the common FOSLMS. Even though many projects to develop FOSLMS were initiated in the early 2000s, some of these projects have been abandoned or become inactive. In this regard, this treatise has attempted to cite free and open source library management system projects that are active.

Table 7: Some active FOSLMS

SN	Name of software	Year released	Country
1	ABCD	2008	Brazil/Belgium
2	Evergreen	2006	United Sates of America
3	Koha	2000	New Zealand
5	NewGenLib	2008	India
6	OpenBiblio	2002	Netherland
7	PMB	2003	France
8	SLIMS	2006	Indonesia

According to Londhe and Patil (2015), Koha leads other FOSLMS such as Evergreen, PMB and NewGenLib in terms of releases and community activities. According to research conducted by Londhe and Patil in 2015, Koha ranked first among FOSLMS because it has excellent modules; it also has an active community of users and developers.

2.10.2.1 ABCD

The acronym ABCD in Spanish stands for "Automatización de Bibliotecasy Centros de Documentation". In English, ABCD is directly translated as "Automation of Libraries and Documentation Centres" (ABCD, 2015). In Brazil, the Latin American and Caribbean Center on Health Science Information Knowledge Management, Bioethics and Research (BIREME) released ABCD in 2008 with financial support from VLIR-UOS, the Flemish Interuniversity Council in Belgium. ABCD is web-based library anchored on CDS/ISIS technology; it being the first free software developed and distributed by UNESCO. The latest release is ABC 2.1b, released in June 2019.

This library system has several modules mirroring the operations of a library that include cataloguing, circulation, serial management, acquisition and WebOPAC (De Smet, 2009). It is important to mention that ABCD is in conformity with Library and Information Science standards such as metadata standards (MARC and Dublin Core). It also conforms to ISO 2709 standard for information coding and exchange. This system uses Z39.50 protocol to retrieve bibliographic records from other library systems. Furthermore, ABCD is written mainly in four programming languages, namely; PHP, Java, JavaScript and Python. This library management system runs on both Windows and Linux platforms and is available in Spanish, English, French and Portuguese languages. In addition, ABCD runs on Apache server and powered by MySQL database.

2.10.2.2 Evergreen

Evergreen was developed by the Georgia Public Library Service (GPLS) to support libraries in the Public Information Network for Electronic Services (PINES) consortium; a network of over 275 public libraries that seek to share information resources. The development of Evergreen began in 2004, and in 2006 and PINES successfully migrated to Evergreen (Riewe, 2008). Evergreen is one of the stable and mature FOSLMS and the current version is 3.4, released in October 2019. Modules found in Evergreen are acquisition, cataloguing, circulation, serials and Web OPAC.

This library management system is written in Perl, C and Java Script, and it runs on Apache server. However, Evergreen uses a database management system called PostgreSQL not MySQL. Evergreen can be installed on Linux, Windows and Mac operating systems (Londhe & Patil (2015). Like any other modern library management system, Evergreen conforms to industry standards, which include metadata standards such as MARC and XML. It also conforms to ISO 2709 standard for information coding and exchange.

2.10.2.3 Koha

Koha, which means 'gift' or 'donation' among the Maori people, the natives of New Zealand, was began in 1999. A group of rural libraries in Harowhenua District of New Zealand funded Koha's development because it became unsustainable for these small libraries to pay for commercial software (Ukachi, Nwachuku & Onuoha, 2014). Katipo Communications Limited developed Koha in 2000 for Harowhenua Library Trust. Later, Koha was released under GPL licence thus paving way for other developers and users to join the Koha family.

Koha is the first fully-fledged integrated library management system to be developed. It is available in many languages, which include English, French, Chinese and Arabic (Reddy & Kumar, 2013). The library management system runs on Linux operating systems and requires Apache as a server. Koha uses MySQL or MariaDB database management system. Like other major library management systems, Koha conforms to industry standards that include metadata standards such as MARC and XML. Further, Koha conforms to ISO 2709 standard for information coding and exchange. Koha uses Z39.50 protocol for exchange of bibliographic records with other library management systems. This award winning library management system is released twice in a year. At the time of writing this thesis, the latest release of Koha was 19.11.05, released on 22 April 2020. Like any library management system, Koha has several modules; these include acquisitions, administration, authorities, circulation, cataloguing, serials management, patrons and reports (Koha Library Software Community, 2019).

2.10.2.4 NewGenLib

NewGenLib is an open source integrated library management system developed in India and released in 2005. Kesavan Institute of Information and Knowledge Management, and Verus Solutions Pvt Limited started NewGenLib as a proprietary initiative and gained substantial user

base. In 2008, the developers of NewGenLib changed the release licence to General Public Licence, thus, paving way for more players to come on board (Kurmar & Thomas, 2009). The latest release of NewGenLib is 3.1.1 released in April 2016. This library management system has among other modules, acquisitions, technical processing (cataloguing and classification), serials management, administration, MIS reports, task to do today (daily scheduler) and OPAC.

This library management system is purely written in Java. It runs on Apache Tomcat server and uses the PostgreSQL database management system. NewGenLib uses Apache Lucene as its search engine. The software conforms to the industry standards such as metadata standards such as MARC, XML, Dublin Core MODS 3.0 and AGRIS (Muruli & Kumar, 2014). NewGenLib makes use of Z39.50 for federated searching. Further, NewGenLib allows harvesting metadata from external repositories. This implies that it is OAI-PMH compatible.

2.10.2.5 OpenBiblio

OpenBiblio is another free library management system available for library automation. Dave Stevens created OpenBiblio in 2002 but now the system is maintained by Hans van der Weij in the Netherland (Bwalya, 2017). This library management system is written in Preprocessor Hypertext Language (PHP) and available in many languages which include English, French, Spanish and Russian. Dave Stevens thought of coming up with an easy-to-use, well-documented, easy-to-install library management system. Like any other software, OpenBiblio has evolved and its latest release is version 0.7.2, released in August 2014. This is the version recommended for new installations and for updating older versions. OpenBiblio contains basic modules, which include Web OPAC, circulation, cataloguing, administration and reports modules. This system runs on Apache server and uses MySQL database management system. OpenBiblio complies with many industry standards that include MARC and ISO. It however does not support Z39.50 protocol.

2.10.2.6 PMB

The PMB, initially called PhpMyBiblio, is a fully featured open source integrated library management system developed and maintained by a French company called PMP Services. Francois Lemarchand, Director of Public Library of Agneaux started PMB in 2002, and released it in 2003 (Londhe & Patil, 2015). It is worth mentioning that PMB is one of the mature FOSLMS

with more than 13 years of existence. The library system is written in PHP and works on Linux, Windows and Mac operating systems. It is available in English, French, Spanish, Italian, Arabic, Dutch and Portuguese. The software provides four essential features, namely; library management, watch and documentary products, publication of editorial content, and electronic document management. The modules of PMB are divided into two as follows:

(i) Management module which includes specific functions for the librarian such as circulation, catalogue, authorities, editions, SDI (selective dissemination of information) and watch module, acquisition, content management systems (CMS) and administration, and
(ii) OPAC with a content management feature that makes it to be a highly customisable portal.

In terms of interoperability of the software, PMB conforms to all the Library and Information Science industry protocols and standards. It allows the use of Z39.50 protocol to search, retrieve and import bibliographic records from other library management systems. It also allows keeping bibliographic records in UNIMARC and ISO 2709 record exchange formats. Further, it allows records or data to be kept in XML data format. On the other hand, PMB is also compatible with Open Archive Initiative (OAI) server and client that allow the bibliographic records in PMB to be harvested by search engines and other harvesters (Smile, 2017).

2.10.2.7 SLIMS

The letters SLIMS stand for Senayan Library Management System. It is an open source integrated library management system that was started in Indonesia in 2006. Senayan is a place in Jakarta where SLIMS was developed, hence its name. The system was initially developed for the Ministry of Education and Culture, which was unable to afford the cost of the commercial library management system it was using (Jurriens, 2017). As at time of writing this thesis, SLIMS 9 BULIAN was the latest release.

The core developers of SLIMS are librarians and the system is written in PHP. This system runs on Apache server and uses MySQL or MariaDB database management system. Modules found in SLIMS include circulation, digital, contents/files (PDF, DOC, RTF, XLS, PPT, Video, Audio, etc.), catalogue database management, serial publication control, online public access catalogue (OPAC) with thumbnail document image support (for images of book covers).

It must be noted that SLIMS supports all major library and information industrial standards, including major metadata standards such as MARC and Dublin Core. Further, SLIMS supports OAI-PMH (Open Archives Initiative Protocol for Metadata Harvesting) in Dublin Core format, for metadata harvesting purposes. Furthermore, SLIMS supports Z39.50 SRU and uses Nayanes as a federated search engine (FOSS4LIB, 2013).

*2.10.3 **Criteria for Choosing a Good Free and Open Source Library Management System***

A good FOSLMS possesses several features. In this regard, any library seeking to adopt FOLSMS should examine it in light of these features. The features to consider include:

2.10.3.1 Basic Hardware and Operating System Requirements

Any software (open or closed) is installed and booted on the computer hard disk and uses resources from the Random Access Memory (RAM). According to Tiwari (2013), before selecting software (either FOSS or proprietary) to use, there is need to carefully look at the basic hardware requirements. Some software would require large amounts of hard disk and RAM for them to be installed. In this regard, a good FOSLMS should run on a machine with minimal amount of hard disk and RAM. Further, it should run on several operating systems such as Windows, Linux and Macintosh operating systems.

2.10.3.2 Reliability and Maturity of Software

Experience has shown that software that has been in existence for a long time is stable and mature. Like a child moves from childhood to adulthood, software too pass through these maturation stages. As they move from one stage to another, they get polished and refined. Early versions of software often offer relatively few features with defects. According to Pan (1999), robustness failure rate drops when the version numbers go up. It can therefore be said that mature software will perform better than newly introduced software (Wheeler, 2011). This presupposes that a library should adopt free and open source library management system that is mature enough.

2.10.3.3 Conformity to Existing International Standards

In Library and Information Science field, standards on how, to describe the physical features of information resources, importing and exporting bibliographic data have emerged. These include Machine Readable Cataloguing 21 (MARC 21), Common Communication Format (CCF) Resource Description and Access (RDA), and data export/import ISO 2709 (MARC/CCF)**.** These

have become international standards. According to Sangeeta (2010), a good library management system should support internationally known standards so that library staff could have the latitude to exchange bibliographic data with other libraries around the globe. Further, a good library management system should comply with UNICODE that is widely used as data encoding system for assigning numbers to all characters for the computer to understand. This would allow interoperability; allowing data to be exchanged between different computers' platforms.

2.10.3.4 Integrated System

One of the features of a good library management system is that it should be an integrated system; meaning that it should have all the modules that represent all of the housekeeping functions of a library such as cataloguing, circulation, OPAC, serials, and reports. As Balassubramanian (2011) observes, current library management systems are integrated systems, based on relational database architecture. All the library housekeeping operations of a library are contained in one database.

2.10.3.5 Customisation and Expandability (Scalability)

The system should permit addition of new features to meet the local need and use. Scalability is the ability of a computer application or product (hardware or software) to continue to function well when changed in size or volume in order to meet a user need (Metcalfe, 2013). Typically, the rescaling is to a larger size or volume. It is the ability of a computer system to increase capability while retaining or increasing response time and throughput performance (Search Data Center, 2006). Such a system can accommodate additions to its capacity and capabilities (The Law Dictionary, 2020). A good library management system should allow the plug-ins and further give the adopting library the latitude to customise it so that graphical user interface mirrors local requirements of the library.

2.10.3.6 User Friendliness

Many librarians and computer system experts agree that good software should not be difficult to use by both the library staff and users. It should be user-friendly (Sangeeta, 2010). The software should have a graphical user interface (GUI). It should also provide expert advice and assistance in performing any task. It should empower the experienced user with short-cut and inexperienced user with menu-driven icon, dialogue box, etc., giving clickable access to the software.

2.10.3.7 Capacity of the Software

It is the desire of any librarian to adopt a library system that is robust enough to allow all the bibliographic records of the libraries stored in there. However, some systems have restrictions for data to be stored in them (Müller, 2011). For example, OpenBiblio allows storage of up to 50,000 bibliographic records. A good FOSLMS should be robust enough to allow the library capture and store its entire library collection on the system database.

2.10.3.8 Documentation

Documentation is one of the most important components of an application development. Even programmes developed following the best programming practices become useless if the end users are not able to utilise fully their functionalities (Kipyegen & Korir, 2013). A well-documented application is also useful for other programmers because even in the absence of the author, they can understand it. Some software barely has documentation thus making it difficult for the users to use it. For FOSS, documentation is not only important to users but also to the software's developers who may wish to contribute to the development of software.

2.10.3.9 Active Community of Users and Developers

Good software should have many users. Users are important in an open source project because they use the product and give the project a purpose and help it grow. Further, users provide feedback about features and bug reports (The Linux Foundation, 2020). User community should be active by collaborating and networking with each through platforms such as wikis and blogs. If the user community is large and active, a software user with problems can easily find solutions from another user. The presence of an active user community makes the software sustainable. Some FOSLMS have inactive user communities, thereby making it difficult to attract new users. Further, a good FOSLMS should have an active community of developers. It is a fact that FOSS does not have full-time developers. The developers of FOSS are volunteers who need to collaborate with each other to ensure that the new version of the software and patches are developed, and released. This makes the software sustainable. In addition, FOSS with active community of developers (experts) makes it easier and faster for software users to get technical support when they need it.

2.10.4 ***Global Adoption of Free and Open Source Library Management Systems in Higher Education Institutions***

As articulated above, libraries in HEIs across the globe are continuously adopting FOSLMS. Among other reasons, is the desire reduce the cost of software ownership. The adoption of FOSLMS in libraries is not heterogeneous as there are differences in the manner FOSLMS have been adopted. These differences vary from country to country, and from region to region. Further, some of the discussed FOSLMS have a global appeal while others have a regional or country appeal as demonstrated below.

2.10.4.1 Africa

For many years now, many libraries in Africa have struggled and others have failed to automate their operations using proprietary library management systems. Mutula (2012) reports that as the first wave of library automation swept around the world, sub-Saharan Africa remained the laggards of the new library technological dispensation. The laggard status of sub-Saharan African libraries in automation is due to among other factors, prolonged adverse economic conditions, budgetary constraints, high cost of ICT facilities and inadequate ICT training. Mutula further argued that because of budgetary constraints faced by university and public libraries in sub-Saharan African countries, Computerised Documentation Services/Integrated Set of Information Systems (CDS/ISIS) from UNESCO at a nominal fee became the main library automation software during the late 1980s for most libraries.

The CDS/ISIS was not an integrated library system as its name suggests. It was not an enterprise resource planning software. It had no library modules present in modern library management systems but was a computer library software that allowed libraries to create independent database tables representing their operations. Simply put, CDS/ISIS was not based on a relational database model.

The birth of FOSLMS in the early 2000 has fundamentally changed the landscape of library automation in Africa. Many libraries now find it easy to automate all the library functions using a single library management system. Libraries in Africa, where financial resources are very much scarce, have breathed a sigh of relief with the coming of FOSLMS, such as Koha, ABCD,

OpenBiblio and PMB as they can automate their operations. It is important to mention that some libraries in Africa are still using CDS/ISIS and J-ISIS.

2.10.4.1.1 Southern Africa

Before the birth of Koha in 2000, CDS/ISIS was a household name among libraries as regards to automation. As Abboy and Hoskins (2008) contend, in the 1990s, some libraries in Southern Africa automated their libraries using CDS/ISIS. CDS/ISIS has been widely used in developing countries. A research conducted by Abboy and Hoskins in 2008 on the use of CDS/ISIS in Southern Africa showed that CDS/ISIS was widely used in Southern Africa except South Africa. Namibia and Zimbabwe took a lead in the use CDS/ISIS (Abboy & Hoskins, 2008). The study further revealed that special libraries dominated the use of CDS/ISIS in Southern Africa. Abboy and Hoskins also reported that some libraries in Zambia had been using CDS/ISIS since 1992 and that despite Zambia not participating in the survey, the country had over 500-trained users of CDS/ISIS by the year 2004. Special libraries in Zambian institutions such as the Bureau of Standards, Institute of Economic and Social Research (INESOR), Export Board of Zambia (former), Food and Agriculture Organisation (FAO), Seed Bank Documentation Centre, University of Zambia and Southern Africa Development Community (SADC), Plant Genetic Resource Centre, were among libraries that adopted CDS/ISIS in Zambia. This goes to show that CDS/ISIS had been a household name in Southern Africa in the area of library automation. In the late 2006, some libraries in Southern Africa migrated to an improved version of CDS/ISIS called J-ISIS. For instance, the Economic Commission for Africa Library in Lusaka was by the year 2011 using J-ISIS as its library management system.

Since the coming of FOSLMS such as Koha, Evergreen, OpenBiblio and ABCD, many libraries in Southern Africa have migrated to such systems. In Southern Africa and Zambia in particular, there is increased trail of evidence through literature, indicating that libraries in Zambia are increasingly adopting Koha. According to MESVTEE and VVOB (2013), all public colleges of education in Zambia received training in Koha library management system, with a view to making the use of it in college libraries to ensure easy access of information resources by student teachers and lecturers. The VVOB (a Belgian Organisation) which provided financial support towards the training of public colleges of education librarians began by sending a librarian from Charles Lwanga College of Education for Koha training in Scotland in 2012, so that he could become a

trainer of trainers. The training college of education librarians received from MESVTEE and VVOB has made many of them to automate their libraries using Koha. According to Sitali (2012), Charles Lwanga College of Education has pioneered in the use of Koha in public colleges of education. According to Marshall Breeding (2017), the other library reported to be using Koha in Zambia is Zambia Institute of Business Studies and Industrial Practice (ZIBSIP). DANARAH Computers Limited (2017) reports having automated some libraries in HEIs in Zambia using Koha; these include Mulungushi University and Zambia Centre for Accountancy Studies (ZCAS). Below is the list of some HEIs in Zambia that have automated their library operations with Koha.

Table 8: Some HEIs that have Adopted Koha in Zambia

SN	Name of HEI	Type of HEI	HEI Ownership
1	Charles Lwanga College of Education	College of Education	Public
2	Chainama College of Health Sciences	TEVET	Public
3	Chipata College of Education	College of Education	Public
4	David Livingstone College of Education	College of Education	Public
5	Justo Mwale University College	University	Private
6	Kasama College of Education	College of Education	Public
7	Kwame Nkrumah University	University	Public
8	Kitwe College of Education	College of Education	Public
9	Lewanika Nursing School	Nursing School	Public
10	Malcom Moffat College of Education	College of Education	Public
11	Mansa College of Education	College of Education	Public
12	Mongu College of Education	College of Education	Public
13	Mukuba University	University	Public
14	Mulungushi University	University	Public
15	Solwezi College of Education	College of Education	Public
16	Zambia Institute of Special Education	College of Education	Public
17	Zambia Centre for Accountancy Studies	University	Public
18	ZIBSIP	TEVET	Public

(Source: MESVTEE & VVOB, 2013; Marshall Breeding, 2017; DANARAH Computers Limited, 2017)

Table 8 shows more public colleges of education have automated their operations using FOSLMS; only one nursing school was automated with FOSLMS.

Further, a research conducted by Banda and Impi (2015) on the adoption of Koha as a library management system in Lusaka Province by libraries, revealed that out of 73 of the libraries

surveyed, 11 were found to have adopted Koha. This study however did not indicate how many academic libraries in Lusaka Province were using Koha but it points to the fact that the use of Koha as a library management system in Zambia was rising.

OpenBiblio is another FOSLMS libraries use in Zambia. According to Wishart (2012), Grace Academy in Ndola (run by Seeds of Hope, an NGO) has a functioning library that has been automated with OpenBiblio. Wishart (2012) describes OpenBiblio as easy to install and use. Smaller libraries such as school libraries prefer to use OpenBiblio as well as smaller academic libraries. There is however scanty information on the number of libraries especially from HEIs that have adopted OpenBiblio in Zambia.

As earlier indicated, WINISIS is still being used by a number of libraries in Zambia. According to Marshall Breeding (2017), Zambia Bureau of Standards Documentation Centre uses WINISIS as its library management system. No documentation exists which points to the fact that HEIs libraries in Zambia use WINISIS.

In Zimbabwe, Koha is one of the widely used FOSLMS. A private company called Bibliotech supports the use of Koha in library automation in Zimbabwe. Bibliotech has been providing Koha consultancy services to many libraries in Zimbabwe. It has carried out library automation among HEIs, which include Theological College of Zimbabwe and Zimbabwe Christian College as shown by table 9 below.

Table 9: Some HEIs that have Adopted Koha in Zimbabwe

SN	Name of HEI	Type of HEI	HEI Ownership
1	Theological College of Zimbabwe	College	Private
2	Harare Theological College	College	Private
3	Zimbabwe Christian College	College	Private
4	Domboshawa Theological College	College	Private

(Source: Bibliotech, 2016)

Further, scanning of literature on the use of Koha in Zimbabwe has revealed that HEIs libraries such as Midlands State University and Mutare Teachers College are using Koha. These findings show that the use of Koha is rife among HEIs in Zimbabwe. However, based on what Table 9 presents, one could argue that more privately owned HEIs in Zimbabwe have adopted Koha.

In Malawi, Koha has been adopted by many libraries, including higher educational libraries. Among HEIs that have adopted Koha, include Mzuzu University that began piloting with Koha in 2008 and later adopted it (EIFL, 2010). Chaputula and Kanyundo (2019) who surveyed all the 43 registered HEIs in Malawi as regards the diffusion of Koha integrated library systems established that 84.2 percent HEIs in Malawi had automated their operations and that there was a high adoption level of FOSLMS in HEIs in Malawi. Over 81.3 percent of libraries in HEIs in Malawi were found to have automated their operations using Koha. Furthermore, the study by Chaputula and Kanyundo revealed that one HEI in Malawi was using NewGenLib System. Koha has also been adopted by non-academic libraries in Malawi such as the Malawi National Library Services (Cormack, 2010).

In South Africa, there is scanty information on the use of FOSLMS among HEIs. Maybe this points to the fact that many libraries in South Africa are still using commercial systems. Many libraries in HEIs in South Africa can still sustain the subscription fees for commercial software. However, Koha is said to be used by the Society of Jesus in South Africa and Centre for Creative Education libraries in South Africa (Wiki.koha-community.org, 2019).

2.10.4.1.2 East Africa

The use of FOSLMS is rife too in East Africa. Libraries in countries such as Kenya, Ethiopia, Uganda and Tanzania have embraced FOSLMS. In Kenya, many libraries are using FOSLMS. According to a research conducted by Adera in 2013 among 200 libraries in Kenya, on the possibility of Kenya's libraries adopting open source library management systems, the use of FOSLMS in Kenya is at par with commercial library management systems. The research further revealed that Koha was the mostly used FOSLMS in Kenya, as 67 per cent of libraries surveyed indicated using it as shown in Figure 3 below.

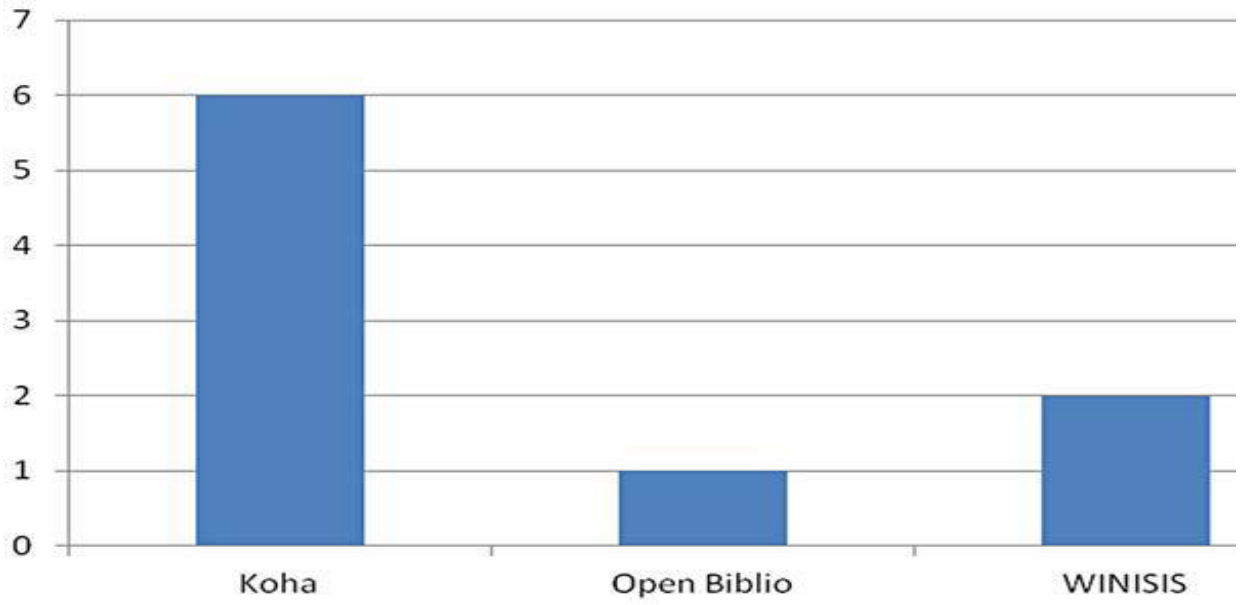

Figure 3: Distribution of FOSS Systems Adopted by Libraries in Kenya
(Source: Adera, 2013)

OpenBiblio and WINISIS came second and third, respectively (Adera, 2013). Another research conducted in Kenya by Makori and Mauti (2016) on Koha and its potential impact on information management organisations, revealed that it was widely used in HEIs as a library management system in the following HEIs.

Table 10: Some HEIs that have Adopted Koha in Kenya

SN	Name of HEI	Type of HEI	HEI Ownership
1	Australian Studies Institute (Kenya)	Institute	Private
2	Gretsa University	University	Private
3	Kenyatta University	University	Public
4	Kenya Institute of Management	Institute	Private
5	Management University Africa	University	Private
6	Masinde Muliro University	University	Public
7	Pwani University College	University	Public
8	Umma university	University	Private
9	Shalom Institute	Institute	Private
10	Strathmore university	University	Private
11	Technical Institute of Kenya	Institute	Public
12	Technical University of Mombasa	University	Public
13	Zetech University	University	Private

(Source: Makori and Mauti, 2016; Marshall Breeding, 2017)

In Kenya and other East African countries, ABCD is promoted by VLIR-UOS in Kenya and other East African countries. According to Marshall Breeding (2016), Moi University (both Thatcher and Nairobi Campus libraries) are using ABCD as a library management system.

It is clear from the findings above, that Koha is widely used FOSLMS in libraries in Kenya and more importantly in HEIs. It can be argued that both public and private HEIs have switched to Koha. However, more privately-owned HEIs in Kenya seem to have adopted FOSLMS.

In Ethiopia, where FOSLMS are widely used, Koha has become popular. It has a huge user community among libraries in higher institutions of learning. According to Marshall Breeding (2018), Addis Ababa and Adma universities are using Koha. Further, the website called ETHIOKOHA on 11 December 2019 showed that many libraries in Ethiopia were using Koha to manage their collections. Below is a list of some HEIs in Ethiopia that are reported by Marshall Breeding and ETHIOKOHA to have been using Koha.

Table 11: Some HEIs in Ethiopia that have Adopted Koha

SN	Name of HEI	Type of HEI	HEI Ownership
1	Addis Ababa University	University	Public
2	Adama University	University	Public
3	Ambo University	University	Public
4	Arba Minch University	University	Public
5	Bahr Bar University	University	Public
6	College of Telecommunication and Information	College	Public
7	Civil Service College	College	Public
8	Debre Berhan University	College	Public
9	Gonder University	University	Public

(*Source*: Marshall Breeding, 2018; ETHIOKOHA, 2011)

Some HEIs in Ethiopia use ABCD; these include Jimma University. Like in the case of Kenya, VLIR-UOS is promoting the use of ABCD in Ethiopia among HEIs.

The literature about Ethiopia in terms of the use of FOSLMS reveals that Koha is widely used and HEIs (universities) that are publicly-owned lead in the adoption of it. However, there is completely no literature on the adoption of FOSLMS by privately-owned HEIs in Ethiopia.

In Uganda, the use of FOSLMS has gained momentum. Many libraries including those in HEIs are turning to FOSLMS. In Uganda, Koha has stolen the show too, with many libraries adopting it. According to Adoma and Ponelis (2015), Koha is by far the most recognised open source integrated library system. This prompted the Consortium of Uganda University Libraries (CUUL) to recommend and encourage the adoption of Koha in all Ugandan libraries and arranged training for its membership in 2011. As a result, many libraries in HEIs in Uganda use Koha. These include, Uganda Christian University Library and Kyambogo University Library (Marshall Breeding, 2018; Buwule & Ponelis, 2015). Below are some of the HEIs that have adopted Koha in Uganda.

Table 12: Some HEIs in Uganda that have Adopted Koha

SN	Name of HEI	Type of HEI	HEI Ownership
1	Kabale University	University	Public
2	Kyambogo University	University	Public
3	Makerere University Business School	University	Public
4	Ndejje University	University	Private
5	Nkumba University	University	Private
6	Uganda Christian University	University	Private
7	Uganda Management Institute	Institute	Public
8	Uganda Martyrs University	University	Private

(Source: Marshall Breeding, 2017; Buwule and Ponelis, 2015; Ugandan Libraries Forum, 2017)

It is clear from the literature review on the adoption of FOSLMS in Uganda that the use of them among HEIs is widespread and Koha has more adoption footprints. Further, it has emerged that both private and public HEIs have adopted them. This is contrary to the findings on Ethiopia in which only public HEIs are documented on the adoption of FOSLMS.

Tanzania is also another country in East Africa that have adopted s FOSLMS. In the library sector, FOSLMS as compared to commercial software are adopted among universities and colleges in Tanzania to automate their operations. In this regard, Dodoma University, State University of Zanzibar and the Open University of Tanzania libraries use Koha as their library management system (Samzugi, 2016). Other HEIs such as Mzumbe University and Sokoine University of Agriculture use ABCD.

2.10.4.1.3 West Africa

For long now, CDS/ISIS has been widely known by library professionals in West Africa. Like the Southern and Eastern of Africa, West Africa has dumped CDS/ISIS and embraced FOSLMS such as Koha.

In Nigeria, CDS/ISIS had been a household name for librarians as regards automation. According to Obajemu, et al. (2013), 82.5 per cent of librarians surveyed in Nigeria reported knowing CDS/ISIS. This shows how popular CDS/ISIS had been in Nigeria for many years. However, CDS/ISIS has been replaced by Koha in Nigeria. Koha has quickly established itself as a choice of many libraries for automation. According to a research conducted by Kari and Baro in 2014 among 36 academic libraries, 24 (66.7%) of the surveyed libraries use Koha. Further, Edem and Bassey (2016) in the study of the adoption of software packages in universities in Nigeria, among 58 universities, revealed that Koha was widely used software; 28 (48.27%) of the university libraries surveyed were found to be using it. Koha has gained more popularity and acceptability in Nigerian libraries, especially academic libraries. It suffices therefore to say that Koha is widely used in HEIs in Nigeria. Below is Table 13 which attempts to show some HEIs in Nigeria that have adopted Koha.

Table 13: Some HEIs in Nigeria that have Adopted Koha

SN	Name of HEI	Type of HEI	HEI Ownership
1	Adeyemi College of Education	College	Public
2	African University of Science and Technology	University	Private
3	Babcock University	University	Private
4	Bowen University, Iwo	University	Private
5	Federal University Dutsin-ma	University	Public
6	Federal University of Oye-Ekiti	University	Public
7	Isakaita College of Education	College	Public
8	Redeemer's University	University	Private
9	National Teachers' Institute	Institute	Public
10	University of Nigeria	University	Public

(Source: https://wiki.koha-community.org/wiki/KohaUsers/Africa)

Table 13 shows that the use of Koha in library automation in HEIs in Nigeria is widespread. It is also clear from Table 13 that more HEIs that are public in Nigeria have adopted FOSLMS. Further, universities seem to have adopted FOSLMS (Koha) than any other types of HEIs.

In Francophone West African countries, CDS/ISIS and PMB have been widely used. According to eifl (2010), many institutions in the region use the CDS/ISIS database. Many also employ PMB. This FOSLMS in French-speaking African countries is widely used. However, Koha has also permeated the French-speaking Africa with University of Bamako (Faculty of Medicine Library) in 2010 began to experiment with Koha with a view to replacing CDS/ISIS.

2.10.4.2 Asia

Asian countries have not stood aloof in the adoption of FOSLMS. Asia has not only been the user of FOSLMS but it has also been developing such software. Countries like India have not only used FOSLMS but also actively participated in their development.

2.10.4.2.1 Bangladesh

Many HEIs in Bangladesh have adopted FOSLMS. SLIMS, a library management system developed in Senayan in Indonesia is popular among HEIs libraries in Bangladeshi (Alam, 2018). It is the second-most used FOSLMS in the country. Koha remains the most used FOLSMS in Bangladesh. Table 14 shows some HEIs in Bangladesh that have adopted SLIMS.

Table 14: Some HEIs in Bangladesh that have Adopted SLIMS

SN	Name of HEI	Type of HEI	HEI Ownership
1	Bangabandhu Sheikh Mujib Medical University (BSMMU)	University	Public
2	Bangladesh Agricultural Research Institute (BARI) Library	Institute	Public
3	Bangladesh Academy for Rural Development, BARD	University	Public
4	Jhenaidah Cadet College	College	Public
5	Munshiganj Technical School and College	College	Private
6	Teachers Training College, Dhaka	College	Public
7	Teachers Training College, Pabna	College	Public
8	The Bangladesh Institute of Research and Rehabilitation for Diabetes, Endocrine and Metabolic Disorders (BIRDEM)	Institute	Public
9	National Institute of Nuclear Medicine and Alias Sciences	Institute	Public

(Source: https://slimsbd.wordpress.com/bdusers/)

Koha is also very popular in Bangladesh many HEIs use it. A visit to Koha users for South Asia website on 10 May 2020, revealed that more than 30 HEIs in Bangladesh use Koha. These include East West University, North South University, Primeasia University and University of Liberal Arts Bangladesh.

Table 15: Some HEIs in Bangladesh that have Adopted Koha

SN	Name of HEI	Type of HEI	HEI Ownership
1	Bangladesh University of Heath sciences	University	Private
2	Barind Medical College	College	Private
3	BGMEA University of Fashion & Technology	University	Private
4	BRAC University	University	Private
5	City University	University	Private
6	Eastern University	University	Private
7	Independent University Bangladesh	University	Private
8	Islamic University of Technology	University	Private
9	Khulna University of Engineering & Technology (KUET)	University	Public
10	Martin Luther College	College	Private
11	Premier University Chittagong	University	Private
12	Sher-e-Bangla Agricultural University	University	Public
13	Southeast University	University	Private
14	University of Rajshahi	University	Public
15	Uttara University	University	Private

(Source: https://wiki.koha-community.org/wiki/KohaUsers/SouthAsian)

From Tables 14 and 15, one can tell that Koha is widely used in Bangladesh compared to SLIMS. The two tables also show that many public HEIs use SLIMS while more privately-owned HEIs in Bangladeshi use Koha.

2.10.4.2.2 India

India has been home to many FOSLMS. Prior to the birth of integrated FOSLMS, Indian libraries have been using CDS/ISIS like their counterparts in other developing countries. However, Indian libraries today have embraced free and open integrated library management systems such as Koha and NewGenLib. According to Kurmar and Jasimudeen (2012), Koha was first installed in India at St Joseph's College, Devvagiri in 2010. Since 2010, Koha has attracted small and big libraries in India. Many prestigious library automation projects in India have deployed Koha due to its capability to handle Indian languages.

Many libraries have migrated to Koha in India. Marshall Breeding (2018) shows that there are more than 199 libraries in India that have migrated to Koha. Further, a quick look at Koha community of users' website reveals that they are 294 registered libraries in India that have adopted Koha. These statistics from Marshall Breeding and Koha users' community website are not conclusive or complete because not all library users in India have registered with Koha community or Marshall Breeding. However, the statistics show how widespread is the use of Koha in India. Table 16, shows some of the HEIs that have adopted Koha in India.

Table 16: Some HEIs in India that have Adopted Koha

SN	Name of HEI	Type of HEI	HEI Ownership
1	Barasat College	College	Private
2	Alliance University	University	Private
3	Behala College	College	Public
4	Bidhannagar College	College	Public
5	Calcutta Girl's B.T. College	College	Private
6	Chakdaha College	College	Private
7	Chochon University of Science and Technology	University	Private
8	Christ University	University	Private
9	Indian Institute of Space Science and Technology	Institute	Public
10	Indian Maritime University (IIPM)	University	Public
11	Madras Institute of Technology	Institute	Public
12	Mahatma Ghandhi University	University	Public
13	Mysore University	University	Public
14	National Institute of Technology	Institute	Public
15	National Institute of Science Education and Research	Institute	Public
16	National Law University	University	Public
17	Presidency University	University	Public
18	South Asian University	University	Public
19	The University of Burdwan	University	Public
21	West Bengal State University	University	Public

(*Source*: Koha Community, 2019; Marshall Breeding, 2017; Muruli and Kumar, 2014)

Another FOSLMS used by libraries in India is NewGenLib. According to Kampa (2018), NewGenLib is widely used in India; it is another choice for libraries contemplating migrating to FOSLMS. Table 17 below shows that NewGenLib has attracted not only small libraries but also big libraries in HEIs.

Table 17: Some HEIs in India that have Adopted NewGenLib

SN	Name of HEI	Type of HEI	HEI Ownership
1	Bangalore University	University	Public
2	Central Institute of Plastics Engineering and Technology	Institute	Public
3	Indira Gandhi Delhi Technical University for women	University	Public
4	Karnataka State Open University	University	Private
5	Maulana Azad National Urdu University	University	Public
6	Sree Chaitanya Institute of Technological	Institute	Private
7	TKR College of Engineering and Technology	College	Private

(*Source*: Muruli and Kumar, 2014)

Tables 16 and 17 above have shown that libraries in India use both Koha and NewGenLib for automation. However, like in the case of Bangladesh, Koha is the most used FOSLMS among libraries in India. It has also emerged that both Koha and NewGenLib are used more by public-owned HEIs in India.

Libraries in India use other FOSLMS for library automation (Kampa, 2018). These include ABCD and Evergreen. For example, Modern College of Arts, Science and Commerce, and Centre for South Indian Studies have adopted ABCD as their library management system.

2.10.4.2.3 Pakistan and Malaysia

Other Asian countries that have embraced FOSLMS include Pakistan and Malaysia**.** Like in the case of Bangladesh and India, Koha has dominated the library market in these two countries, with several libraries adopting it. In Pakistan, Koha has been a household name among libraries with many academic libraries having adopted it. These include University of Malak, Bahria University, Garrison Cadet College, the Islamic College University, Pakistan Institute for Parliamentary Services and Sindh Madressatul Islam University (Fullstack Solutions, 2016).

In Malaysia, the picture is the same; Koha has been widely adopted by HEIs. A check on Koha user community website shows a number of academic libraries using Koha in Malaysia. These include University Sains Malaysia, University Putra Malaysia and Kolej Poly-Tech (wiki.koha-community.org, 2019).

2.10.4.2.4 Australia and New Zealand

In Australia and New Zealand, Koha is widely used. As already pointed out, the conceptualisation and development of Koha took place in New Zealand. Some libraries in Australia and New Zealand have migrated to Koha from commercial library systems. Most of the users of Koha in Australia and New Zealand are public and special libraries. Wiki.koha-community.org (2017) shows some libraries that have adopted Koha in Australia, as depicted in Table 18 below.

Table 18: Some HEIs in Australia that have Adopted Koha

SN	Name of HEI	Type of HEI	HEI Ownership
1	Australia Academy of Science	Academy	Not-For-Profit
2	Australia College of Christian Studies	College	Private
3	Harvest Bible College	Institute	Private
4	Institute of Business Studies	Institute	Private
5	Nan Tien Institute	Institute	Private
6	Perth Bible College	College	Private
7	Sydney College of Divinity	College	Private
8	Tarniet Senior College	College	Private

(Source: Marshall Breeding, 2017; Wiki.koha-community.org, 2017)

From Table 18 above, it is clear that in Australia, the use of Koha is predominantly by private HEIs. This is contrary to the situation in many developing countries such as India, Bangladesh, Ethiopia and Uganda where public HEIs are widely using Koha.

In New Zealand, Koha is has struggled to attract HEIs. Very few privately-owned HEIs have adopted Koha (Marshall Breeding, 2019). These include WhiteCliffe College of Arts and Design, and Institute of Business Studies.

2.10.4.3 Europe

Europe has not lagged behind in the adoption of FOSLMS. Among the FOSLMS that have been widely adopted in academic libraries in Europe, include Koha and PMB. Koha has penetrated libraries in Europe and a variety of libraries such as public, special and academic libraries use Koha. In Europe, private firms such as PTFS Europe support Koha's adoption. Koha's support is dominated by PTFS Europe (a software vendor), which by 2016 had installed Koha in more than 68 libraries and a large percentage of these libraries being supported by PTFS Europe are academic libraries. In the UK for example, PTFS Europe has Koha service contract with over 40 libraries and several of which are medium sized HEIs libraries. According to Calyx (2016), medium-sized

HEIs in the UK that include University of Hertfordshire, Blackpool and The Fylde College, University of Arts London, UK Wiltshire College, Belfast Metropolitan College and St Helens College, have adopted Koha. In the UK, the majority of HEIs that have adopted FOSLMS (Koha) are private colleges. This is contrary to what is happening in Africa, where many private and public owned colleges and universities have adopted FOSLMS.

In Ireland, a number of academic libraries use Koha. These include Dublin Business School, Griffith College, Irish Management Institute, Royal College of Physics of Ireland, School of Theoretical Physics, Dublin Institute for Advanced Studies and Geophysics, School of Cosmic Physics, Dublin Institute for Advanced Studies (Koha-community.org, 2017). Private companies have also emerged in Ireland to provide Koha consultancy services that include Interleaf Technology. According to Interleaf Technology (2016), the company supports 21 libraries in the implementation of Koha; most of these libraries belong to HEIs. Like observed in the case of the UK, private colleges in Ireland dominate the use of Koha in library automation.

In France, Koha and PMB are commonly used; they are a choice among libraries that wish to migrate from commercial library management systems. As such, PMB is more popular in France because it is locally developed. It is used mainly in public, special and academic libraries. For example, Ministries, Constitutional councils, Regional councils, Metro-poles, the Academy of Rennes, Radio France and Documentation Centres of Brittany all use PMB. Further, secondary schools use PMB. A survey conducted in 2005 in France, ranked PMB at number 3 in terms of popularity among the surveyed library management systems, with more than 1800 clients (PMB, 2015).

Koha also has some adoption footprints in France, with French nationals such as Paul Poulain actively involved in the development of Koha since 2002. Poulain has gone further by establishing a company called BibLibre that provides services to Koha among French libraries. Koha is a product of choice among medium and large size libraries in France. A quick check on Koha community on 19 February 2017 revealed that there were 23 libraries using Koha in France. The actual number of libraries using Koha could be higher than this because some libraries have not registered with Koha community. Among the prominent libraries that have adopted Koha in France, include University Lyon3, University of Rennes 2, and Aix-Marseille University (Koha

Wiki, 2017). In France, the adoption of FOSLMS is not limited to private owned HEIs but also public HEIs, which include big public universities such as University of Lyon 3. This contradicts what has been a trend in the UK and Ireland, where only small privately owned HEIs have adopted FOSLMS.

In Sweden, the use of FOSLMS is gaining ground. For instance, University of Stockholm library management in 2014 took a strategic decision to leave ExLibris Voyager library system, to adopt Koha (Stockholm University library, 2015). A French company called BibLibre performed the migration of data from Voyager to Koha. The University uses Koha as a circulation system. This implies that other functions of the university library are automated using another library system but the two systems are integrated.

2.10.4.4 North America

In North America, several HEIs have adopted FOSLMS. Koha is widely adopted in North America and it has continued to grow its popularity among small-and medium-sized HEIs in the in USA and Canada.

In the USA, Koha has gained ground as it is used by many HEIs. According to the Marshall Breeding (2016), Koha continues to attract a diverse demographic of small to midsized academic, school and public libraries in the USA. To support the implementation of Koha among libraries in the USA, private consulting firms have been established to provide consultancy services to libraries that wish to automate their operations with Koha. Prominent among such firms is ByWater Solutions, which has several contracts with various libraries to support them in the implementation of Koha. The number of libraries it provides consultancy services on Koha had reached 919 in 2016, and of which 665 public libraries, 100 were academic libraries and 95 were school libraries. In 2019, the number of academic libraries that have adopted Koha in the USA has increased to 151 (Marshall Breeding, 2020). Further, the Marshall Breeding report points out that there are other companies that provide Koha services in the USA which include LibLime, which has a total 134 libraries on its cards as regard the support of its Koha version called LibLime Academic Koha. In addition, a company called Equinox Software supports the implementation of Koha in the USA and has support service contracts with 33 libraries.

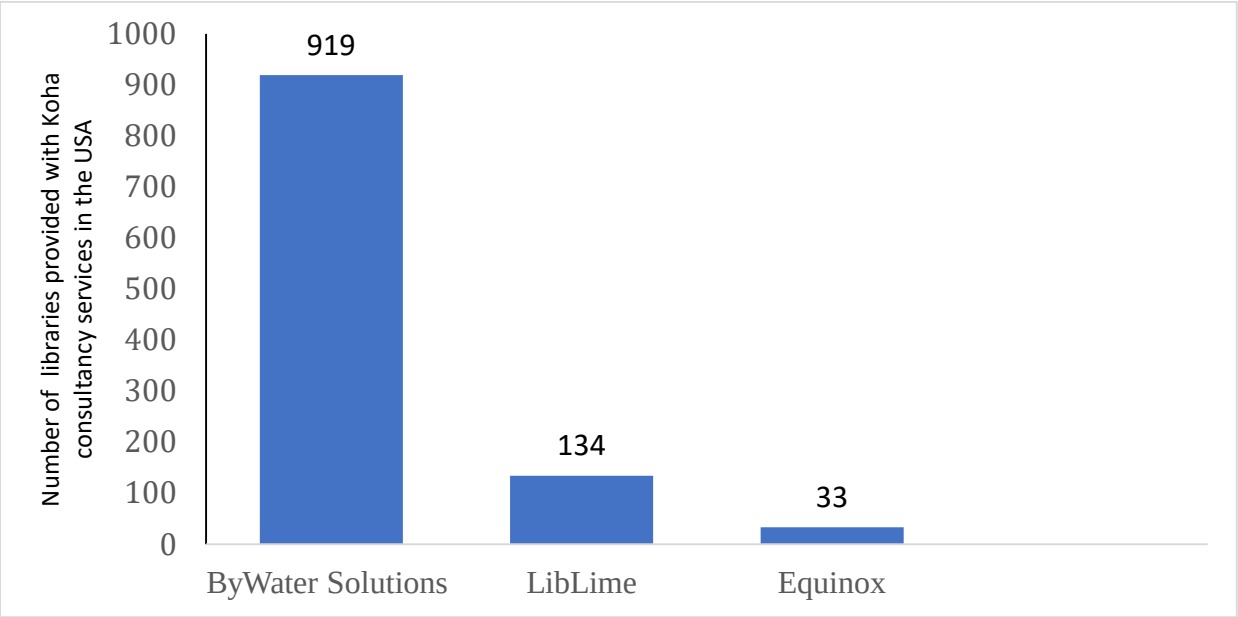

Figure 4: Companies and Number of Libraries Supported with Koha Implementation in the USA by 2016

(Source: Marshall Breeding, 2016)

According to Calyx (2016), Koha has been installed by HEIs libraries in the USA, which include Antioch University, Samuel Merritt University, Davis College, and New York University of Health Sciences. The above statistics by Marshall Breeding and Koha community suggest that Koha has been widely adopted in the USA among libraries in academic libraries, and it continues to grow in its popularity.

Evergreen is another FOSLMS that is widely used in the USA. It is popular among public libraries but not HEIs libraries. Evergreen is still trapped by its original development concept of being a system that supports public libraries consortia. It prospers in supporting consortia of small to medium-sized public libraries (Marshall Breeding, 2018). Equinox software, the original developers of Evergreen has continued to support Evergreen. Equinox has attracted more public libraries with 791 receiving support from it. Another 400 public libraries are using Evergreen without support services from Equinox (Marshall Breeding, 2016). However, a check at the roster of Evergreen libraries revealed that few HEIs libraries in the USA were using Evergreen; these include Hekman Library at Calvin College, Kirtland Community College and William Jessup University (Evergreen DokuWiki, 2017). What has emerged from the literature reviewed on the adoption of FOSLMS in USA is that more colleges that are privately-owned have adopted

FOSLMS, while many big and publicly-owned HEIs are still using commercial library management systems.

In Canada, Koha is becoming a household name among libraries, with many libraries, small and big, adopting it. It widely used in many regions of Canada. Some local governments have made it mandatory to use Koha in school libraries. For example, Prince Edward Province has implemented Koha in public schools (Marshall Breeding, 2009). Like in the USA, Koha has continued spreading its tentacles; companies such as ByWater Solutions, Equinox, LibLime and other independent consultants, facilitate the continuous growth in popularity of Koha. Unlike in USA where ByWater Solutions has more Koha support service contracts with libraries, in Canada LibLime is the leading consultant. According to Marshall Breeding (2017) there were 143 libraries in Canada using Koha; these included a small percentage of HEIs libraries. Among the HEIs using Koha in Canada, include Alberta Bible College. The research has shown that majority of libraries using Koha in Canada are school libraries followed by public libraries.

Evergreen is also gaining ground in Canada as it trails behind Koha. Different types of libraries that include special libraries such as Statistics Canada use Evergreen. However, libraries from HEIs in Canada are slowly migrating to Evergreen. According to Marshall Breeding (2008), the Robertson Library of the University of Prince Edward Island became the first academic library to move to the open source Evergreen on 4 June 2008. Other HEIs using Evergreen include Niagara College libraries.

2.10.4.5 South America

Latin American countries have adopted FOLMS and Koha is widely used. According to the Koha user community website monitored on 4 June 2017, Colombia has a huge community of Koha users followed by Argentina. The website shows Brazil and Venezuela having a handful of Koha users. Many libraries in public and private HEIs from Colombia, Argentina and Chile use Koha. These include, Facultad de Ingeniería de la Universidad de Buenos Aires (FIUBA) and Academia Nacional de la Historia (ANH) also in Argentina; Biblioteca Mariano Renedo Lucero-Universidad Adventista de Chile and Universidad Tecnologica Federico Santa María in Chile; Red de Bibliotecas Escolares de Alianza Educativa and Centro de Documentación de COLCIENCIAS in Colombia (Wiki.koha-community.org, 2020).

South America is home to other FOSLMS; these include OpenBiblio and ABCD. OpenBiblio is popular among small libraries and archives in South American school libraries. Small libraries in countries such as Colombia, Venezuela, and Chile are using OpenBiblio. ABCD is another library system that is widely used in South America. De Smet and Spinak (2016) contend that ABCD has a visible presence in South America. ABCD is also popular in its birthplace, Brazil. This library management system has also developers in the same country. This makes it to be widely adopted among libraries in Brazil. From the literature reviewed on the use of FOSLMS in Latin America, it is clear that Koha is widely used in both public and privately-owned HEIs.

2.11 Benefits of Using Free and Open Source Library Management Systems in Higher Education Institutions

FOSLMS present many benefits to libraries that for many years have been struggling to automate or sustain the endless subscriptions for the use of proprietary library management systems. The benefits accrued to libraries include among others, saving and redeployment of financial resources and provision of electronic or online library services to their clientele.

2.11.1 Saving and Redeployment of Financial Resources

Open source library systems save libraries from continuously investing their meagre financial resources in proprietary library management systems. According to Kurmar and Thomas (2009), investing in a proprietary library management system is a never-ending process. In addition to huge initial investment, libraries are compelled to shell out money to retain the use of a library management system. Nagia (2012) argues that many libraries do not have huge amounts of money to burn and any that they do get, usually goes to purchase additional information resources. In this regard, the use of FOSLMS makes it possible for libraries to redeploy or refocus their meagre financial resources on other pressing issues, such as acquiring information resources that are current and relevant to the user communities. This is true in the sense that FOSLMS are free of subscription fees. Further, their adoption and maintenance costs are lower than that of commercial library management systems. For example, Kurmar (2011) compared the licence fees of two commercial library management systems with FOSLMS as shown Table 19.

Table 19: License Fees of some Library Management Systems

SN	Name of library system	Type of system	License Fees (USD)
1	Alice	Commercial	54,796.55
2	Koha	Free and open source system	Free
3	NewGenLib	Free and open source system	Free
4	VTLS	Commercial	125,260.48

(Source: Adapted from Rajeev, 2011)

Table 19 above table shows that the licence fees of many commercial library management systems are too high for many libraries, especially in Zambia to afford. Even those that manage to pay licence fees do so at the expense of providing other library services.

2.11.2 Online Library Services

Free and open source library management systems have opened a window of hope for libraries to automate their operations in order to provide online library services to their user communities. According to Ngozi (2012), the advent and development of open source, software in the present age has made the transition from traditional technology-based library services to online services. Online library services are more efficient and cost effective. Online library services provided by use of FOSLMS include improved discovery and access to information resources by library users. Among other online library services provided are Web OPAC, self-circulation, online reservation, e-current awareness, online reference and online inter-library loan services.

2.11.2.1 Web OPAC

Most of the modern FOSLMS such as Koha enable libraries to automate the catalogue by implementing a Web OPAC, replacing the card and book catalogues which libraries that are not automated use. The transition from card catalogue to Web OPAC makes it easy for library users to search the catalogue and know information resources that are available in the library at a particular time. According to Nagia (2012), the card catalogue has been replaced by online catalogue, which has made it easier for library users to locate information resources through a network and pick it upon arrival. According to Hussain (2013), OPAC allows searching the entire catalogue online, conveniently and quickly, using one or more search criteria. One can search by author, title, keywords, class number, one, or a combination of the search criteria. Web OPAC shows even the status of a book, and indicates whether it is loaned out or available on the shelf or lying elsewhere. Online catalogue service has been widely implemented in many libraries

operating in both developed and developing countries. In Zambia, Mulungishi University is an example of a HEI that has implemented Web OPAC through Koha library management system. Mulungushi University Library's Web OPAC is accessible through the Internet anywhere in and outside Zambia. The implementation of Web OPAC among libraries enhances information resource discovery and access to information resources among library users.

2.11.2.2 Self-circulation

Another online library service is self-circulation of information resources. Some free and open source library management systems such as Koha and ABCD provide for the implementation of self-circulation service. This service entails that library users can log onto the library management system, search for an information resource, and borrow it if it is available, and present to the issue desk for stamping by library staff. In some situations, where the library user is off-site, a library staff has to deliver the borrowed information resource to the client at a fee. In the case of e-resources, a borrowed resource is downloaded to the computer terminal of the borrower through programmes such as Kindle where it will be used until the expiry date. Amazon.com (2013) reports that there are more than 11,000 libraries in the United States that offer public library books for Kindle, which allows the user to borrow e-books which are sent directly to a Kindle device or reading applications where they will be available for a specified period of time like a regular library book. The practice of self-circulation is rife in libraries in developed countries. For example, UC DAVIS University Library in the United States of America uses ICTs to provide self-circulation of information resources to its users.

Many libraries in the developing world however, do not provide self-circulation service to their clientele. Many libraries have not enabled this service in their library management systems because they probably fear the abuse of library resources by the users. Apart from borrowing information resources on their own electronically, Hussain (2013) observes that self-circulation service has made it possible for library users to renew the borrowed materials without being at the library. Modern library automation systems have liberated library users; they can renew the borrowed information resources at the comfort of their homes or offices provided they have Internet and can log into the library management system of the library. Academic libraries in the developed world have already developed and implemented self-circulation that enables library users to renew borrowed materials off-site. For example, University of California, Los Angeles (UCLA) Library

management system allows users to renew the information resources borrowed electronically. In India, some HEIs using FOSLMS such as Koha have also implemented self-circulation library services. For instance, India Institute of Technology (main campus) has implemented this service.

2.11.2.3 Online Reservation

Modern FOSLMS provide for online reservation of information resources. Library patrons can reserve information resources online, without them going to the library (Hussain, 2013). All they need to do is to login into the library management system of their library, search for material, and place it on hold if it is being used by other users so that when it is returned, the library staff will inform the user about the material and come and collect it. Among the FOSLMS that provide online reservation of information, resources include ABCD, Koha, SLIMS, Evergreen and NewGenLib.

2.11.2.4 Current Awareness

According to Balnaves and Keast (2010), open source software developers have been quick to implement Web 2.0 functionality in their systems. Some FOSLMS such as Koha and NewGenLib integrate social networking tools, such as Facebook and Twitter that enable library users to communicate easily with library staff. According to Krishna, Juran and Sarkhel (2016), social media integration feature is not feasible in some commercial library management systems such as Alice for Windows and LibSys. Libraries using Web 2.0 tools can inform their users about the new materials acquired, and notify them about change of time the service is provided or inform them about other services available. In this regard, a library operating in this century needs to have Facebook and Twitter accounts where it should be posting announcements to the users. This helps libraries to inform their users on their day-to-day operations. In addition, Koha and other FOSLMS provide for the use of e-mail and short text messages (SMS) to provide current awareness to library users.

2.11.2.5 Online (Virtual) Reference Services

In this information age, there is a growing practice of offering reference services in libraries and information centres online. FOSLMS enable financially-unviable libraries to implement virtual library service. Library users do not need to go to the reference librarian office to inquire about any library services. Like the case of online current awareness, users can inquire online and the

librarian responds to them online using an e-mail and social networking media such as Facebook and Twitter.

2.11.2.6 Electronic Inter-library Loan

Electronic interlibrary loan as the name suggests, is the service in which library users borrow an information resource from a library that is participating in the library co-operation electronically. Inter-library loan service allows users to obtain library material, which is not readily available locally. Koha and Evergreen allow the implementation of union catalogues. The collections of partner libraries could be managed on one Koha or Evergreen installation. The systems however show which partner library holds the physical material in Web OPAC. For example, health service libraries in the Greater Western Area Health Services in Australia have implemented a union, catalogue using Koha (Keast, 2011). Similarly, all the public libraries in the State of Georgia in the USA have implemented a union catalogue using Evergreen (Georgia Public Library Services, 2017).

2.11.3 Saving of Professional Manpower Time

Library automation saves time of library professionals. Professional staff's time that could have been spent on performing routine and reparative technical works such as bibliographic verification/searching, order placement, checking duplicated, charging and discharging of records are saved in an automated library environment (Ngozi, Nwachukwu & Uloma, 2014). Technically, FOSLMS such as Koha and Evergreen allow performance of such routine tasks with an electric speed. In Koha for instance, you can order new materials because book vendors can be defined in the system. With Koha, one can easily check duplicate titles and track the performance of the library budget, as the library's budget can be defined in the system. Koha tracks any expenditure from the budget and the balance is immediately calculated. Library staff can also track the delivery of serials because Koha and other FOSLMS have dedicated modules to manage serials. These modules make it easy to monitor serial vendors as regards to meeting the subscription terms in supplying the library with serials.

2.11.4 Improved Control and Management of Library Resources

Control and management of library resources is improved in libraries that have automated their operations. Libraries that are not automated struggle to perform stock control and management functions such as stock-taking and weeding because it is difficult to know which materials are

available or have become outdated (Ngozi, Nwachukwu & Uloma, 2014). The coming of FOSLMS has enabled many libraries to automate their operations, thus making it easy to perform stock inventory and weeding. Therefore, FOSLMS such as SLIMS have modules dedicated to stock-taking, which can allow librarians to easily know materials that have gone missing. Further, FOSLMS like other library management systems, have the ability to show the number of times an information resource has been used or borrowed over a given period. If a library wishes to weed all materials that are not being used in the library, it is easy to identify such materials. For those materials that may have high usage, library management could consider buying more copies of that title, to meet the increased demand of the title. Further, a library could easily know the total numbers of materials available in the library by simply performing an inventory/acquisition search. This makes control and management of the library collection easy.

2.11.5 Control Over Bibliographic Records

Another opportunity presented to libraries by FOSLMS is the handing over of power to libraries to own their bibliographic records and other library records. According to Morshed (2008), proprietary library management systems lock the data, making it impossible or expensive for libraries to migrate from commercial library management systems. This practice is likened to *technology hostage-taking*. Sometimes libraries are held hostage technologically by commercial software vendors. If a library wishes to discontinue subscribing to the software, it has to pay the vendor to have the data unlocked. The cost to have access to data may be too high for a library to afford, thus failing to migrate to another system. Many libraries are unable to migrate from commercial library management systems to FOSLMS because of fear of losing data, held by the library software vendor. Contrary to this practice, FOSLMS do not lock in data; rather they allow libraries to own their data, thus making it easy for them to migrate to another system.

2.11.6 Reliability of Services

FOSLMS also bring reliable and stable library services to libraries as their technologies, tools and standards they use are open source. Many FOSLMS such as Koha, ABCD, SLIMS, OpenBiblio and Evergreen use open standards such as Z39.50/URU for searching and retrieving bibliographic records from other systems. They are also written using open source programming languages such as PHP, Perl, and Python. Further, FOSLMS are powered by free and open source database management systems such as MySQL, MrriaDB and PostgreSQL. These standards and

technologies being open, implies that they are owned by the community not by a one company which can go under or change terms to access the technology or standards, thus sabotaging all institutions that relied on that technology and standard to provide a service. As long as the community continues to exist, these standards and technologies will continue to exist.

2.11.7 Copy Cataloguing

Original cataloguing is expensive; therefore, a library needs dedicated cataloguer(s) who methodically create the bibliographic records of information resources. Libraries that are not automated with integrated library management systems do not enjoy the benefits of copy cataloguing. The birth of FOSLMS such as Koha, Evergreen and SLIMS has allowed libraries to automate and practice copy cataloguing. According to LISwiki (2017), copy cataloguing is the process of building upon original cataloguing; it involves finding a matching existing cataloguing record for an item in hand, editing the record as necessary, and attaching the local holding information to the bibliographic record. Local holding information includes details such as cost of the material, date acquired, storage area, barcode, and material type. Libraries that have automated with Koha for instance, could copy original bibliographic records from Library of Congress, Colombia University and other big libraries that have been configured to be searched using Z39.50 protocol as shown below.

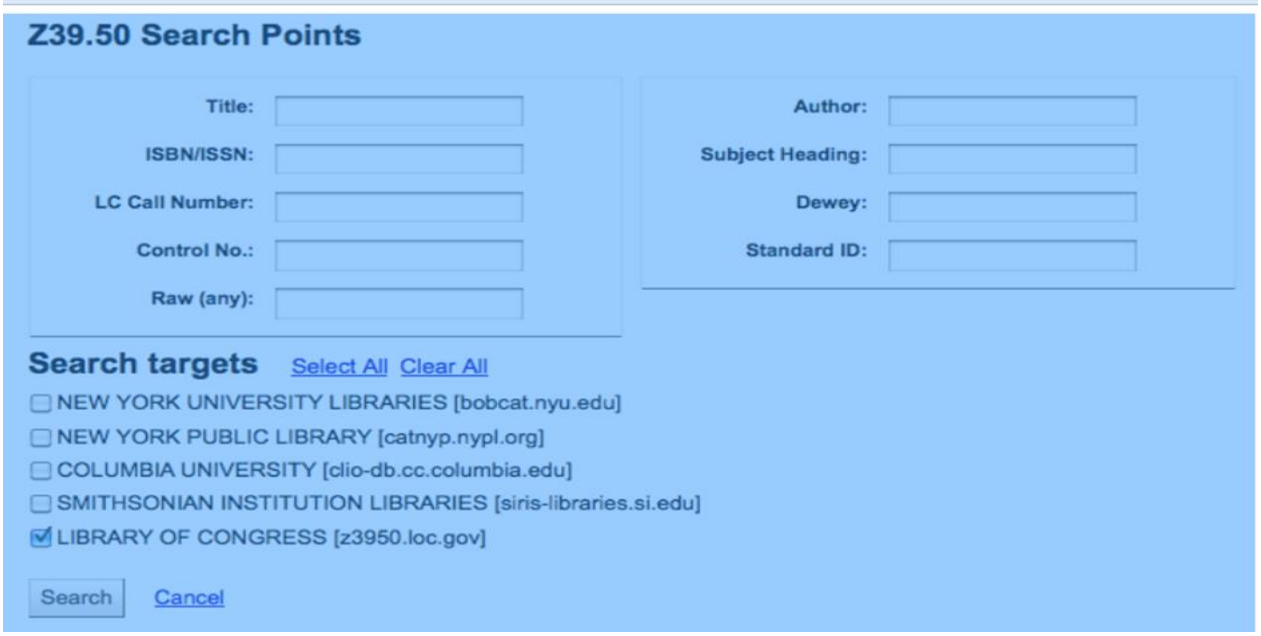

Figure 5: Copy Cataloguing in Koha
(Source: ByWater Solutions, 2019)

Bibliographic records can be imported into a local library system such as Koha, SLIMS and Evergreen. All the libraries need to do is to have a small team of cataloguers who can only edit the imported bibliographic records so that they meet the local library's needs.

2.11.8 Mashups

It is now common practice in libraries to combine internal data and applications with external data sources to provide other services to the library users. According to Engard (2014), the term mashup implies taking data from multiple sources and mixing the data together to provide better services for library patrons. For example, you can combine Google maps with the physical address and pictures of your library to create a mashup of location information for your library that helps the users to locate the library. Further, you can integrate social media such as Twitter into your library system. One can also bring in the book covers from Amazon and Google books into the library catalogue so that when a user searches the catalogue, the book covers are pulled from Google books into Web OPAC of a library system. It is easy to implement the concept of mashup in FOSLMS because most of the technologies used in mashups are open source. According to ByWater Solutions (2017), Koha allows easy integration with Application Programming Interface (API). Other external services such as Google maps, Twitter and Amazon are fused with services that are available in Koha to provide improved library services to the users.

2.12 Challenges of using Free and Open Source Library Management Systems

The use of FOSLMS in libraries is not without challenges; a cocktail of challenges has been cited in many literatures interrogating the viability and sustainability of the use of FOSS in libraries. Those opposed to FOSS have attempted to use these challenges as the basis to dismiss the existence and community standing of FOSS. Among the challenges libraries face in using FOSLMS include:

2.12.2 Inadequate Technical Support

According to a research conducted by Adoma and Ponelis (2015) in Uganda among 35 academic libraries that have adopted Koha as their library management systems, majority (77%) of the respondents cited among other challenges, lack of technical support both during and after the implementation of the system. Similarly, Muruli and Kumar (2014) discovered that one of the problems associated with the adoption of FOSLMS in India is lack of technical support. Many libraries surveyed in India ranked number one the problem of lack of technical support as a major

impediment in the adoption of FOSS in libraries. Unlike commercial library management systems where technical support is provided by the vendor, in FOSLMS, libraries have to make a plan regrading individuals or companies that will be providing technical support during and after the implementation of free and open source library management system. Many companies are springing up to offer technical support to libraries using free and open source library systems. As indicated above, large companies have been established in the USA and Canada to provide technical support to libraries at a fee. These include ByWater Solutions and Equinox. In India, companies that provide technical support include Informatics India Pvt Ltd and DELNET. In Africa too, private companies have been established to provide technical support to free and open source library systems especially Koha. These include Sabinet in South Africa and Projektlink Konsult Limited domiciled in Nigeria (Koha Library Software Community, 2017). These companies' charges range from hundreds to thousands of USA Dollars for services. For instance, companies in India charge as much as 50,000 Rupees (USD 779) equivalent per year for providing technical services to libraries after implementation of the systems (Anjaneya & Lalitha, 2014). In the USA and Canada, Bywater Solutions and other companies' charges are in thousands of USA Dollar per year. The fact that commercial companies have emerged to provide consultancy and technical support to libraries is slowly diluting the initial philosophy and thinking of the founders of Free and Open Source Software Movement. Companies providing technical support services on the use FOSLMS will soon be holding libraries hostage in the manner similar to commercial software vendors.

2.12.3 Lack of Trained Human Resource

According to Kurmar and Thomas (2009), one of the downsides of free and open source library software is that a library has to hire technical support of the software service provider for services such as installation, data migration and maintenance. Many libraries simply do not have the in-house expertise to support FOSS. Further, they do not have the ability to train staff on the use of new technologies. For a library to implement FOSLMS successfully, it should have staff with skills and knowledge of Linux administration because many of the FOSLMS run on Linux. Many librarians are poorly-trained in ICTs especially library automation technologies. This is because Library and Information Science school's curricula in several countries have week ICT courses, thereby making it difficult for libraries to have a cadre of library staff with ICT skills and

competencies needed to operate in the digital era (Munyoro, 2014). Seena and Sudheir (2014) in their study of ICTs skills among library staff at Kerala University in India recommended that a new model curriculum for Information Science programmes in universities be devised by integrating the traditional and modern knowledge and applications. They further recommended that ICT should be a core component of formal Library and Information Science education, incorporating the skills and expertise in handling the digital libraries and application of ICT in libraries.

A quick check on some selected web pages of Library and Information Science schools in Southern and Eastern African universities shows a positive outlook as many schools have ICT courses in their curricula as shown in Table 20 below. For actual ICTs, course names refer to Appendix 1.

Table 20: Some Library Science Schools in Southern and Eastern Africa ICTs Courses

SN	Name of HEI	Country	Number of ICTs Courses
1	Makere University	Uganda	7
2	Moi University	Kenya	13
3	University of Namibia	Namibia	6
4	University of Zambia	Zambia	2
5	University of Zululand	South Africa	3
6	University of Western Cape	South Africa	3
7	University of Botswana	Botswana	7
8	Zimbabwe Open University	Zimbabwe	6

(Source: Website pages of Library and Information Science Schools in Africa)

From the above encouraging results, one could argue that despite many Library Science schools introducing ICTs courses in their curricula, the problem of inadequate ICTs skills among library staff has persisted.

2.12.4 Complexity/Unfriendliness

Some FOSLMS are not easy to install and configure, as they are difficult to set up. Unlike proprietary software, FOSLMS require considerable amount of effort in installing and customising them. For example, FOSLMS such as Koha requires complex skills to do with Linux commands for one to install it. Further, it requires skills in SQL, HTML and CSS for one to customise it properly to meet the needs of the library. Below is a Table 21showing four FOSLMS with skills required for one to install and configure them.

Table 21: Some Free and Open Source Library Systems with Technical Skills Required

SN	FOSLMS	Platform or System	Technical Skills Required
1	Koha	Linux (Ubuntu and Debian)	Linux commands, SQL, HTML, CSS
2	ABCD	Windows and Linux (Ubuntu etc.)	Linux commands, SQL, HTML, CSS
3	OpenBiblio	Windows and Linux (Ubuntu etc.)	Linux commands, SQL, HTML, CSS
4	SLIMS	Windows and Linux (Ubuntu etc.)	Linux commands, SQL, HTML, CSS

Among the above library management systems, OpenBiblio is easy to install and configure followed by SLIMS. They are easy to install on Windows platform. On Linux, both OpenBiblio and SLIMS are difficult to install, one needs to have Linux command skills. OpenBiblio is also easy to customise. This is the reason OpenBiblio is a choice of small libraries with less skilled human resource. Koha exclusively runs on Linux. This calls for high level of skills in Linux commands unless one wishes to run a live CD of Koha.

Apart from being difficult to install and configure, other FOSLMS lack user-friendly interfaces or features that library staff and users may be familiar with. This can affect productivity and put off library staff from adopting or using the programmes with ease (Invest Northern Ireland, 2018). Library staff too need to be fully oriented on how to use modules or else the installed library management system could remain a white elephant because library staff may fail to use it without proper orientation and training.

2.12.5 Inadequate Liabilities and Warranties

Proprietary software vendors are known for comprehensive warranties. This is not the case with FOSLMS. Unlike proprietary software, where developers provide indemnification and warranty, free and open source software provide limited warranty and no liability or infringement indemnity protection (Invest Northern Ireland, 2018). This is because a free and open source software code is not a preserve of one developer but many developers scattered all over the globe, as development of such software is done using the bazaar model, hence making it difficult to guarantee safety and reliability of the software to the users. In short, the use of free and open source software is at owner's risk. If the software crashes because of poor coding, one cannot turn to someone and claim compensation as no one bears responsibility.

2.12.6 Maintenance and Other Hidden Costs

Like commercial library management systems, FOSLMS require maintenance. The fact that many libraries lack staff with technical skills to maintain both the hardware and FOSLMS, libraries have to engage a third-party company to maintain the software. The third-party has to be paid annually

for the services being provided to the library. This in turn becomes a major burden for libraries, especially in developing countries, where there is lack of funding. A Koha consulting firm in the USA estimated the cost at $10,700 USD, including hardware in the first year of support. Thereafter, the annual support cost would be $2,500 (Riewe, 2008). Further, there are hidden costs that come with the implementation of FOSLMS; these include the cost (in terms of time) of mastering the software and cost of upgrading certain hardware for the software to work well.

2.12.7 Sustainability

The other challenge of using FOSS in libraries is the issue of sustainability. Some FOSLMS are not sustainable; their future is not certain because they do not have a stronger community of developers and users. For instance, Kuali OLE, a library management system became defunct in 2016. Kuali OLE was one of the FOSLMS that was started in 2007 among academic libraries in the US and UK. It had funding from Andrew W. Mellon Foundation. The academic libraries had collaborated with Kuali Foundation, and relied on Kuali Rice Middleware as the enterprise service bus for the project. Kuali Rice did not advance to be able to support the multitenant architecture that is increasingly expected of enterprise business applications. Further, the Kuali projects also made a major transition from non-profit foundation support to a commercial business environment (Marshall Breeding, 2017). The case of Kuali OLE demonstrates the risk associated with the use of free and open source systems, which they are easily discontinued, thus, leaving user libraries stranded.

Many other FOSLMS today suffer from high degree of uncertainty and these include OpenBiblio and ABCD. According to Bwalya (2017), OpenBiblio currently does not have a critical mass of developers, contributors and users. The responsibility of developing the software still rests squarely on one man, Hans Van Der Weij. Many software developers have not come on board to propel the software to greater heights. As a result, the software is not frequently released. The latest release for OpenBiblio was in 2014. Failure by OpenBiblio to attract many developers puts the software's future in question, thereby endangering the operations of libraries that have adopted it. Similarly, ABCD is also struggling to build a mass of developers and users. The software has a lean number of developers from Cuba, Brazil and Belgium. This is also the case with its user community. Software without a mass of developers and users can fold up any time and leave libraries stranded. It is therefore imperative that libraries scrutinise free and open source software

before adopting them. Londhe and Patil (2015) attempted to catalogue a number of abandoned FOSLMS projects as shown in Table 22.

Table 22: Some Abandoned Free and Open Source Library System Projects

SN	Project Name	Abandonment Year
1	Avita	2007
2	Emilda	2005
3	FireFly	[2003?]
4	GNU Library Management System	2002
5	GPL Library System	2010
6	infoCID	2005
7	Java Book Cataloguing System	2000
8	Jayuya	2006
9	Kuali OLE	2016
10	Library Manager	2002
11	Open MarcoPolo	2008
12	OtomiGenX	2009

(Source: Londhe and Patil, 2015; American Library Association, 2017)

2.12.8 Inadequate Documentation

Good software should have a detailed documentation as in technical and user manuals. With no vendor responsible for the software, FOSLMS require detailed and up-to-date documentation. Proper documentation gives information on how to install the software on various operating systems, use of the software, how to fix bugs and update the software in case of new releases. This however is not the case with all FOSLMS. Some free and open source software lack detailed documentation making it difficult for both technical and library staff to use the software (Uzomba, Oyebola & Izuchukwu, 2015). Bwalya (2017) argues that one of the weaknesses of OpenBiblio is lack of sufficient documentation. The available documentation is not adequate and offers little or no help to both technical and library workers who wish to use OpenBiblio. In the absence of sufficient documentation, it is difficult to learn how to install and use the software. Further, it is difficult to resolve problems that may arise when using the software. Currently, PMB is another FOSLMS with little or no documentation in English language. This makes it difficult for libraries in English-speaking countries to adopt it.

2.12.9 Difficulties in Migrating Data

Available records have shown that most libraries insist on using proprietary software because of their inability to migrate bibliographic records to open source software (Uzomba, Oyebola & Izuchukwu, 2015). There is always this fear of losing data in the process of migrating from the existing system to open source option. This fear is realistic as libraries lose data during the process of migration from commercial systems to FOSLMS if not properly handled. The loss of data during migration could be due to the different data formats in which the library records are kept. For instance, if bibliographic records in a commercial library system were kept in UNIMARC, and if one wishes to migrate to FOSLMS that keep records in MARC 21, it will require converting data from UNIMARC to MARC 21. This may result in the loss of some data. It is however noted that the loss of data happens even when one wishes to migrate among FOSLMS. For instance, if a library wishes to migrate from WINISIS to Koha, the bibliographic records from WINISIS, which are not in MARC format, have to be converted to MARC before importing them into Koha. This requires the installation of software called MARC converter; to change non-MARC records to MARC. In the process of converting data, some records are lost. Further, loss of data may occur if the vendor of the commercial software locks-in the data as a way of keeping the library from migrating to FOSLMS.

2.13 Theoretical Frameworks and Research Model

There are several theories that seek to explain the adoption of technology. Prominent among these theories are Diffusion of Innovations Theories (DITs), Theory of Reasonable Action, Theory of Planned Behaviour (TPB), Technology Acceptance Model (TAM) and Unified Theory of Acceptance and Use of Technology 2 (UTAUT2), Management Information Systems Adoption Model, and, Delone and Mclean's Model of Information Systems Success. In this regard, four theories namely, UTAUT2, Diffusion of Innovations (Perceived attributes of innovation theory), Management Information Systems Adoption Model and, Delone and Mclean's Model of Information Systems Success have been analysed with a view to developing a model that guided this study.

2.13.1 Unified Theory of Acceptance and Use of Technology 2 (UTAUT2)

The Unified Theory of Acceptance and Use of Technology 2 (UTAUT2) is an extension of Unified Theory of Acceptance and Use of Technology (UTAUT) developed by Venkatesh in 2003. It is

worth noting that UTAUT2 has gained popularity among researchers because it has attempted to explain the adoption of technology using an array of variables as predictors. The theory has been widely tested and found to be appropriate for explaining the adoption of technology across different industries.

UTAUT2 was developed by Venkatesh, Thong and Xu in 2012, as a remedial measure to UTAUT's failure to explain how new technology is adopted by consumers (organisations and persons) not users. It was discovered that UTAUT focused on how users (employees in organisations) adopt and use technology). It neglected explaining how consumers (companies and individuals) adopt and use the technology. As a theory, UTAUT was anchored on four constructs, namely: *performance expectancy; effort expectancy; social influence;* and *facilitating conditions* with *age*; *gender; experience;* and *voluntariness of use* as moderating variables (Mun, 2014). Later, UTAUT2 was extended UTAUT by including *3* constructs in a bid to explain the adoption and use of technology by consumers. This has effectively taken the theoretical constructs to *7* namely:

2.13.1.1 Performance expectancy

This refers to the degree to which the use of new technology benefits consumers in performing certain activities (Huang & Kao, 2015)). This entails the degree to which consumers think that the use of new technology will improve their performance.

2.13.1.2 Effort expectancy

This refers to the degree of ease associated with the use of a new technology by a consumer; the degree to which the potential consumers or users of new technology think that the use of new technology requires little effort.

2.13.1.3 Social influence

Social influence refers to the extent to which consumers perceive other important people would wish them to use the new technology (Nordhoff *et al*, 2020). In this regard, people and organisations adopt the new technology because others who are influential are using the new technology.

2.13.1.4 Facilitating conditions

This is consumers' perceptions of the availability of resources and support to use the new technology. This refers to the degree to which an individual believes that organisational and technical infrastructure exists to support their use of the system (Nordhoff et al., 2020).

2.13.1.5 Hedonic motivation

This implies the fun or pleasure consumers derive from using a new technology. According to the proponents of UTAUT2, if new technology provides much fun and pleasure, it will attract more consumers.

2.13.1.6 Price value

In UTAUT2, price value is consumers' cognitive trade-off between the perceived benefits of technology and the monetary cost of using it. In this regard, if consumers perceive that the benefits driven from using new technology outweighs the cost, the technology will attract more adopters and users.

2.13.1.7 Experience and habit

This is the extent to which people perform certain behaviors automatically because of learning (Nordhoff et al., 2020). Certain behaviours in life are performed automatically, unconsciously because of the experience and learning. People's experience and habit influence their behavioural intentions and use of the new technology.

The proponents of this theory contend that the seven constructs or factors influence consumers' behavioural intentions of using new technology. However, two factors, namely *facilitating, conditions* and *habit* determine the actual use of technology (Huang & Kao, 2015). The proponents of UTAUT2 further argue that *age*, *gender* and *experience* variables moderate the seven factors as depicted in Figure 6.

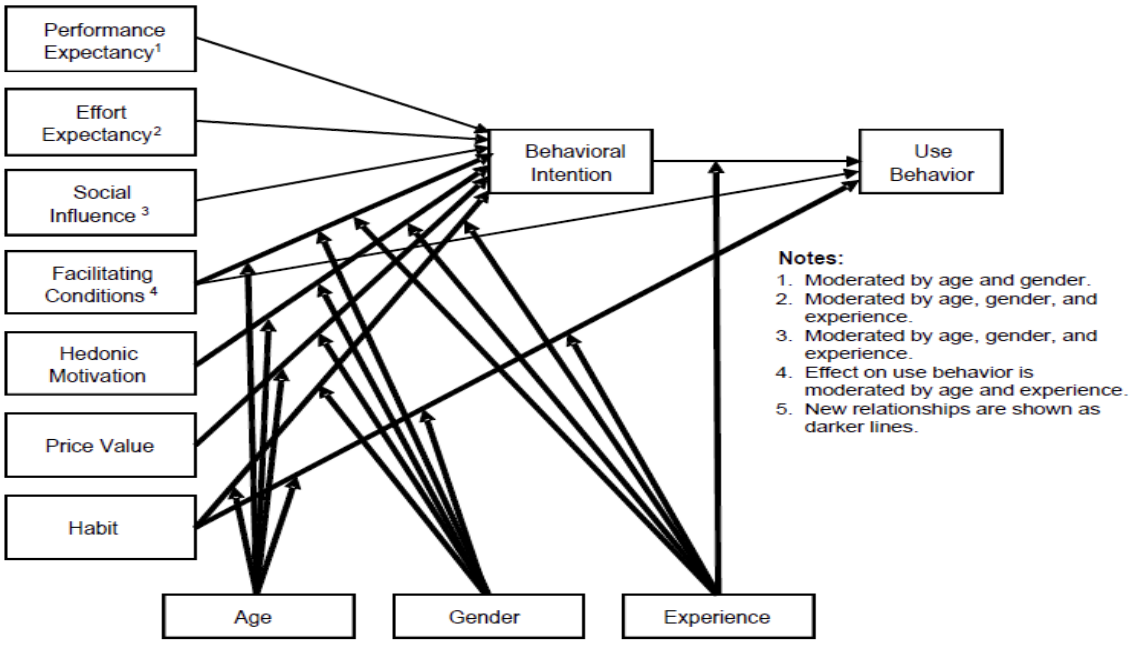

Figure 6: UTAUT2 Research Model
(Source: Venkatesh, Thong & Xu, 2012)

The proponents of UTAUT2 and independent researchers have conducted numerous researches to demonstrate how age, gender and experience variables moderate the seven constructs in the theory. For example, a research conducted in Indonesia in 2015 on the adoption of instance services applications revealed that younger customers were interested in the performance expectancy of technology (Indrawati & Marhaeni, 2015). Similarly, Venkatesh, Thong and Xu (2012) when they surveyed 1,512 mobile internet consumers in Hong Kong discovered that younger consumers were likely to adopt technology if it improved their work.

Further, Indrawati and Marhaeni (2015) discovered that when men consider the adoption of technology, they are concerned with hedonic aspects of technology while women are concerned with the price value of technology. This implies that men can easily adopt technology if they derive pleasure from using it. On the other hand, women are concerned with the cost of adopting technology. Women (especially old ones) were said to adopt technology, which was deemed less costly. These findings validate the initial findings of Venkatesh, Thong and Xu who in 2012 in Hong Kong, discovered that female mobile internet consumers (especially old ones) were sensitive to price value of technology; they were seen to adopt technology that was perceived to be cheaper. This is because old women are gatekeepers of families' financial resources.

Venkatesh, Thong and Xu further discovered that experience, age and gender worked in tandem to moderate habit on behaviour. They argued that older people have difficulties learning new things because of decreased capabilities in information processing, as such they rely on heuristics and schema acquired from experience. In this regard, old male consumers with usage experience will rely mostly on their habits to use technology.

The proponents of UTAUT2 further discovered in their 2012 Hong Kong research that existing conditions such as training and support facilitate customers' use of technology and that existing conditions construct is moderated by age, gender and experience. They established that older customers had difficulties in processing information, thereby hindering their ability to learn new technology. Venkatesh, Thong and Xu (2012) also established that men tended to rely less on facilitating conditions when considering adopting new technology, and that greater experience can lead to greater familiarity with technology, resulting in better knowledge structures, which facilitate learning, thus reducing users' dependence on external support.

Studies in psychology have shown that experience can moderate the effect of behavioural intention to use technology. Huang and Kao (2015) argue that the frequency of car use reduces the effect of behavioural intention on future use of the car. This implies that behavioural intention to use technology is higher with consumers with less experience.

Although UTAUT2 attempts to explain factors that influence the use of new technology by workers/users in organisations, the four factors, namely performance expectancy, effort expectancy, social influence, and price value could also explain the adoption of technology by an organisation such as libraries in HEIs in Zambia. In this regard, some scholars have used UTAUT2 or UTAUT to explain factors influencing the adoption of new technology by organisations. For example, Chaputula and Kanyundo (2019) in their study of diffusion of Koha among HEIs in Malawi had used UTAUT, the old version of UTAUT2 as a theoretical framework in an attempt to explain factors influencing the adoption of Koha in Malawi among HEIs. In their study, Chaputula and Kanyundo found that cost and ease of use were some of the factors influencing the selection and deployment of Koha in HEIs in Malawi.

According to UTAUT2, it can be argued that libraries in HEIs in Zambia's adoption of FOSLMS is influenced by four factors, namely; performance expectancy, effort expectancy, social influence,

and price value. It can therefore be contended that the adoption of FOSLMS in HEIs in Zambia is influenced by the perception that FOSLMS perform better and that they were easy to use. Further, the adoption of FOSLMS in HEIs in Zambia could be said to be influenced by the lower cost of adoption associated with FOSLMS. Like any other free and open source software, FOSLMS are perceived to be cheaper in terms of adoption cost as compared to commercial library systems.

2.13.2 Perceived Attributes of Innovation Theory

The Perceived Attributes of Innovation Theory is a sub-theory of diffusion of innovation theories propounded by Everett M. Rodgers when he was serving as a communication theorist at the University of New Mexico in 1962. It is rooted in communication to explain how, over time, an idea or product gains momentum and diffuses (or spreads) through a specific population or social system. Because of diffusion, people, as part of a social system, adopt a new idea, behaviour, or product (Singer, 2019). The key to adoption is that the person must perceive the idea, behaviour, or product as new or innovative. It is through this that diffusion is possible. Five characteristics of an innovation exist that determine its adoption (Rodgers, 2003). These are; (1) relative advantages over an existing innovation, (2) compatibility, (3) complexity, (4) trialability, and (5) observability.

2.13.2.1 Relative advantage

This refers to the degree to which an innovation is perceived to be better than the idea it supersedes. Relative advantage is expressed in economic profitability, in status-giving or other ways. In this regard, Rodgers (1983) cited the fall in price of pocket calculators in 1972 from $250 to $10, after a few years because of improved technology, as an example of relative of advantage as calculators became cheaper than the ones produced before technology improved. Further, Rodgers illustrates that farmers in the USA in 1960s adopted hybrid corn seeds because of the perceived improved production resulting in high profits.

2.13.2.2 Compatibility

Compatibility refers to the degree to which an innovation is perceived as consistent with existing values, past experiences and needs of potential adopters. According to Rodgers (2005), people use the past experience to judge new ideas. In this regard, the farmers in 1960s in Mexico applied chemical fertilisers on top of their potato seeds (as they had done with cattle manure) thereby

damaging their seeds and causing a negative evaluation of the innovation. Similarly, the name given to an innovation often affects its compatibility and its rate of adoption. For example, a major USA soap company introduced its trademarked product "Cue" into French-speaking nations, where the word has an obscene connotation. This affected its adoption.

2.13.2.3 Complexity

This is defined as the degree to which an innovation is perceived as relatively difficult to understand and use. Any new idea may be classified on the complexity-simplicity continuum. Some innovations are not clear, and tend to be difficult for the potential adopters to understand or use them. The more difficult to use the innovation, the fewer are the adopters. For example, in the 1960s, Canasta, a card game was difficult for many Americans to learn and adopt it; its procedures were complex and difficult to master. This, however, was not the case with television that simply required one to turn a knob to operate it.

2.13.2.4 Trialability

Trialability is defined as the degree to which an innovation maybe experimented with on a limited basis. New ideas that can be tried on the instalment plan will be more generally adopted than innovations that are not divisible. According to Rodgers (1983), a trailable innovation reduces uncertainty among adopters. In this regard, people tend to adopt an innovation that other people have adopted; an innovation which has been seen to be working.

2.13.2.5 Observability

This is the degree to which the results of an innovation are visible to people. Some innovations' results are observed and communicated easily to other people. Some innovations however, are difficult to describe to other people. Computer innovations for example, have both hardware and software; the hardware is observable than the software. In this regard, software technology has a relatively slower rate of adoption (Rodgers, 1983).

Reading from the above theory of perceived attributes of innovation, one could argue that FOSLMS adoption in HEIs in Zambia is dependent on it being perceived to offer some advantages/benefits to the adopting libraries, and that they should conform to the existing values, past experiences and needs of librarians in HEIs in Zambia. Further, if librarians in HEIs perceive FOSLMS to be easy to use and that it has been tried, tested and found to be working well, many librarians in HEIs in Zambia would adopt that FOSLMS. However, according to this theory, the

FOSLMS may not be feasible to librarians because it is not hardware but software. This may affect FOSLMS attractiveness to librarians in HEIs in Zambia, thus affecting its adoption rate.

2.13.3 Management Information Systems Adoption Model

The Management information systems adoption model was developed by Al-Mamary, Shamsuddin and Aziati in 2014 in an attempt to find a suitable way to explain the successful implementation of management information systems in Yemeni organisations. According to Al-Mamary, Shamsuddin and Aziati (2014), there are three broad categories of characteristics that influence the adoption of management information systems among organisations in the telecommunication industries in Yemeni. These are; technological, organisational and people's characteristics.

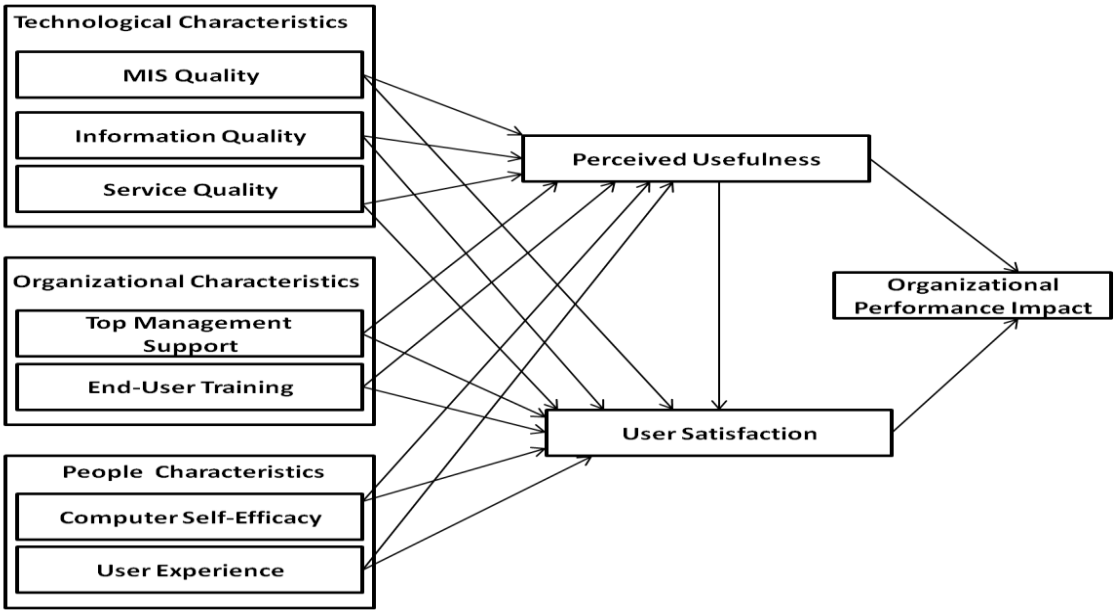

Figure 7: Management Information Systems Adoption Model in Yemen
(*Source:* Al-Mamary, Shamsuddin & Aziati, 2014)

2.13.3.1 Technological characteristics

These are desired characteristics of an information system for its adoption. These features are management information systems (MIS) quality, information quality and service quality. The MIS quality relates to the ease of use, flexibility, response time and reliability of a system. Information quality implies the relevance, understandability, accuracy, conciseness, completeness, currency, timeliness; and the usability of the information output of a system and service quality has to do

with the support that system users receive from the technical support department (Mamary, Shamsuddin & Aziati, 2014).

2.13.3.2 Organisational characteristics

Organisational factors determine the successful adoption and implementation of a system. Internal organisational factors are top management support and end-user training. Top management support refers to the extent to which top management encourages, and allocates necessary resources for use of MIS while end-user training refers to the training provided by computer specialists in the company, friends, consultants, or educational institutions external to the company (Mamary, Shamsuddin & Aziati, 2014). This entails that if management of any organisation that wishes to adopt an information system has not committed resources such as human resources, financial resources and providing basic computing infrastructure, the adoption and use of such a system will be difficult. Further, if end-users in the organisation that is intending to adopt an information system have not received adequate training on how to use the system, its adoption will be problematic.

2.13.3.3 People characteristics

These are characteristics to do with people, who in an organisation intend to adopt a new system which are computer self-efficacy and user experience. Computer self-efficacy refers to an individual's belief that he or she has the skills and abilities to use computing technology to perform specific tasks while user experience is prior experience of an individual with a specific technology. These people factors if present will result in the successful implementation of a system. There is need therefore to have people who are computer literate employed and that they should have adequate experience prior to the implementation of an information system.

As captured in the diagram, the technological characteristics result in perceived usefulness, the degree to which a person believes that using a system would enhance his or her job performance while organisational and people's characteristics lead to user satisfaction. According to Mamary, Shamsuddin and Aziati (2014), perceived usefulness and user satisfaction ultimately result in organisational performance impact.

In accordance with the Management Information Systems Adoption Model, technology design characteristics of the system as in being easy to use and reliable and its performance determine its

adoption. In this regard, it can be argued that if FOSLMS are perceived to be easy to use, reliable and perform better, many libraries in HEIs in Zambia will adopt them. Further, the above model suggests that organisational factors such as management support and end user training affect the adoption of any system. This implies that if management in HEIs commits financial and other resources, and provide training to librarians on FOSLMS, more libraries in HEIs could adopt FOSLMS. The model further postulates that people's characteristics, such as computer self-efficacy and experience of staff with a new technology have a bearing on its adoption. This entails that librarians with computer literacy and who have experienced with FOSLMS, are more likely to adopt FOSLMS than their counterparts who are computer-illiterate and do not have some experience with FOSLMS.

2.13.4 Delone and Mclean's Model of Information Systems Success

The information systems success model commonly known as Delone and McLean IS Success Model, is an information systems (IS) theory which seeks to provide a comprehensive understanding of IS success. It identifies, describes, and explains the relationships among six of the most critical dimensions used to evaluate information systems' success. William H. Delone and Ephraim R. McLean developed this theory in 1992. It was later refined in 2003 and 2004 following immense feedback received from other scholars.

There are six critical dimensions of IS Success Model, namely; information quality, system quality, service quality, system use/usage intentions, user satisfaction, and net system benefits.

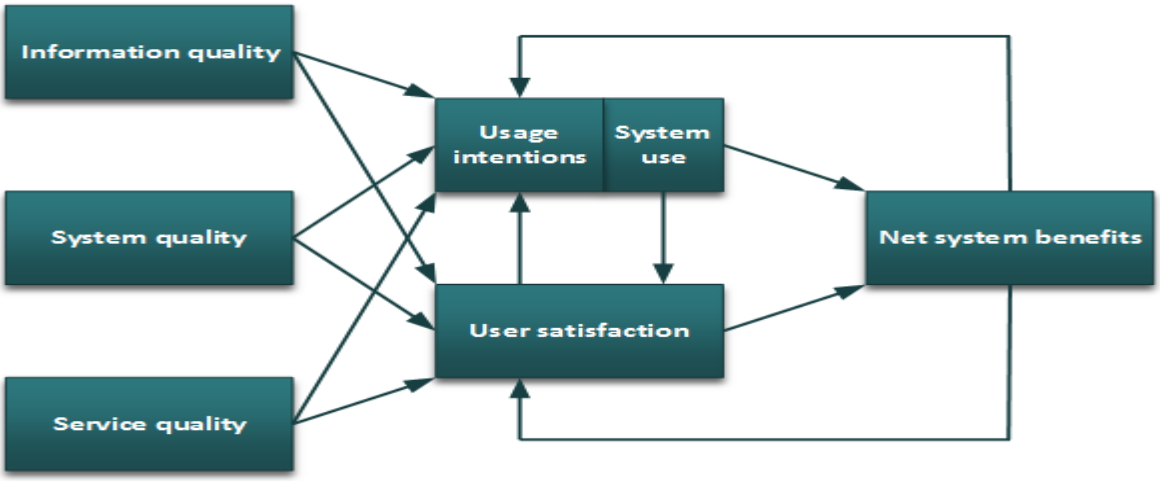

Figure 8: Information Systems Success Model
(Source: Delone & McLean, 2004)

The first three dimensions of a system constitute the design attributes, which make a system accepted by users and subsequently adopted.

2.13.4.1 Information quality

Information quality refers to the quality of the information that the system is able to store, deliver, or produce. These dimensions are important in the evaluation of any system. Information quality affects both the users' satisfaction with the system and the users' intentions to use the system, which, in turn, affect the extent to which the system is able to yield benefits for the users and organisations (Halonen et al., 2009).

2.13.4.2 System quality

This is defined as the extent to which the system is able to deliver benefits by means of mediational relationships through usage intentions and user satisfaction constructs. In this regard, a quality system should be easy-to-use, user-friendly, stable, secure, fast and responsive (Halonen & Others, 2009).

2.13.4.3 Service quality

Service quality implies the quality customers' service support that system users receive from the technical support department (Mamary, Shamsuddin & Aziati, 2014). Service support ought to be prompt, responsive and fair. The service quality directly influences usage intentions and users' satisfaction with the system, which, in turn, affects the net benefits produced by the system. According McLean (2004), the three factors, promptness, responsiveness and fairness result in system use/usage intentions, user satisfaction with the system and overall net system benefits accrued to the organisation for adopting the system.

In line with this model, it can be argued that if FOSLMS guarantee quality of information kept in them, many librarians in HEIs are likely to adopt them. Further, if FOSLMS were perceived to be ease to use, stable and offer advantages, more HEIs in Zambia could adopt them. It can also be argued that if FOSLMS developers provide customer services that are prompt and efficient, more libraries in HEIs in Zambia are likely to adopt them.

2.13.5 Proposed Model and Hypotheses for the Study

After analysing the four theories and models relating to the adoption of innovation and information systems, it has become apparently clear that there are factors that influence the adoption of any technology. These factors act as independent variables; they influence the intention of who will be adopters to think of using the invention and eventually adopt it. Five factors have been isolated and synthesised from the four theories, namely; low cost of adoption, ease of use, management support, system performance and social influence as shown in figure 9.

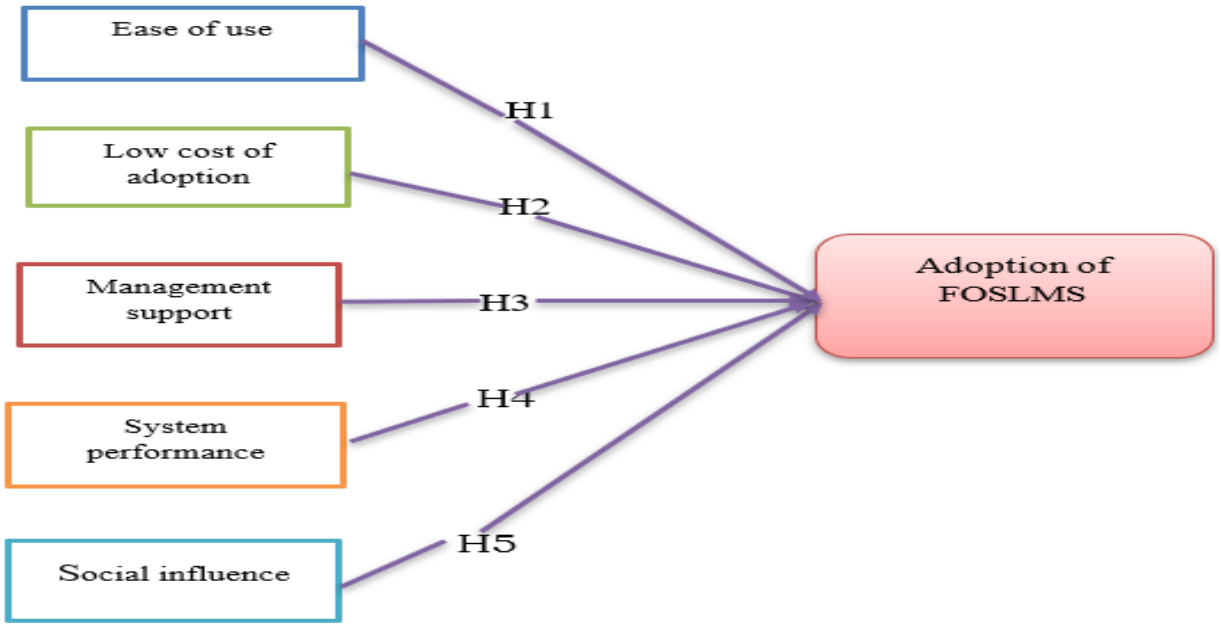

Figure 9: Proposed Model for the Adoption of FOSLMS in HEIs in Zambia
(*Source*: Adapted from Venkatesh, Thong and Xu, 2012; Rodgers, 1983; Al-Mamary, Shamsuddin & Aziati, 2014; DeLone & McLean, 2004)

As captured in Figure 9 above, the five independent variables influence the adoption of FOSLMS and subsequently leading to the adoption of FOSLMS. These factors can be grouped into four, namely; technological, economic, organisational and social factors.

2.13.5.1 Technological Factors and their Hypotheses

Technological factors are design attributes of any technology (Halonen & Others, 2009; Mamary, Shamsuddin &Aziati, 2014). These have to do with the features of any given information system such as FOSLMS which make people and organisations get attracted to it. Ease of use and system performance are the two attributes hived off from the four theories and models for this study. In this regard, it can be argued that FOSLMS have to be ease to use; they should not be complicated,

otherwise very few libraries in HEIs in Zambia will ponder adopting them. In this regard, FOSLMS should also perform better than other systems and improve the performance of libraries in HEIs in Zambia if they have to be adopted. Therefore, it was theoretically expected that:

(i) Libraries in HEIs in Zambia have adopted FOSLMS because they are perceived to perform better.
(ii) Libraries in HEIs in Zambia have adopted FOSLMS because of they are perceived to ease of use.

2.13.5.2 Economic Factor and its Hypothesis

Economic factors such as the cost or price value of adopting any technology matters (Huang & Kao, 2015). Libraries and other institutions are struggling to have more financial resources to provide library services (Nagia, 2012). Cost in many libraries determines the type of library management system to adopt. If the price or cost of adopting a library management system is high, very few libraries will be willing to adopt such a system (Kisanjara & Tossy, 2014). In this regard, if the cost of adopting FOSMLS is much lower than that of commercial library management systems, then more libraries in HEIs in Zambia are likely to adopt FOSLMS. It was therefore, assumed that:

(i) Libraries in HEIs in Zambia adopted FOSLMS because they believe that FOSLMS are cheaper

2.13.5.3 Organisational Factor and its Hypothesis

Among the organisational factors analysed from various factors, management support has stood out. It has become abundantly clear that no successful implementation of an information system such as FOSLMS could be materialised if management has not provided the much-needed supporting conditions (Kisanjara & Tossy, 2014; Mamary, Shamsuddin & Aziati, 2014). Management support in any project starts with management of an organisation, deciding or agreeing to adopt a given technology or system. Further, management support is seen in the provision of financial support to buy the necessary ICTs infrastructure for the implementation of the new system. Management support also involves the provision of training to the organisation's employees so that they have better understand of the new technology to be adopted. In this regard, management support is key in the adoption of FOSLMS in HEIs in Zambia; management has to

consent to the project of adopting FOSLMS and subsequently provide the needed support to such a project or else FOSLMS adoption cannot succeed. It was therefore, theoretically believed that:

(i) Libraries in HEIs in Zambia have adopted FOSLMS because of management support.

2.13.5.4 Social Factor and its Hypothesis

As articulated in UTAUT2 and other theories, social influence plays a key role in the adoption of any technology (Huang & Kao, 2015). If influential people and organisations in society adopt an innovation, more people and institutions are likely to adopt such a technology. In this regard, the adoption of FOSLMS in HEIs in Zambia could be influenced by social factors. For example, if influential libraries such as the University of Zambia adopted FOSLMS, more libraries in Zambia would ponder adopting it. Further, if professional body for librarians in Zambia, the Library and Information Association of Zambia (LIAZ) recommends to its members the adoption of FOSLMS, more libraries in HEIs are likely to adopt FOSLMS. It is theoretically therefore proposed that:

(i) Libraries in HEIs in Zambia have adopted FOSLMS because of social influence.

2.14 Gaps in the Literature Reviewed

Many studies relating to the adoption of FOSLMS have been reviewed in this chapter. These studies have been helpful but they have not been precise in addressing the research problem at hand. Studies conducted by Adera (2013); Kari and Baro (2014) and other researchers in Kenya, Nigeria and other countries have consistently established that Koha was the most used FOSLMS in libraries. This is insightful in an attempt to answer one of the objectives that sought to determine the most used FOLMS in HEIs in Zambia. However, many of the reviewed studies lacked contextual relevance to the problem at hand. For example, the study conducted by Adera (2013) on the feasibility of adoption of open source integrated library systems for libraries in Kenya, revealed that Koha was the most widely. The study was conducted in HEIs but also libraries from other sectors; it was conducted among 200 libraries which included not only higher educational sector libraries but also pubic and special libraries in Kenya. This entails that the focus of the study was not on libraries in HEIs but all type of libraries.

The other study conducted in Kenya by Makori and Mauti (2016) on Koha and its potential impact on information management organisation was based on two universities; one from the public sector and the other one from the private sector. The sample size for this study was too small and that the study too lacked contextual relevance to the problem under investigation. Further, the study was

not conducted in all the types of HEIs as some types of HEIs such as colleges of education, polytechnics and nursing schools were not part of the study. Furthermore, the study above focused solely on Koha, other FOLMS were not studied, hence failing to adequately address the research problem at hand.

The studies reviewed from Nigerian scholars also failed to adequately answer the research questions posed in the study as some studies focused only on Koha while other studies were conducted only in university libraries. For instance, Kari and Baro (2014) conducted a study on the use of library software in Nigerian university libraries and challenges among 32 academic libraries which revealed that 24 (66.7%) of the surveyed libraries used Koha. This study was not conducted in all institutions in the higher education sector but in university libraries in Nigeria. In this regard, colleges of education, polytechnics and nursing schools were not part of the study. Similarly, the study by Edem and Bassey (2016) on the adoption of software packages in university libraries in Nigeria, whose results showed that Koha was widely used, did not cover all institutions in the higher education sector; it covered only 58 university libraries in Nigeria. This entails that other types of HEIs were not studied.

It has also emerged that all the reviewed studies by Adera (2013), Kari and Baro (2014), Edem and Bassey (2016) and others on the adoption and use of FOSLMS in libraries in Kenya, Nigeria and Uganda have failed to determine the type of HEI that have adopted s FOSLMS more than the others. The objectives of the reviewed studies were not to compare the adoption of FOLSMS among all types of HEIs, hence the need to carry a study that addressed this aspect of FOSLMS adoption.

The study by Chaputula and Kanyundo (2019) in Malawi which aimed at investigating the diffusion of Koha in HEIs in Malawi also helped to establish that Koha was the most used FOSLMS in HEIs. However, this study only focused on the adoption of Koha in Malawi; no other FOSLMS were covered. Furthermore, the study by Chaputula and Kanyundo did not capture libraries from Polytechnics or Trades schools; only universities, colleges, and nursing schools were studied; therefore, its findings cannot be entirely relied upon to explain the adoption of FOSLMS in HEIs in Zambia.

Further, in all the literature reviewed, no study was dedicated to uncover the actual benefits accrued to libraries for using FOSLMS. In this regard, studies by Business Software Alliance (2007), COMESA (2009), and Saini (2011) just highlighted the general benefits of using free software; they did not specifically bring out the benefits of FOSLMS in library context, hence this study.

Similar to what the benefits of using FOSLMS were discussed by scholars, many challenges encountered in the adoption and use of FOSLMS in libraries were not adequately addressed. Much of the literature reviewed focused so much on the general challenges of using free and open source software. Very few researchers such as Kurmar and Thomas (2009), Adoma and Ponelis (2015), Muruli and Kumar (2014), and Uzomba, Oyebola and Izuchukwu, (2015) attempted to highlight some of the challenges of using FOSLMS. However, their studies were biased towards the challenges of using Koha in academic libraries. Therefore, the challenges raised in these studies apply only to Koha not to other FOSLMS used in library automation. Considering the contextual inadequacies and narrowness of the reviewed studies, it was imperative that a study on the adoption footprints of FOSLMS, benefits and challenges be conducted in HEIs in Zambia is conducted so that primary data is collected and analysed, to provide accurate answers to the research questions.

2.15 Summary of Chapter 2

The concept of free and open source software can be traced back to Richard Stallman, who in 1983 started a project called GNU and Free Software Foundation to promote the development of free and open source software. Free and open source software guarantees the software users many freedoms, which include the freedom to use the software free, and copy and distribute it to others. Free and open source software is released under several licences that include General Public Licence (GPL) and Apache 2.0.

Many countries have adopted free and open source software (FOSS) for various reasons. The main reason is the desire to reduce the cost of acquiring software. In some countries, policies exist that facilitate the adoption of FOSS. Some policies are mandatory, compelling government departments to use FOSS while others are preferential and advisory in nature. Globally, Europe leads in the number of FOSS public policy initiatives, while the Middle East is ranked least averagely low and Africa begin second from the last. In terms of the adoption and use of FOSS, Africa is the least and North America is leading.

As regards to the emergency of free and open source library management systems (FOSLMS), literature has shown that they emerged in the late 1980s as a result of high costs of software, with UNESCO developing the first ever library management system called CDS/ISIS. At the beginning of 2000, many FOSLMS sprang up, and popular among them are Koha, Evergreen, OpenBiblio, ABCD, PMB, SLIMS and NewGenLib. Literature has shown that FOSLMS are widely used among libraries in HEIs globally.

In Africa, many libraries in HEIs in English-speaking countries mostly use Koha, while in Francophone countries, PMB is popular. In North America, Koha and Evergreen are popular among higher learning institution libraries. In the Asian communities, Koha is widely used by libraries for automation among the HEIs. NewGenLib and SLIMS are proving to be popular among libraries in HEIs in India and Bangladesh, respectively.

In Europe, Koha is the choice of many HEIs but PMB has been popular in libraries in France because it was developed from there. In South American countries, many libraries in HEIs prefer Koha. However, ABCD is popular in Brazil.

The benefits of using FOSLMS in libraries in HEIs, include saving and redeployment of financial resources, provision of online library services which include WebOPAC, self-circulation, online reservation, current awareness, and electronic interlibrary loan. Other opportunities presented by FOSLMS to libraries in HEIs, include saving of professional manpower time, improved control and management of library resources, control over bibliographic records, implementation of copy cataloguing and provision of mashup services.

The challenges of using FOSLMS established in the literature reviewed include inadequate technical support, lack of trained human resource in libraries with adequate ICTs skills and high hidden costs. Other challenges of using FOSLMS include complexity of some library systems, inadequate documentation and difficulties in migrating data from commercial to FOSLMS.

A proposed model driven from Unified Theory of Adoption and Use of Technology 2 (UTAUT2), Perceived Attributes of Innovation Theory, Management Information Systems Adoption Model, and Delone and Mclean's Model of Information Systems Success guided this study. According to the proposed model, the adoption of FOSLMS in HEIs in Zambia is influenced by five independent

variables, namely cost, ease of use, management support, system quality and social influence. These independent variables are moderated by age, gender and level of education of librarians in HEIs.

There are some gaps in the studies reviewed. Many studies conducted in Kenya, Nigeria and other countries have failed to answer adequately, the research questions posed in this study because they lack contextual relevance. Further, some of the studies focused on the adoption of Koha in universities and not all FOSLMS in all HEIs, hence, the need to conduct a study which addresses the asked questions.

CHAPTER 3: RESEARCH DESIGN AND METHODOLOGY

3.0 Overview of Chapter

This chapter explains the research design adopted for the study; it contains specific details on the plan deployed in order to collect data needed to answer the research questions. Among the specific details explained in this chapter include the research philosophy, approach, strategy, and data collection methods. Further, this chapter explains how the collected data was analysed, and reliability and validity issues of the study.

3.1 Research Design and Methodology

The main objective of this study was to establish the adoption levels of free and open source library management systems (FOSLMS) in libraries in higher education institutions (HEIs). Further, the study sought to establish factors influencing the adoption of FOSLMS and find out the opportunities and challenges the adoption of FOSLMS has presented to libraries in HEIs in Zambia. The study's aims were translated into seven research questions that needed to be addressed by collecting and analysing data from libraries in HEIs in Zambia. These questions were:

(i) How widespread is the use of FOSLMS in HEIs in Zambia?

(ii) What is the most used FOSLMS in HEIs in Zambia?

(iii) What factors influence the adoption of FOSLMS in HEIs?

(iv) What are the benefits accrued to libraries in HEIs using FOSLMS?

(v) What challenges are faced by HEIs libraries in Zambia that have automated or are automating their operations using FOSLMS?

The above research questions begged for answers, hence the need to have a design or plan that could facilitate the collection and analysis of required data. According to Kothari and Garg (2014), research design is the arrangement of conditions for collection and analysis of data in a manner that aims at combining relevance to research purpose with economic procedure. It is a conceptual structural anchor of any research; it constitutes a blueprint for the collection, measurement and analysis of data.

3.1.1 Research Philosophy

Social research designs are modelled after many paradigms. Similarly, the design adopted for this study was influenced by a social paradigm called positivism. This epistemology was

conceptualised by August Comte in the late 19th century. Comte and other advocates of positivism paradigm argue that observation and reason are scientific ways of understanding human behaviour; true knowledge is based on experience of senses and can be obtained by observation and experiment (Nirod, 2005). This implies that social inquiry can be objectively and scientifically conducted in order to come up with empirical evidence. Disciples of positivism contend that any scientific research should be guided by four principles, namely:

(i) determinism -implies that events are caused by other circumstances, hence the need to understand such causal links to predict and control events;

(ii) empiricism - collection of verifiable empirical evidence in support of theory or hypothesis;

(iii) parsimony- refers to the explanation of the phenomena in the economic way possible; and

(iv) generality - the process of generalising the observation of the particular phenomenon to the world at large.

According to Nirod (2005), positivism paradigm systematises the knowledge generation process with the help of quantification, which enhances precision in the description of parameters and discernment of relationship among them. The pursuit to collect and analyse data in this study, rigorously followed specific and rigid procedures in order to ensure accurate measurement and observation of elements of the study.

The use of the positivism paradigm in research designs in Library Science started three decades ago. The emergence of evidence-based librarianship in the late 1990s necessitated the need for researchers in Library Science and its allied disciplines to use positivism research philosophy in research designs (Togia & Malliari, 2017). In this regard, scientific steps and procedures for collecting and analysing of data were followed to minimise errors in the results presented.

3.1.2 Research Approach

There are basically two research approaches, namely, deductive and inductive. The deductive approach is used in the developing of the hypothesis or hypotheses upon a pre-existing theory and then formulate the research approach to test it. On the other hand, inductive allows for the creation of a theory rather than adopting a pre-existing one as in the deductive approach (Silverman, 2013). According to Snieder and Larner (2009), the deductive approach can be considered particularly suited to the positivist approach, which permits the formulation of hypotheses and the use of

statistical testing of expected results to an acceptable level of probability. Considering the fact that the study did not only seek to describe the adoption footprints of FOSLMS but also test some hypotheses as regards the factors influencing FOSLMS adoption in HEIs in Zambia, the study took a deductive approach. As a result of the deductive approach and positivism philosophy adopted, it was prudent to qualify this study as quantitative and descriptive research.

The study was quantitative as it involved the collection and analysis of numerical data. It also sought to find patterns, make predictions, test causal relationships, and generalize results to wider populations (Bhandari, 2021). The study was also descriptive in design as it attempted to describe the adoption level, benefits, and challenges associated with the adoption of FOSLMS in HEIs in Zambia. According to Babbie (2007), the major purpose of descriptive studies is to describe the state of affairs, as they exist. Donald and Delno argue that descriptive studies are not only restricted to fact-findings but also to the formulation of principles of knowledge and solution to problems. The descriptive study also involves measurement, classification, analysis, comparison, and interpretation of data. In this regard, the study did not only describe the state of affairs as regards the adoption of FOSLMS but also analyse and interpret the research findings.

3.1.3 Research Strategy

In this quantitative study, a cross-sectional survey design was used. According to Creswell (2003) and Fink (2013), in cross-sectional survey, data is collected at a single point in time; it is a snap shot of a group of people or organisations. With this design, libraries in HEIs in Zambia were studied at a single point in time in 2018. Kombo and Tromp (2013) argue that a survey research is used to answer questions that have been raised to solve the problems that have been posed or observed. Further, a survey is used to asses needs and set goals. It can also be used to determine whether specific objectives have been met, and establish baselines against for future comparisons. A survey is also used to analyse trends across time and generally to describe what exists in what amount and in what context. Fink (2013) further observes that a survey is used in three ways:

(i) to quantitatively describe specific aspects of a given population;
(ii) to test the model against observations of the phenomenon through the use of the identified independent and dependent variables; and
(iii) simply as data collection tool for carrying out a survey research.

All the three uses of a survey fit into the research objectives and questions of this study. Through this design, libraries in HEIs were studied with a view to describing the adoption footprint of FOSLMS. Data was also collected to describe the benefits/opportunities and challenges presented to these libraries by FOSLMS. Further, the cross-sectional survey design sought to test the proposition from the proposed model that the adoption of FOSLMS in HEIs in Zambia was influenced by five independent variables, namely, cost, ease of use, management support perceived usefulness and social influence. Further, the survey design was used as a tool to collect data needed to answer the research questions.

3.1.4 Data Collection Methods

The study was conducted in Zambia among libraries in HEIs. Zambia is made up of ten provinces and the land mass of Zambia is 752,618 km² (World Bank, 2016). All the ten provinces were part of the study. The population of the study constituted all HEIs with functioning libraries. The lists of HEIs were obtained from government bodies mandated to accredit such institutions. These bodies were the Higher Education Accreditation Authority (universities), Teaching Council of Zambia (colleges of education), Nursing Council of Zambia (nursing schools) and Technical Education Vocation Entrepreneurship Training Authority (vocational and skills training institutions). The HEIs lists were scrutinised with a view to removing HEIs without functioning libraries. In this regard, principal officers for all newly established HEIs were contacted by phone to establish whether their institutions had functioning libraries.

3.1.4.1 Population

It was salient that the population constituted only librarians from HEIs that had functioning libraries or else the researcher might end up having a wrong population for the study, which could result in having unwanted elements for the study. HEIs with functioning libraries were likely to have adopted FOSLMS in their automation processes. After scrutinising the lists, the population was reduced from 492 to 154. The scrutiny of HEIs revealed that majority of the Technical Education, Vocational and Entrepreneurship Training (TEVET) institutions in Zambia that constitute a big percentage of HEIs, operate without libraries. Further, newly established private colleges and universities were found to be operating without libraries. It is pertinent to point out that this population (154) for the study, excluded colleges affiliated to Defence Forces in Zambia; they were not captured by this study because of security reasons.

3.1.4.2 Sampling Procedure and Sample Size

Considering that the population of HEIs in Zambia with functioning libraries stood at 154, it was possible to survey all the libraries in these HEIs. In this regard, all the 154 libraries in HEIs were studied by employing a complete census or total enumeration method. According to Israel (2013), all respondents should be sampled if the population does not exceed 200. In this regard, one respondent holding the position of Chief librarian or a person in charge of the library in HEI participated in the study. Census surveys result in an increased confidence interval. Conducting a census survey ensured enough respondents, hence, resulting in a high degree of statistical confidence in the survey results (Cvent, 2016). Furthermore, every HEI that meets the inclusion criteria participated in the study, thus giving every HEI an equal chance to be part of the study. This resulted in the collection of reliable data for the study. Table 23 below summarises the number of elements for the study by type of HEI.

Table 23: Census Survey Elements by Type of HEI

SN	Type of HEI	Sample Size	Percentage (%)
1	Colleges of education	46	30
2	Nursing schools	30	19
3	TEVET colleges	40	26
4	Universities	38	25
	Total	**154**	**100**

3.1.4.3 Data Collection Instruments and Procedure

Deductive research approach and survey strategies employ questionnaires to collect data about a phenomenon. In this regard, the study deployed hand-delivered questionnaires to collect data from respondents. According to Babbie (2007), a questionnaire is an instrument specifically designed to elicit information that will be useful for analysis. In this regard, the researcher and research assistants delivered questionnaires by hand to the respondents. This was done to ensure high rate of response. Further, telephone interviews were conducted for librarians who were found in far-reaching areas of Zambia. In this regard, the questions from the questionnaire were read to the respondents and the interviewer recorded their responses. This saved both time and financial resources to reach far lying places of Zambia. In the questionnaire, majority of the questions were close-ended. This was done to ensure uniformity of responses. In addition to close-ended questions, statements with Likert scale items were used to solicit data on some research questions that could not be answered by close-ended questions. Further, the questionnaire contained some

open-ended questions to attend to research questions or objectives that were not covered by both closed-ended questions and Likert scale statements (Wiersma & Jurs, 2004).

To ensure that the questions in the questionnaire help to illicit the needed information/data, the questionnaire was piloted in thirty libraries in HEIs with a view to testing the instrument. The feedback from the thirty libraries helped to refine the questionnaire.

In terms of data collection, the researcher employed 6 research assistants to help in collecting data. This was necessary, considering the fact that the sample of the study was large and that HEIs are dotted across the country. The research assistants and the researcher were delivering one questionnaire per library in the HEIs, and returned later to collect the filled questionnaire. This ensured that the respondents had the freedom to answer the questions without the interference of the researcher and research assistants.

3.1.4.3.1 Operational Definitions of Variables and their Measurements

The independent variables and a dependent variable have been operationally defined in this study as follow (table 24).

Table 24: Operational Definition of Variables

SN	Name of Variable	Definition of Variable	Level of Measurement
1	Ease of use	The belief that it is easy to use FOSLMS	Nominal
2	Low cost of adoption	The perception that it is cheaper to adopt FOSLMS than commercial library system	Nominal
3	Management support	Provision of financial, ICTs infrastructure and training of staff to facilitate the FOSMLS adoption	Nominal
4	System performance	The belief that FOSLMS performs better than commercial systems	Nominal
5	Social influence	The perception that other libraries and library professionals were using FOSLMS	Nominal
6	Adoption of FOSLMS	The use of FOSLMS in automating library operations	Nominal

3.1.5 Data Analysis Procedures

Collected data was quantitatively analysed using software called Statistical Package for Social Science (SPSS) version 22 and GNU Not Unix PSPP (GNU PSPP). In the first place, the collected

data was checked for gaps and inconsistencies. Thereafter, questions were coded, and responses were assigned numbers in readiness for data entry. During data coding, open-ended questions responses were grouped into categories and numbers assigned to categories. After coding was done, data was entered into the SPSS and was analysed, in which descriptive statistics were generated on various questions.

Considering the fact that the study was quantitative in design and a complete census was employed, inferential statistics such as estimations were not used. This was because the study was based on the entire population of HEIs with functioning libraries and not a sample. However, a non-parametric statistical test called Fisher's exact test was used to determine whether or not there is a relationship between the identified independent variables and dependent variable. In this regard, the following hypotheses were tested using the Chi-square test of independence with a 0.05 level of significance as shown in Table 25.

Table 25: Hypothesis Testing Using Chi-square Test of Independence

Null Hypothesis	Alternative Hypothesis
H_0: Libraries in HEIs in Zambia have adopted of FOSLMS not because they perceive FOSLMS to be easy to use	H_1: Libraries in HEIs in Zambia have adopted of FOSLMS because they perceive FOSLMS to be easy to use
H_0: Libraries in HEIs in Zambia have adopted FOSLMS not because they believe FOSLMS were cheaper	H_1: Libraries in HEIs in Zambia have adopted FOSLMS because they believe FOSLMS were cheaper
H_0: Libraries in HEIs in Zambia have adopted FOSLMS not because of management support	H_1: Libraries in HEIs in Zambia have adopted FOSLMS because of management support
H_0: Libraries in HEIs in Zambia have adopted FOSLMS not because they perceive FOSLMS to work well	H_1: Libraries in HEIs in Zambia have adopted FOSLMS because they perceive FOSLMS to work well
H_0: Libraries in HEIs in Zambia have adopted FOSLMS not because of social influence	H_1: Libraries in HEIs in Zambia have adopted FOSLMS because of social influence

Furthermore, the sampled population's normality was tested using one-sample Kolmogorov-Smirnov and Shapiro-Wilk tests of normality at 0.05 level of significance. The one-sample Kolmogorov-Smirnov and Shapiro-Wilk tests are used to test whether a sample comes from a specific distribution (Real Statistics, 2021). These non-parametric tests determine whether a

sample comes from a population that is normally distributed. The age variable being numeric was used in this test.

Table 26: Normality Testing Using Kolmogorov-Smirnov and Shapiro-Wilk Tests

Null Hypothesis	Alternative Hypothesis
H_0: Sampled population is not normally distributed	H_1: Sampled population is normally distributed

3.1.6 Reliability and Validity of the Study

In research, there is a need to evaluate the research methods and techniques used in order to ascertain the reliability and validity of results. Reliability is about the consistency of a measure and validity is about the accuracy of a measure (Middleton, 2020). If the same result can be consistently achieved by using the same methods under the same circumstances, the measurement is considered reliable while if research has high validity, that means it produces results that correspond to real properties, characteristics, and variations in the physical or social world (Middleton, 2020). In this regard, the data collection instrument was piloted on 10 respondents from HEIs. This was done to ensure that the questionnaire measured what it intended to measure. Furthermore, the questionnaire was peer-reviewed to ensure that the questions adequately cover the concepts and variables identified in the literature review on the adoption of FOSLMS.

3.1.7 Limitations of the Study

The findings of this research were affected by among other factors, which include the use of self-administered questionnaires in data collection, and some respondents may have misunderstood certain questions. This could have negatively affected the research findings. Further, the research findings have been affected by the fact that many librarians in Zambia have elementary ICTs skills. As a result, some librarians may not have been in position to evaluate the FOSLMS they were using in order to give proper accounts on the challenges and opportunities/benefits, which these library management systems present to them. These limitations however, were mitigated by the use of follow-up telephone interviews with respondents who were found to have not answered some questions properly.

3.2 Summary of Chapter 3

This study was rooted in a social paradigm called positivism, which argues for conducting social inquires in a scientific way. According to positivism epistemology, social inquiries are objectively and scientifically conducted in order to come up with empirical evidence. In view of this epistemology, the research design adopted in this study was quantitative descriptive in nature and that a survey method was used.

The study employed a complete census survey in which all 154 HEIs with functioning libraries were surveyed; 25 per cent were universities, 26 per cent were TEVET institutions, 19 per cent were nursing schools and 30 per cent were colleges of education.

Data was collected using hand-delivered questionnaires and telephone interviews. The collected data was analysed quantitatively using a software called Statistical Package for Social Sciences (SPSS). Both descriptive and non-parametric statistics were used in presenting the research findings. The main limitation of the study was the use of self-administered questionnaires on respondents, resulting in wrong responses as some questions were misunderstood. This however, was mitigated by the use of follow-up oral interviews.

CHAPTER 4: PRESENTATION OF RESEARCH FINDINGS

4.0 Overview of the Chapter

This chapter presents the research findings. It begins by describing the response rate, characteristics of the respondents and the libraries studied. Thereafter, it presents the findings on specific research objectives.

4.1 Response Rate

As articulated in chapter 3, the study employed a complete census; all the 154 higher education institutions (HEIs) were eligible for the study. However, 142 HEIs participated in the study by completing a questionnaire while 12 did not participate. This represents a response rate of 92 per cent. A high (44) number of the HEIs were colleges of education as shown in Figure 10 below.

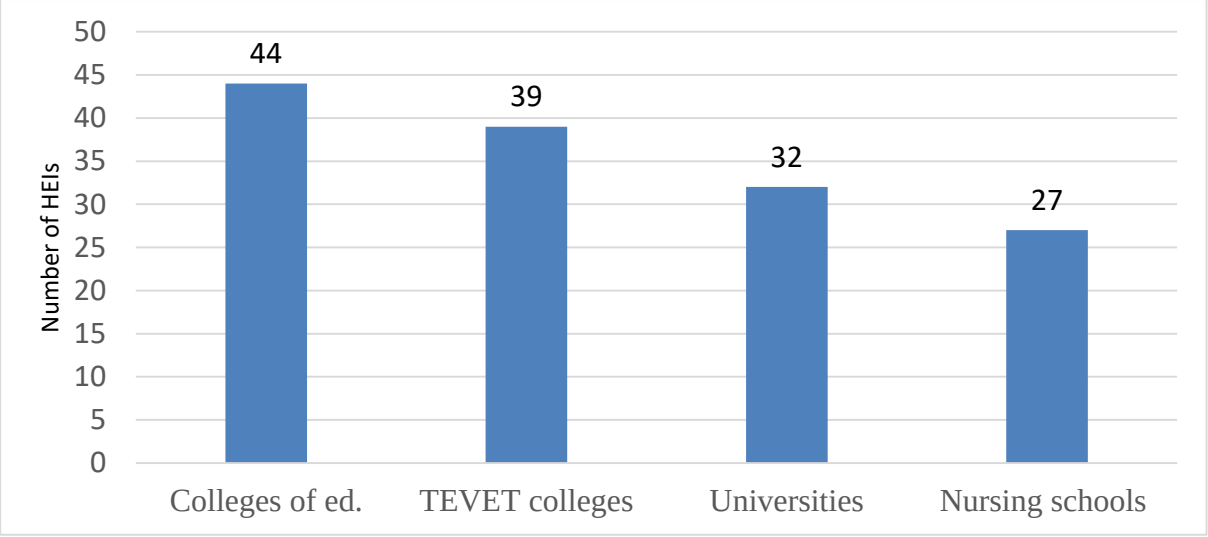

Figure 10: Types of HEIs that Participated in the Study

In percentage terms of the HEIs that participated in the study, 31 per cent were colleges of education, 27 per cent were TEVET colleges, 19 per cent were nursing schools, and 23 per cent were universities. Among the 12 HEIs that did not take part in the study, six were universities (privately-owned) because it was difficult to locate them as most of them did not have fixed abode. Further, three nursing schools did not take part in the study; they declined to take part in the study without giving reasons. Other HEIs that declined to take part in the study were one TEVET college and one college of education.

Many (51) of the HEIs in the study came from Lusaka Province, followed by Copperbelt Province (with 33 HEIs). Very few (3) HEIs came from Muchinga Province because the Province is host to a few HEIs in Zambia as shown in Table 27 below.

Table 27: HEIs Participation by Province

SN	Province	Frequency	Percentage (%)
1	Central	11	8
2	Copperbelt	33	23
3	Eastern	7	5
4	Lusaka	51	36
5	Luapula	4	3
6	Muchinga	3	2
7	Northern	6	4
8	North-Western	6	4
9	Southern	17	12
10	Western	4	3
	Total	**142**	**100**

4.2 Distribution of the Sample Population

As depicted in Table 28, the distribution of the sampled population is normal as Kolmogorov-Smirnov, and tests conducted on the variable age show normality. The p-value obtained in this test is .000, which is far below the 0.05 significance level as shown in table 28. Therefore, the null hypothesis which stated that the sampled population was not normally distributed was rejected. This implies that data is normally distributed.

Table 28: Tests of Normality

	Kolmogorov-Smirnov[a]			Shapiro-Wilk		
	Statistic	df	Sig.	Statistic	df	Sig.
Age	.254	142	.000	.859	142	.000

Furthermore, the Skewness and Kurtosis show that the sampled population is normal; the computed Skewness and Kurtosis were-.172 and .364 respectively as depicted in figure 11 below. Furthermore, the Q-Q plot and the histogram on the variable age in figure 11 also show that the sampled population is fairly distributed.

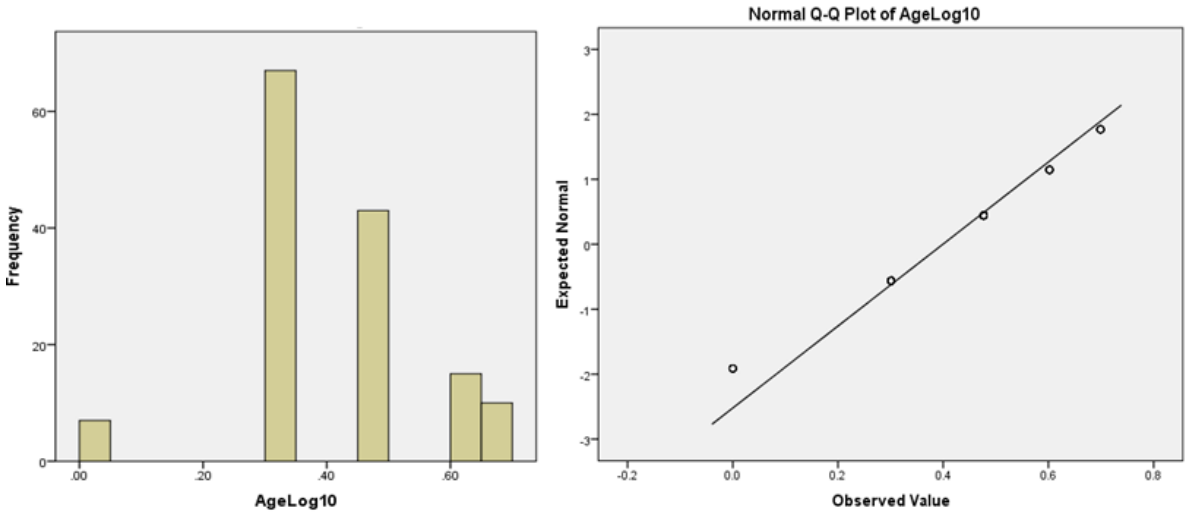

Figure 11: Histogram and Q-Q Plot on Normality of Sampled Population

4.3 Demographic Characteristics of the Respondents

As indicated in chapter 3, in each HEI, one staff from the library, preferably the person in charge of the library such as Chief Librarian, participated in the study. Table 29 below shows the gender and age of the participants. Majority (83) of the respondents were female, which translates into 58 per cent participation of women in the study, while 59 were male, representing 42 per cent participation of men. In terms of age of the respondents, majority (74) were aged less than 35 years old. Further, 43 were aged 35-44, 15 were aged 45-54 and 10 respondents were aged above 55 years, as reflected in Table 29.

Table 29: Demographic Characteristics of Respondents

SN	Variable	Value	Frequency	Percentage (%)
1	Gender	Female	83	58
		Male	59	42
2	Age	<35	74	52
		35-44	43	30
		45-54	15	11
		55>	10	7

Table 30 below presents the job descriptions, qualifications in library and information science (LIS) and work experience of the respondents. A considerable high number of respondents (62) were librarians, 26 were Library Assistants, 35 were Assistant Librarians, and one was a Chief Librarian. Other respondents included 13 participants who held various job titles such as Records

Officers, Marketing Officers, Administrative Officers and Lecturers designated to manage libraries in some HEIs.

The majority (110) of the participants in this study possessed qualifications in LIS, which in percentage terms stands at 77.5 per cent, while 32 (22.5%) respondents indicated not having qualifications in LIS. Among those who indicated having a qualification in LIS, many (47) held diploma qualifications. Further, 45 respondents reported holding Bachelor's degrees, 8 master's degree and one respondent had a doctoral degree in LIS. Those who indicated not having qualifications in LIS, had degrees and diplomas in fields such as Education, Nursing, Marketing and Administration. A few respondents had no tertiary qualification but a Grade Twelve Certificate.

In terms of the number of years the respondents had been working in the library, a considerable high number (45) of respondents had been working in the library for a period of 1 to 3 years. Further, 22 respondents reported having been working for a period of less than one year, 42 had been working for a period of 4-7 years, 18 indicated having been working for a period of 8 -11 years, and 15 had been working for more than 12 years.

Table 30: Other Demographic Characteristics of Respondents

SN	Variable	Value	Frequency	Percentage (%)
1	Positions/Job Titles	Library Assistant	26	18
		Assistant Librarian	35	25
		Librarian	62	44
		Chief Librarian	1	0.7
		Others	18	12
2	Qualifications in LIS	Certificate	19	13
		Diploma	47	33
		Bachelor's Degree	45	32
		Master's Degree	8	6
		Doctoral Degree	1	0.7
		Non-LIS Qualification	22	15
3	Years of Work Experience	<1	22	15
		1-3	45	32
		4-7	42	30
		8-11	18	13
		12>	15	10

4.4 Characteristics of HEIs Libraries Surveyed

Libraries surveyed were heterogeneous; they were not similar in terms of ownership, size and funding situations. As captured in Figure 12 below, a considerable high number, 63 (44%) of these libraries came from HEIs that were privately-owned, 60 (42%) of the libraries were drawn from exclusively government-owned HEIs, while those that came from HEIs jointly-owned by government and private were 19 (14%). Further, many (43%) of the HEIs had been in existence for over a period of 30 years.

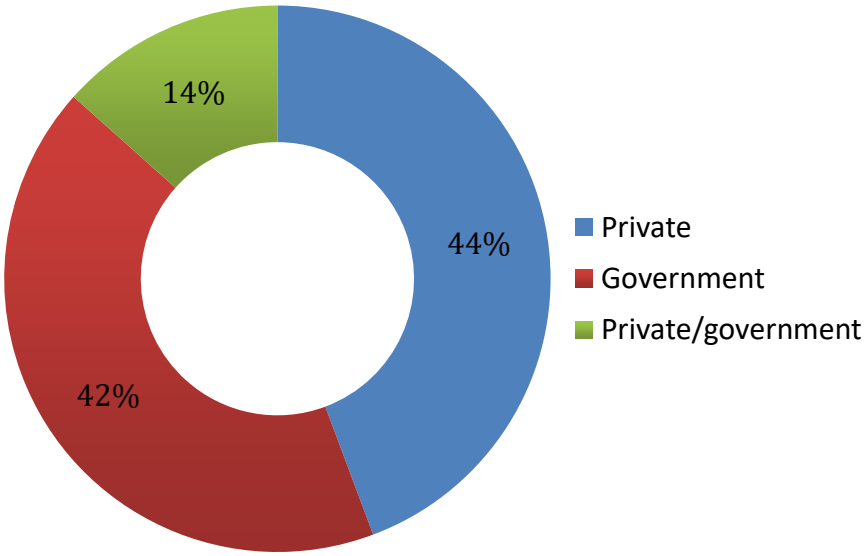

Figure 12: Ownership of HEIs

In terms of size of libraries in HEIs from which the respondents were drawn, many appeared to be small libraries as evidenced by the number of staff and the size of their collections. Majority (86%) of the libraries had 2-5 staff as shown in Table 31 below. Further, 26.7 per cent of the libraries were reported having less than 200 users, 24 per cent had less than 400 users, and 21 per cent and 10 per cent of the libraries had less than 600 and 800 users, respectively. Only 27 per cent of the libraries had more than 800 users.

Table 31: Number of Staff and Users of Libraries Surveyed

SN	Variable	Value	Frequency	Percentage (%)
1	Number of staff working in the library	<5	122	86
		5-10	13	9
		11-15	2	1
		16+	5	4
2	Number of library users	<200	37	26.7
		201- 400	34	24
		401- 600	21	15
		601- 800	10	7
		801>	39	27.4

In terms of the sizes of collections of the surveyed libraries, a considerable high number (46) of libraries had collections of less than five thousand (5,000) copies of information resources, both in print and electronic formats, 25 libraries had less than 1,000 materials and 25 libraries did not state the size of their collections as shown in Table 32 below.

Table 32: Size of Library's Collection

SN	Size	Frequency	Percentage (%)
1	<1000	25	17
2	1001-5000	46	32
3	5001-10000	15	11
4	10001-15000	8	6
5	15001-20000	11	8
6	20001-25000	6	4
7	25001-30000	1	0.7
8	30001>	5	4
9	Do not know	25	17
	Total	**142**	**100**

The research findings have shown that TEVET colleges had a high number of libraries (18), with the collections exclusively in print format followed by colleges of education with 17. On the other hand, a considerable high number of libraries across the spectrum had collections both in print and electronic as depicted by Figure 13 below.

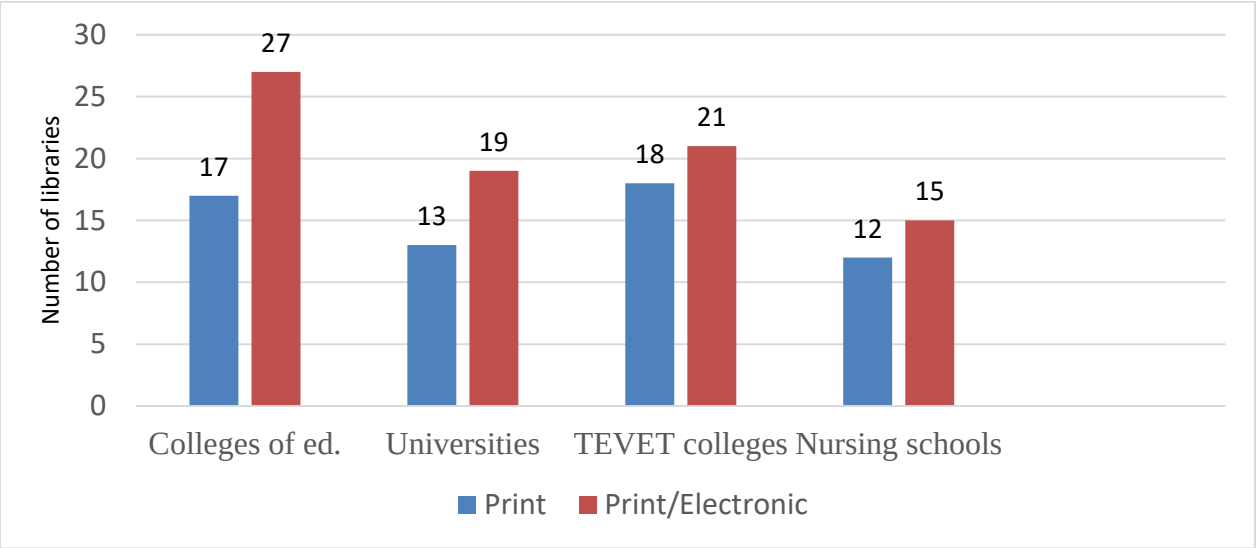

Figure 13: Format of Library Collection by Type of HEI

On the major means of acquiring library materials, majority (61%) of the libraries indicated that they used both purchases and donations to acquire library materials, 30% reported that they exclusively acquired their library materials by purchase while 9 per cent indicated that they acquire materials through donations.

In terms of description of their collections, majority (80%) of the libraries described their collections as a mixed bag. The collections were said to contain both current and outdated materials while 19 (13.4%) indicated having current collections only, and 9 (6.3%) described their collections outdated.

On the issue of having computers in the library, majority (73%) of the libraries reported having computers while 27 per cent did not. The study established that 91.3 per cent of libraries that indicated having computers have had their computers connected to the Internet. As captured in Figure 14 below, many of the libraries without computers were TEVET colleges and colleges of education, 16 and 13, respectively. Further, the study has shown that majority (24) of schools of Nursing had computers in their libraries; only three (3) did not have computers.

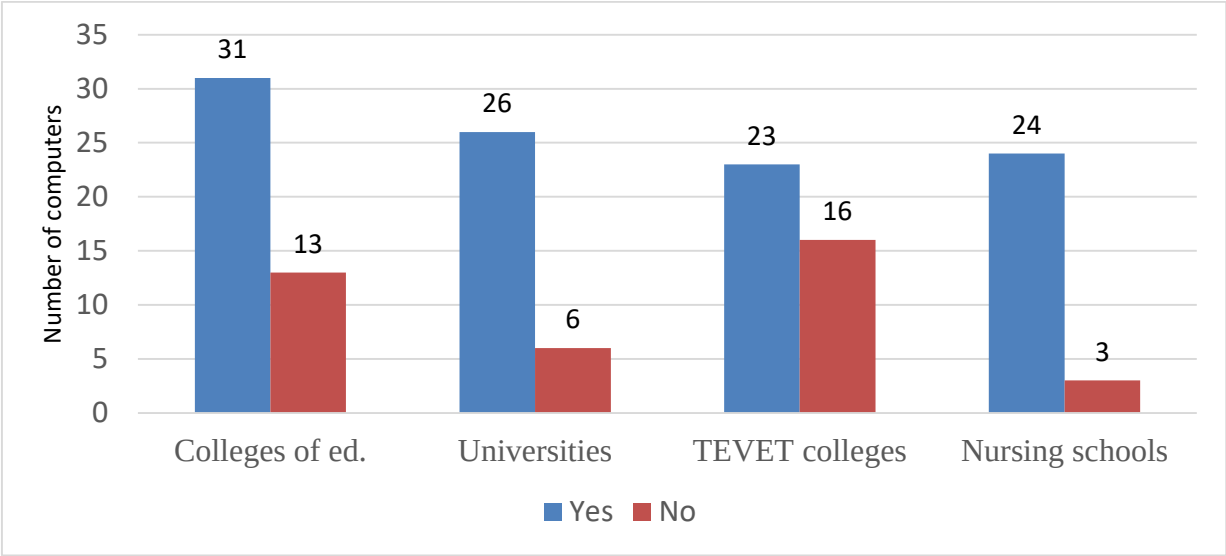

Figure 14: Libraries with Computers by Type of HEI

Table 33 below describes the number of computers in surveyed libraries in HEIs. A considerable high number (43.3%) of libraries had less than 10 computers, 25.9 per cent had between 11-20 computers and 9.6 per cent had between 21-30 computers. Furthermore, 7.6 per cent of the libraries had between 31 and 40 computers, 5.7 per cent had 41-50 computers and 7.6 per cent had more than 51 computers.

Table 33: Number of Computers and Description of Library Funding

SN	Number of Computers	Frequency	Percentage (%)
1	<10	45	43.3
2	11-20	27	25.9
3	21-30	10	9.6
4	31-40	8	7.6
5	41-50	6	5.7
6	51>	8	7.6
	Total	**104**	**100**

Figure 15 below presents the description of level of funding to the libraries by parent organisations. Very few (6%) of the surveyed libraries described funding they receive as being excellent. A high number of libraries (31%) described funding as being poor, 27 per cent described funding as fair, 23 per cent considered funding to them by parent organisations as good and 13 per cent of the libraries described funding as being very good.

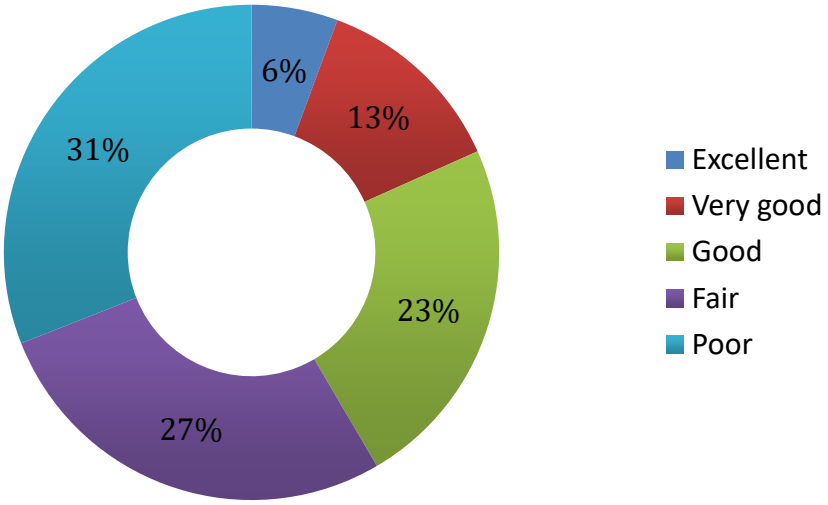

Figure 15: Description of Funding by Libraries

The study revealed that a high number of libraries from exclusively government-run HEIs described the funding they received from their parent organisations as poor as shown in Figure16 below. This entails that HEIs solely run by government had problems funding libraries.

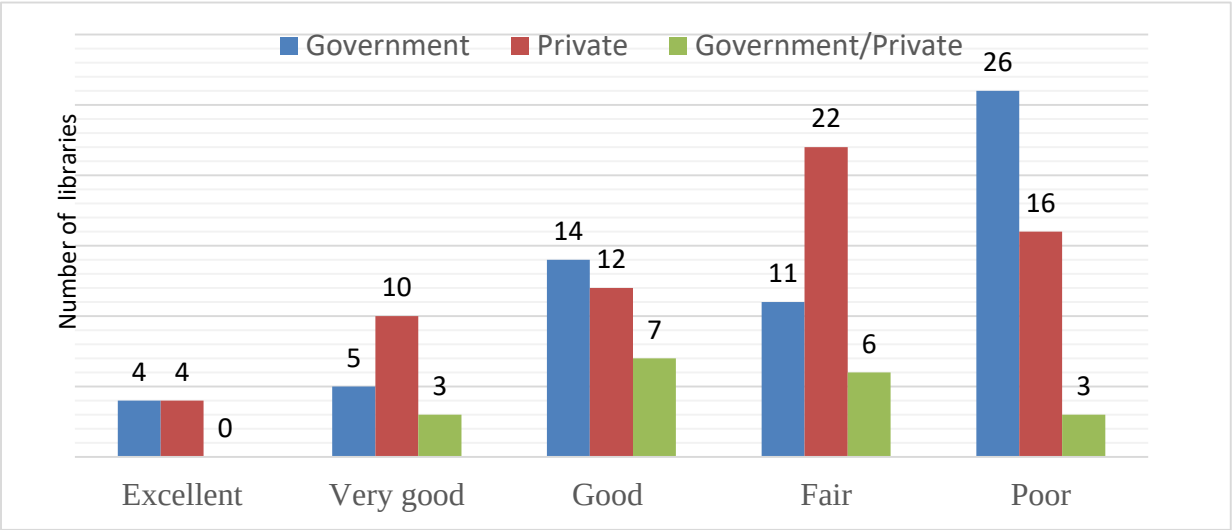

Figure 16: Description of Library Funding by Type of Ownership of HEIs

4.5 Adoption of FOSLMS in HEIs in Zambia

Knowledge on the existence of free and open source library management systems (FOSLMS) is a prerequisite for its adoption. There is need for librarians to know that technology such as FOSLMS

exists. On this front, majority (90) of the respondents indicated that they were aware of the existence of FOSMLS while 52 reported not being aware of the existence of FOSLMS. In percentage terms, it can be said that 63 per cent of the respondents were aware of the existence of FOSLMS while 37 percent were not. It was further revealed that very few (7) LIS certificate holders were aware of the existence of FOSLMS. As can be seen in Table 34 below, many respondents who held a Diploma or better qualification in LIS were more aware of the existence of FOSLMS as compared to those who held certificates. Further, very few (5) of respondents who held non-LIS qualifications were aware of the existence of FOSLMS.

Table 34: Awareness of FOSLMS by Qualification

		Awareness of the Existence of FOSLMS		
Academic Qualification in LIS		**Yes**	**No**	**Total**
1	Certificate	7	12	19
2	Diploma	29	18	47
3	Bachelor's Degree	40	5	45
4	Master's Degree	8	0	8
5	Doctoral Degree	1	0	1
6	Non-LIS Qualification	5	17	22
Total		**90**	**52**	**142**

The awareness of the existence of FOSLMS by the respondents was tested by asking them to state whether the major library management systems (LMS) that were listed were FOSLMS or commercial. The responses showed that many (81) respondents successfully managed to identify Koha as a FOSLMS. On the contrary, many did not know that ABCD, Evergreen and OpenBiblio were also FOSLMS as shown in Table 35.

Table 35: Identification of FOSLMS by Respondents

Are the Library Management Systems below FOSLMS?		**Yes**	**No**	**N/A**	**Total**
1	ABCD	11	80	51	142
2	Alice	3	88	51	142
3	Evergreen	20	71	51	142
4	Koha	81	10	51	142
5	Liberty	7	84	51	142
6	OpenBiblio	41	50	51	142
7	SirsiDynix	4	87	51	142

As regards, the sources of knowledge about FOSLMS, many respondents cited academic studies, workshops and independent research as depicted in Table 36.

Table 36: Sources of Awareness of FOSLMS

SN	Sources of awareness of FOSLMS	Frequency	Percentage (%)
1	Academic studies	29	20.4
2	Workshop	27	19
3	Independent research	18	12.7
4	Workplace and attachment	6	4
5	Friends	5	3.5
6	All the above	4	2.8
7	International training	1	0.7
8	Conferences	0	0.0
9	N/A	52	36.6
	Total	**142**	**100**

On the issue of using library management systems in automating libraries operations, 54 (38%) of the respondents indicated using library management systems to automate the basic functions or operations of their libraries, while 88 (62%) reported not using any library management systems as shown in Figure 17. This implies that 62 per cent of the libraries in HEIs have not automated their operations.

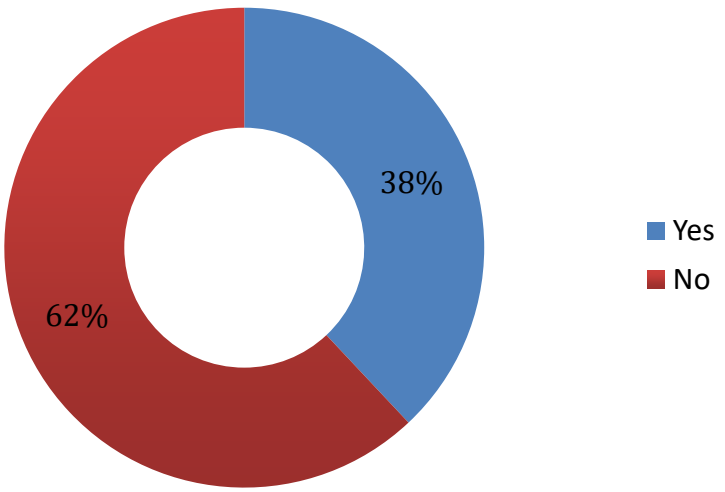

Figure 17: Library Automation Using Library Management Systems

Further analysis of data revealed that 20 (37.03%) university libraries had automated their operations; 15 (27.8%) colleges of education had automated their operations; 13 (24.07%) TEVET college libraries had automated their operations; only six (11.11%) out of 26 nursing schools had automated their library operations as in Figure 18.

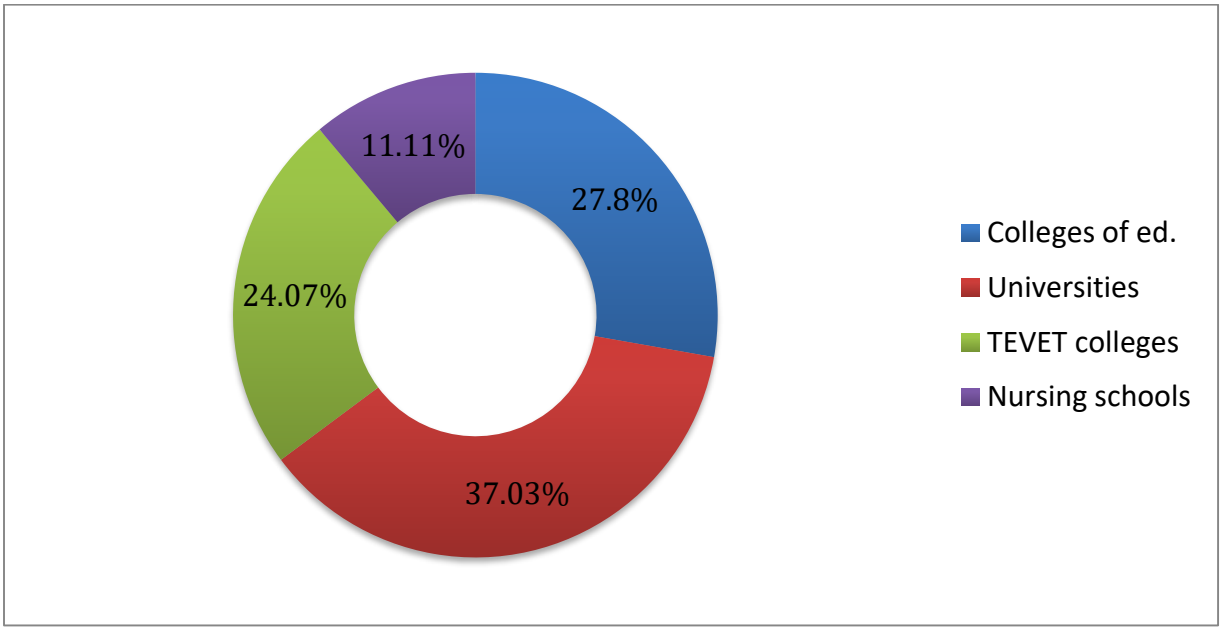

Figure 18: Library Automation by Type of HEIs

The 54 respondents who had indicated using library management systems to automate their libraries were asked to indicate the type of a library management system they were using. Many (42) of the respondents reported using FOSLMS while 12 indicated using commercial library management systems (CLMS). This implies that FOSLMS was more widely used among HEIs that automated their operations. Further analysis of data revealed that colleges of education had more (14) libraries using FOSLMS followed by universities and TEVET colleges, at 13 and 11, respectively. However, more than half (7) of the university libraries indicated automating their operations using commercial library management systems as Figure 19 shows.

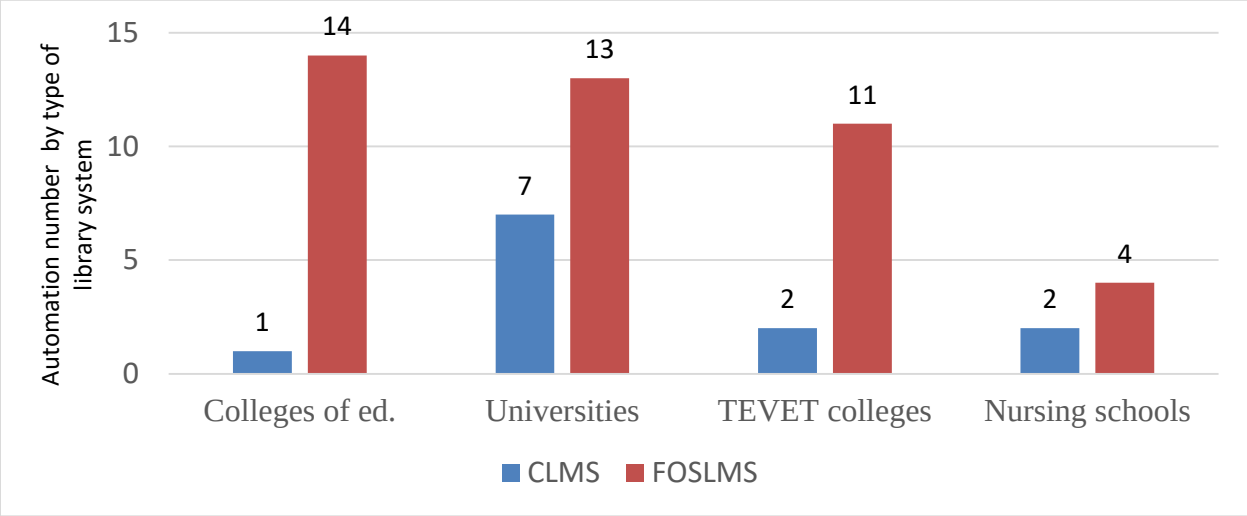

Figure 19: Types of Library Management Systems Used by Type of HEIs

Further, the 54 libraries that indicated that they had automated their operations were asked to state the name of the library management system they were using. Many libraries (41) reported that they were using Koha, which is FOSLMS. One library was reported to be using OpenBiblio. However, commercial library management systems such as Destiny, Library Gold, Unicorn-SirsiDynix, Liberty 5, Librarica and Astria were also cited as shown in Table 37.

Table 37: Name of the Library System Used by Libraries

		Type of library management		
SN	**Library management system name**	**CLMS**	**FOSLMS**	**Total**
1	Destiney	2	0	2
2	Liberty5	1	0	1
3	Librarica	1	0	1
4	Library gold	2	0	2
5	Koha	0	41	41
6	Unicorn-SirsiDynix	1	0	1
7	OpenBiblio	0	1	1
8	(Astria and in-house systems)	5	0	5
	Total	**12**	**42**	**54**

After establishing that 42 out 54 libraries in HEIs had automated their operations using FOSLMS, and that Koha was the most widely used, further analysis of data was conducted to determine the type of HEIs that have adopted FOSLMS more than others. In this regard, it was discovered that colleges of education and university libraries dominated the use of FOSLMS, Koha in particular; 13 colleges of education and 13 universities reported using Koha. Further, 10 libraries from

TEVET colleges were reported to be using Koha. Nursing schools were the least in the use of Koha; only 5 libraries among the surveyed HEIs used Koha. On the other hand, 1 TEVET library was reported to be using OpenBiblio as depicted in Table 38.

Table 38: Name of FOSLMS Used by Type of HEIs

		Name of FOSLMS being used in HEIs libraries		
SN	**Type of HEIs**	*Koha*	*OpenBiblio*	*Total*
1	Colleges of ed.	13	0	13
2	Universities	13	0	13
3	TEVET colleges	10	1	11
4	Nursing schools	5	0	5
	Total	**41**	**1**	**42**

The study has further shown that the use of FOSLMS was more pronounced in libraries attached to HEIs that are exclusively run by government. In this regard, 21 (50%) of government-run HEIs libraries reported using FOSLMS; 11 (26.19%) of quasi-government institutions were found to be using FOSLMS; while 10 (23.80%) of private HEIs libraries were found to be employing FOSLMS as shown in Figure 20.

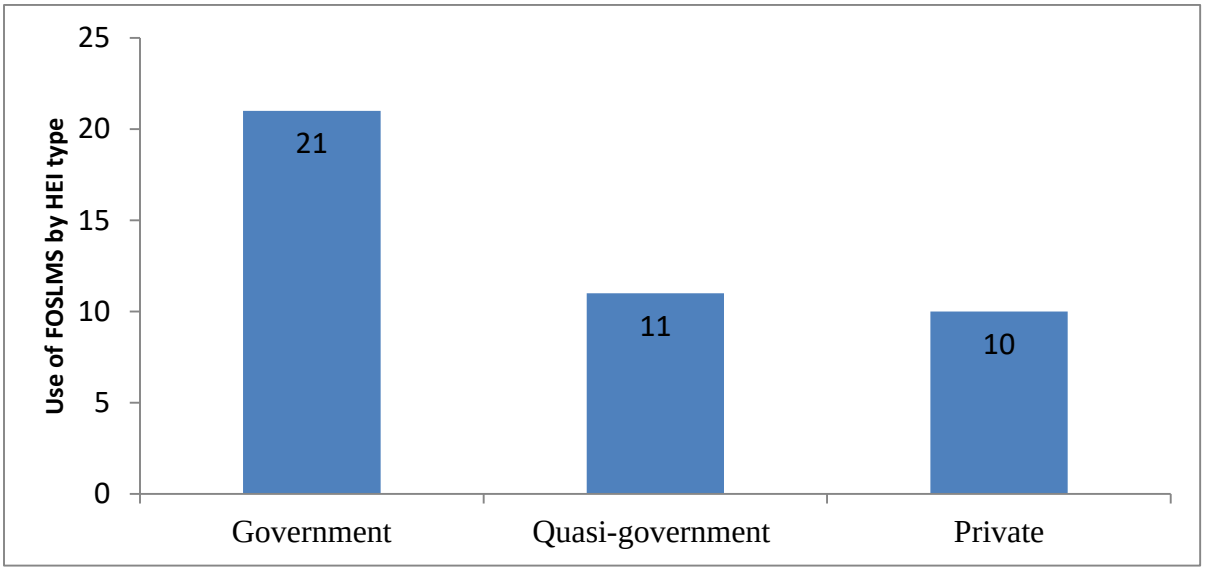

Figure 20: Use FOSLMS by Ownership of HEIs

The research findings further show that the use of FOSLMS, in particular Koha in HEIs in Zambia, is on the upswing with more libraries adopting it. As depicted by the Figure 21 below, in 2009, Koha was being used by one HEI. In 2010, 2 libraries, among the surveyed HEIs, adopted Koha.

However, 2011 did not register any HEIs adopting Koha. From 2012 to 2018, more libraries in HEIs adopted Koha and the peak was 2016 in which 10 HEIs adopted it.

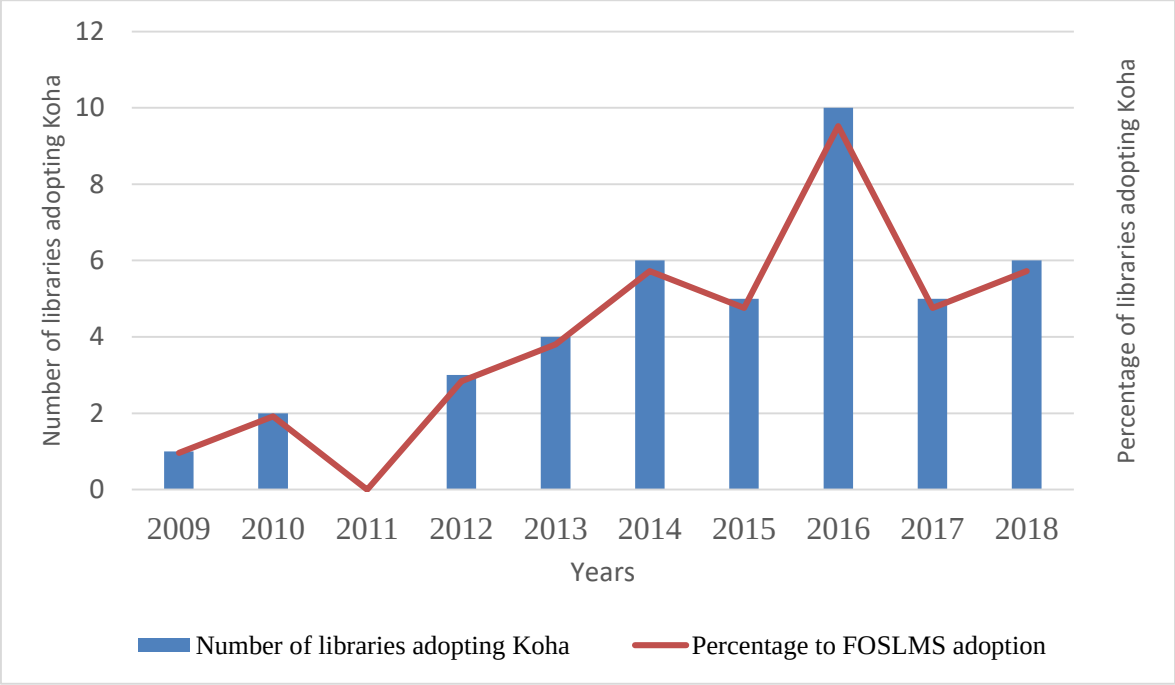

Figure 21: Koha Adoption from 2009-2018 among HEIs

The research has further shown that many library operations have been automated using FOSLMS. Cataloguing functions followed by circulation and report generation are some of the library functions that have been automated by many libraries as shown in Table 30**.**

Table 39: Library Activities Automated with FOSLMS

SN	Library Activity Automated	Yes	No	Total
1	Cataloguing	41	1	42
2	Circulation	37	5	42
3	Report-generation	33	9	42
4	Acquisition	15	27	42
5	Serial management	15	27	42
6	Budget-tracking	9	33	42

The research findings have further shown that all (42) libraries that reported using FOSLMS were not using any library management system before the adoption of FOSLMS. This implies that prior to the adoption of FOSLMS, they were manually operating; their library operations were not automated.

4.6 Factors Influencing the Adoption of FOSLMS in HEIs

As depicted in the proposed conceptual framework of this study, five variables or factors influence the adoption of FOSLMS in libraries in HEIs in Zambia. These are perceived usefulness, ease of use, cost, management support and social influence. In this regard, the 42 respondents whose libraries had adopted FOSLMS were presented with a matrix of five possible reasons for their adoption of FOSLMS. As captured below Table 40, all the 42 respondents using FOSLMS cited cost as the principal reason for adopting FOSLMS; they revealed that FOSLMS was cheaper as compared to commercial library management systems. The other three reasons that were also highly cited by respondents included ease of use of FOSLMS, support from management and the fact that FOSLMS were widely used in Zambia. On the contrary, the perception that FOSLMS performs better than other library systems received the lowest score, majority of the respondents nullified this factor as the reason for adopting FOSLMS.

Table 40: Factors for Adopting FOSLMS

SN	Factors Influencing the Adoption of FOSLMS	Yes	No	Do not know	Total
1	FOSLMS is easy to use	36 (85.71%)	1 (2.38%)	5 (11.9%)	**42 (100%)**
2	FOSLMS adoption cost is cheaper than commercial systems	42 (100%)	0 (0.0%)	0 (0.0%)	**42 (100%)**
3	Management provided support for FOSLMS	30 (71.42%)	9 (21.42%)	3 (7.14%)	**42 (100%)**
4	FOSLMS perform better than commercial systems	12 (28.57%)	14 (33.33%)	16 (38.09%)	**42 (100%)**
5	FOSLMS is widely used by other HEIs libraries in Zambia	28 (66.66%)	6 (14.28%)	8 (19.04%)	**42 (100%)**

The researcher went further to test if there is an association between the five independent variables and the adoption of FOSLMS (dependent variable) in HEIs in Zambia. In this regard, the Chi-square test of independence was computed. As already indicated in chapter 3, the level of significance for the test was 0.05 (95% level of confidence). As can be seen from Table 41 below, on the second hypothesis that stated that libraries in HEIs in Zambia adopted FOSLMS because the cost of adoption is lower than that of commercial library systems, the Chi-square test of independence was not computed because the variable was constant. This is because all the 42 respondents indicated that they adopted FOSLMS because it was cheaper. However, the Chi-

square test of independence was generated on the other remaining four hypotheses and the p-values obtained in the three (3) hypotheses were much lower than 0.05. This implies that the three null hypotheses were rejected; the results obtained were significant.

Table 41: Chi-square Test of Independence

	Null Hypotheses	Fisher's Exact	df	p-value
H_0	Libraries in HEIs in Zambia have adopted of FOSLMS not because they perceive FOSLMS to be easy to use	52.43	2	.000
H_0	Libraries in HEIs in Zambia have adopted FOSLMS not because of management support	28.71	2	.000
H_0	Libraries in HEIs in Zambia have adopted FOSLMS not because they perceive FOSLMS to work well	.57	2	.751
H_0	Libraries in HEIs in Zambia have adopted FOSLMS not because of social influence.	21.14	2	.000

The above Chi-square test of independence shows that variables such as ease of use, management support, and social influence have an influence on the adoption of FOSLMS in HEIs, and the findings are in line with theoretical expectations. However, the assumption that FOSLMS performs better than commercial library systems had a p-value of .751, which was far above the set level of confidence. In this regard, the null hypothesis was not rejected; it entails that there is no association between the performance of FOSLMS and their adoption in HEIs in Zambia. This implies that libraries in HEIs in Zambia have adopted FOSLMS not because of the perception that they perform better than commercial library management systems but because of the other four factors.

4.7 Implementation of FOSLMS in HEIs

In terms of who the libraries in HEIs engaged to install FOSMLS, 18 (42.84%) libraries reported that they had hired private individuals to do the installation, while 13 (30.95%) libraries used local ICT staff to install FOSMLS. Furthermore, 6 (14.28%) libraries indicated that they hired private companies to do the installation of FOSLMS, 1 (2.38%) respondent installed FOSLMS on his/her own while 4 (9.52%) did not know who installed FOSLMS as the respondents were not working for the HEIs at the time of FOSLMS installation as shown in Figure 22.

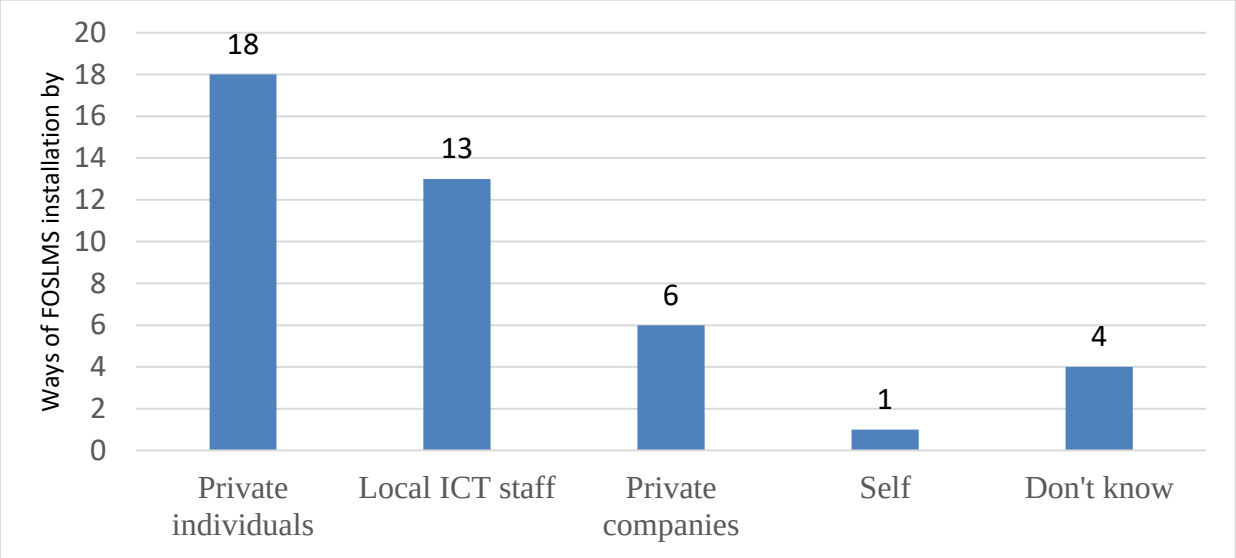

Figure 22: Installation of FOSLMS

The research findings have shown that many 33 (78.57%) respondents indicated having received training after the installation of FOSLMS while 9 (21.42%) did not receive training. On how the library staff received training on how to use FOSLMS, many (64.28%) of respondents indicated receiving training from companies/individuals engaged to install FOSLMS. This entails that the company/individual hired to install FOSMLS had to train the library staff on how to use the FOSLMS installed. Others also cited learning the use of FOSLMS through workshops, college/university and international training as depicted in Table 42 below.

Table 42: Ways librarians in HEIs Received Training on the use of FOSLMS

SN	Receiving training on the use of FOSLMS	Yes	No	Total
1	Company/person that installed FOSLMS	27 (64.28%)	15 (35.71%)	42 (100%)
2	Workshops	15(35.71%)	27(64.28%)	42 (100%)
3	Colleges/Universities	8 (19.04%)	34 (80.95%)	42(100%)
4	International Training	3 (7.14%)	39 (92.85%)	42(100%)

4.8 Benefits of Using FOSLMS

Respondents whose libraries have adopted FOSLMS were asked to rate their level of agreement regarding benefits accrued to them since the adoption of FOSLMS. A five Likert scale with strongly agree (SA), agree (A), disagree (D), strongly disagree (SD) and do not know (DK) choices was used. The results presented in Figure 23 below show that majority (71.4%) of the respondents strongly agreed (SA) that adopting FOSLMS had enabled them to save money by not paying

licence fees; 71.4 per cent of the respondents also strongly agreed (SA), that adoption of FOLSMS has enabled them achieve efficiency and effectiveness in managing their library resources. Further, 59.5 per cent of library staff whose libraries have adopted FOSLMS agreed (A), that adoption of FOSLMS had enabled them provide more reliable library services and 54.8 per cent the respondents agreed (A), that adoption of FOSLMS had enabled them to provide online library services. However, the other two possible benefits of FOSLMS such as implementation copy cataloguing and provision of external services received low scores as in Figure 22.

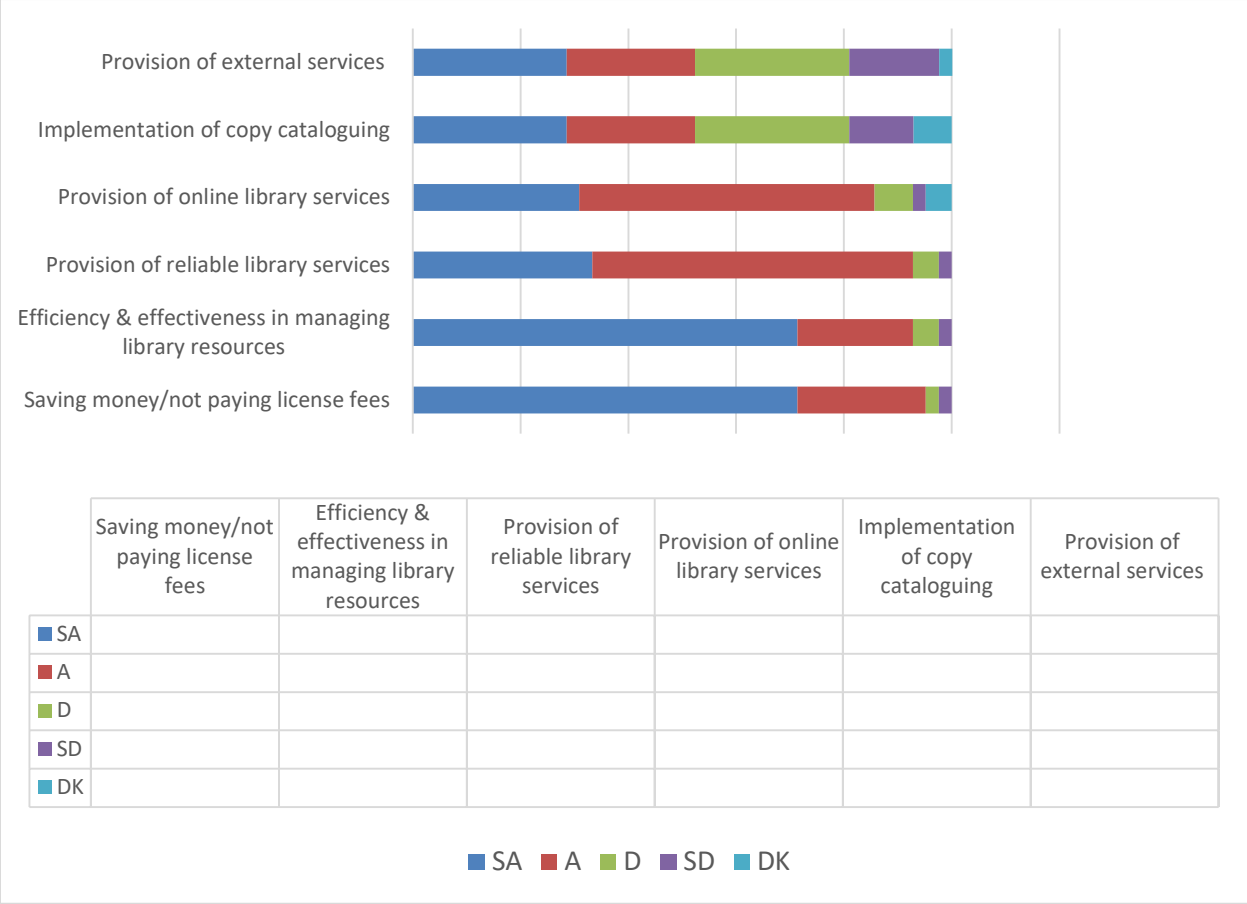

Figure 23: Benefits of Using FOSLMS

The 42 respondents with libraries that had reported using FOSLMS were asked to rate the performance of FOSLMS. All the respondents favourably rated FOSLMS; 21 (50%) indicated that FOSLMS performance had been excellent, 19 (45.23%) reported that the performance of FOSLMS was good while 2 (4.76%) thought FOSLMS performance had been fair as depicted in Figure 23.

Figure 24: Rating the Performance of FOSLMS

4.9 Challenges of Using FOSLMS

As reported in the literature review, any technology's adoption is not free of challenges. In this vein, the researcher asked the respondents, particularly the 42 who had indicated adopting FOSLMS, if they had any challenges in using it. In this regard, 23 (54.76%) respondents reported experiencing some challenges in using FOSLMS, while 19 (45.23%) indicated not having any challenges. The challenges listed by respondents included having difficulties in upgrading the system, challenges in backing-up the database, system crashing, and difficulties in recovering the system once crushed. Other challenges included difficulties in using modules found in FOSLMS, network problems, and lack of technical support. When the challenges were ranked, difficulties in using FOSLMS emerged top, followed by network problems as shown in Table 43.

Table 43: Challenges Using FOSLMS

SN	Challenge	Frequency	Percent (%)
1	Difficult to upgrade	2	4.8
2	Difficult to back up the database	2	4.8
3	Systems crushed and have difficult recovering	4	9.5
4	Difficult using it	6	14.3
5	Network problems	5	11.9
6	Lack of Technical support	4	9.5
7	N/A	19	45.2
Total		**42**	**100.0**

Further, the 42 respondents were asked to indicate the extent to which they strongly agreed (SA), agreed (A) or disagreed (D) and strongly disagreed (SD) with the eight (8) statements on the challenges of using FOSLMS. Further, an option for do not know (DK) was also provided. On the issue of libraries having difficulties using FOSLMS because of lack of trained personnel, many respondents supported the statement as 12 (28.6%) respondents strongly agreed and 19 (42.9%) agreed with the statement as seen in Table 42. However, on the other seven (7) statements on the challenges of using FOSLMS, many respondents disagreed with the statements. For instance, 26 (61.90%) respondents disagreed with the assertion that FOSLMS were not reliable and 9 (21.42%) strongly disagreed. Further, 23 (54%) respondents disagreed with the statement that FOSLMS were difficult to use and 14 (33.33%) strongly disagreed. In the other remaining assumed challenges of FOSLMS, more than half of the respondents disagreed and strongly disagreed with the assertions as captured in Table 44 below.

Table 44: Challenges Associated with FOSLMS in General

SN	Statements on FOSLMS	SA	A	D	SD	DK
1	Lack of personnel that is trained	12 (28.6%)	19 (42.9%)	9 (23.8%)	1 (2.38%)	0 (0.00%)
2	Difficult to get technical support	7 (16.66%)	11 (26.19%)	17 (40.47%)	6 (14.28%)	1 (2.38%)
3	Difficult to migrate bibliographic data to FOSLMS	7 (16.66%)	7 (16.66%)	24 (57.14%)	0 (0.0%)	4 (9.52%)
4	Complex and user-unfriendly	0 (0.0%)	5 (11.9%)	23 (54.8%)	14 (33.3%)	0 (0.0%)
5	FOSLMS are not reliable and lack warranty	2 (4.76%)	5 (11.90%)	26 (61.9%)	9 (21.42%)	0 (0.0%)
6	FOSLMS high maintenance and hidden costs	2 (4.76%)	6 (14.28%)	20 (47.61%)	12 (28.57%)	2 (4.76%)
7	FOSLMS are easily discontinued	1 (2.38%)	14 (33.33%)	18 (42.85%)	6 (14.28%)	3 (7.14%
8	Inadequate documentation	1 (2.38%)	12 (28.60%)	23 (52.40%)	6 (14.38%)	0 (0.0%)

4.10 Summary of Chapter 4

In summary, 142 out of 154 HEIs participated in the study. This constituted a response rate of 92 per cent. Many of the HEIs that participated in the study were colleges of education, followed by TEVET colleges. A relatively high number of respondents (44.36%) came from libraries in private HEIs and that 52.81 per cent of the respondents came from small-to-medium-sized libraries. In terms of the gender of the respondents, majority (58%) were female while 42 per cent were male and that 52 per cent of them were below the age of 35.

As regards the job titles of the respondents, a considerable high percentage (44%) of the respondents was librarians. Further, many (33.07% and 31.69%) of respondents were reported to hold Diploma and Bachelor's degree qualifications in LIS, respectively. Majority (80%) of respondents described their library collections as a mixture of current and outdated materials, and that collections were largely in print format.

In terms of library automation, 54 (38%) of the 142 surveyed libraries were found to have automated their operations. As regards the use of FOSLMS in library automation, 42 (77.77%)

libraries out of 54 libraries were using FOSLMS. It was revealed also that colleges of education, followed by universities had adopted FOSLMS more than other types of HEIs in Zambia, and that libraries from HEIs that were exclusively run by government had adopted FOSLMS more than those that were quasi-government or privately-owned. As regards to the library functions that have been automated by HEIs using FOSLMS, cataloguing and circulation were cited to be the most automated library functions.

The research findings further shows that Koha was the widely used FOSLMS among the surveyed HEIs in Zambia, as 41 (97.61%) out of 42 libraries used it. OpenBiblio was found to be used by only one TEVET college in HEIs in Zambia. Koha's adoption among HEIs reached its pick in 2016 when 10 (24.39%) libraries in HEIs adopted it.

Further, the research findings have also shown that the 42 libraries that reported using FOSLMS adopted it because of many reasons, but the principal reason was that of cost. All (42) libraries that had adopted FOSLMS in HEIs believed that FOSLMS was cheaper, compared to commercial library management systems. Other reasons cited for adopting FOSLMS included the understanding that FOSLMS were easy to use, HEIs management's support towards FOSLMS and that FOSLMS were widely used by other libraries in Zambia. However, the assertion that FOSLMS perform better than any other type of library management system was not supported by the research findings as many respondents did not agree with it. To confirm these research findings, a Chi-square test of independence was performed on four factors (variables), namely; ease of use, better performance, management support and social influence with exclusion of the cost factor (which was constant as all respondents agreed to it). The results of the test were significance in three varibales; there was a relationship between the three factors, namely; ease of use, management support and social influence, and the adoption of FOSLMS in HEIs. The test results in the factor that FOSLMS perform better was not significance; there was no relationship between performance and adoption of FOSLMS in HEIs in Zambia.

The research findings in this chapter have also revealed that a considerable high percentage (42.85%) of the surveyed libraries in HEIs engaged private individuals and companies to install FOSLMS. Further, the findings of the study have shown that majority (64.28%) of the respondents

received training on how to use FOSLMS in their libraries from the private persons or companies that were engaged to provide consultancy by HEIs.

In terms of the benefits that have accrued to libraries that have adopted FOSLMS, majority (95.23%) of respondents indicated that the use of FOSLMS had resulted in their libraries saving some financial resources that would otherwise have been spent on paying licence fees for commercial library management systems. Further, 92.85 per cent of respondents believed that the use of FOSLMS by their libraries had brought about efficiency and effectiveness in the management of library resources. The other benefit cited to have accrued to libraries using of FOSLMS, include provision of online and reliable library services. The research findings have also established that all (42) libraries were satisfied with the performance of FOSLMS.

On whether or not libraries in HEIs experience challenges in using FOSLMS, more than half (54.76%) of libraries from 42 libraries that have adopted FOSLMS reported having some challenges. The main challenge was difficulty in using the modules found in FOSLMS. Other challenges cited included poor internet connectivity, crushing of FOSLMS, lack of technical support, difficulties in upgrading and backing-up FOSLMS databases.

CHAPTER 5: DISCUSSION OF RESEARCH FINDINGS

5.0 Overview of the Chapter

This chapter discusses the research findings presented in chapter 4 by interpreting what they meant in relation to what was discovered in the literature review on the subject of free and open source library management systems (FOSLMS) adoption in higher education institutions (HEIs). It begins by briefly looking at the findings in terms of the characteristics of respondents; thereafter, it discusses the findings according to the research objectives and questions.

5.1 Characteristics of the Respondents

As captured in chapter 4, the respondents in this study were 142, and of which more than 58 per cent were female. This is because female library professionals head many libraries in HEIs in Zambia. This seems to be a global trend as regards the gender of library professionals managing libraries; women make up the majority of the workers in librarianship in many countries. For instance, in 2010, the American Library Association (ALA) conducted a study, which revealed that 82.8 per cent working librarians in the USA were female (Mars, 2018).

Many respondents for the study came from colleges of education, followed by TEVET colleges. Ideally, the TEVET sector, which has a large number of colleges, was expected to contribute more respondents to the study. Unfortunately, many colleges in this sector exist without libraries; they provide technical and vocational training without functioning libraries. The situation however is different with colleges of education; majority of these colleges have functioning libraries. For instance, all (12) public colleges of education have libraries. Further, a considerable high number of privately-owned colleges of education have libraries or a resemblance of a library. This is because colleges of education whether public or privately-owned in Zambia, are mandated by the Higher Education Act of 2013, to affiliate their programmes to any public university (The Higher Education Bill, 2013). In this regard, many colleges of education seek affiliation with the University of Zambia (UNZA), which insists on among other requirements, the existence of a functioning library, thus compelling many colleges of education to set up libraries before affiliated with UNZA.

Furthermore, many respondents (110) had qualifications in the domain of library and information science (LIS) ranging from Certificate to Doctoral degree. Majority had Diplomas and Bachelor's

degrees in LIS. The higher number of respondents in HEIs libraries with a qualification in LIS is attributed to the fact that Zambia was among the first countries in Africa to begin offering Library Science training. For instance, the University of Zambia, Department of Library and Information Science was established in 1967 with support from UNESCO and began training librarians at Certificate, Diploma and Bachelor degree levels. Later in 2006, post-graduate programmes in LIS were introduced to train librarians at Master's and Doctoral Degree levels. Further, in 1980, Zambia Information and Communication Technology College (ZICTC), formerly Zambia Postal and Telecommunication College began admitting Zambians to pursue a Certificate in LIS (Note that ZICT College's library training was meant for Namibian refugees who were staying in Zambia at that time). In 1990, Evelyn Hone College for Applied Arts also began offering a Certificate programme in LIS, and in 1999, it began offering a Diploma programme in LIS (Mulauzi & Njobvu, 2018).

5.2 The Use of Free and Open Source Library Management Systems in Library Automation in Higher Education Institutions in Zambia

The first objective of the study sought to establish the extent to which FOSLMS were used in library automation by HEIs in Zambia. The research findings revealed that the use of FOSLMS was widespread, considering the fact that 42 out of the 54 HEIs that indicated having automated their operations were using FOSLMS. In percentage terms, the use of FOSLMS stands at 78 per cent among libraries in HEIs that have automated their operations. This implies that only a small percentage (22%) of libraries in HEIs is using commercial library management systems (CLMS). These research findings are contrary to the research findings by Adera (2013) on the adoption of FOSLMS in Kenya, which showed a 50 per cent-50 per cent distribution in the use of FOSLMS and CLMS by libraries. Nine libraries surveyed were found to be using FOSLMS, and nine others were found to be using CLMS, thus creating a tie as regards the use of CLMS and FOSLMS in library automation.

The fact that 54, out 142 libraries have automated their operations shows that Zambia still has a huge backlog of libraries in HEIs that have not automated their operations. This implies that 88 (62%) libraries in HEIs have not automated their house-keeping operations, and only 38 per cent have automated their operations. The low level of library automation is not only unique to higher education sector in Zambia but also to other sectors in the country. Further, the low level of library

automation mirrors what is happening in other sub-Saharan African countries. As observed in the literature review, libraries in sub-Saharan Africa for many years, have remained behind in the sphere of library automation (Mutula, 2012; Khoma, 2003). According to Rosenberg (2006), the International Network for Advancing Science and Policy (INASP)'s research findings in 2006 among 107 universities in sub-Saharan Anglophone countries (excluding South Africa) revealed that 16 (15%) of the libraries surveyed were automated. On the contrary, in developed countries, library automation that began in the 1960s, today, it is finished business. Libraries in developed countries are now pursuing new frontiers of knowledge, in areas such as innovation laboratories, provision of decentralised and specialised library services.

Even libraries in Asia have done far much better than African libraries in the area of library automation. For instance, a study conducted by Balu and Reddy (2014) in Kanakarta State, in India, among 236 polytechnic colleges libraries revealed a high level of library automation. In this study, 150 libraries (63.56%) were found to have automated their operations. This is a sharp contrast with the research findings in HEIs in Zambia, where only 38 per cent of the libraries have automated their operations. Although, the study in India focused on library automation in one sector of higher education, it however depicts a picture on how widespread library automation is in India.

The findings of the study points to the widespread use of FOSLMS in HEIs. The fact that 78 per cent of libraries in HEIs in Zambia have automated their libraries activities using FOSLMS shows that the use of FOSLMS is relatively widespread and that it will certainly continue to increase as more libraries automate their operations.

The high number of libraries in HEIs that have automated their operations using FOSLMS is partly attributable to librarians' awareness of the existence of FOSLMS. As presented in chapter 4, 90 (63%) of the library staff interviewed were aware of the existence of FOSLMS. Awareness of FOSLMS is critical in their adoption. However, some respondents who claimed to be aware of the existence of FOSMLS, had difficulties in identifying systems that qualified to be FOSMLS. For instance, library systems such as ABCD, Evergreen and OpenBiblio were deemed not to be FOSMLS by many respondents; they were considered commercial library management systems.

On the other hand, many respondents successfully managed to identify Koha as FOSMLS; this implies that Koha is the most known FOSMLS among HEIs librarians in Zambia.

It is imperative also to mention that the level of awareness of the existence of FOSLMS was higher among respondents with Bachelor's degree and better qualifications in LIS. Respondents with Certificate and those who did not possess any qualification in LIS exhibited low levels of awareness about FOSLMS as in Table 34. This implies that the higher the level of education in LIS attained, the more knowledge one acquires in LIS and FOSLMS in particular.

Furthermore, the research findings have shown that academic studies and workshops have been the main sources of knowledge on FOSLMS among many respondents. In this regard, the University of Zambia, through the Department of Library and Information Science, has mainstreamed library automation using FOSLMS in its under-graduate programme. This seems to have paid dividends, as many students have become aware of the existence of FOSLMS. Further, Library and Information Association of Zambia (LIAZ) and Zambia's co-operating partners (Indian Government, INASP and VVOB) have been conducting training and workshops on the use of FOSLMS to automate libraries' operations. These too seem to be bearing fruits as regards library professionals being aware of the existence of FOSLMS. It has also been observed that Library and Information Science schools in Zambia that offer librarianship training at Diploma and Certificate levels have not incorporated FOSLMS in their curricular, as evidenced by a high number of respondents with such qualifications showing ignorance of the existence of FOSLMS (Table 34). The ignorance level about FOSLMS is higher with Certificate holders standing at 63 per cent which points to a complete blackout on FOSLMS in the curricular. A quick check on the curricular for Certificate and Diploma programmes from ZICT and Evelyn Hone Colleges, respectively, confirms the absence of modules on FOSLMS. The absence of FOSLMS in their curricular largely contributes to the lack of knowledge on FOSLMS by the graduates of these two programmes. The issue of lacking modules on FOSLMS in LIS Certificate and Diploma programmes is not peculiar to Zambia only as many Diploma and Certificate qualifications in sub-Saharan African countries lack modules on FOSLMS. For instance, a Diploma in Library and Information Science from University of Namibia too has no module on FOSLMS.

The research findings have shown that FOSLMS is widely used among libraries from colleges of education and universities. For example, 14 and 13 colleges of education and universities, respectively, reported automating their libraries' basic functions using FOSLMS. It is important also to point out that only one college of education was using a commercial library management system. On the other hand, a considerable high number (7) of universities surveyed were using commercial library management systems. Follow-up interviews with some universities still using commercial library management systems revealed that leadership in some of those universities was skeptical of FOSLMS; it doubted FOSLMS's performance capabilities and reliability. The findings on the type of HEI that have adopted FOSLMS more than the others in Zambia are contrary to study conducted by Makori and Mauti (2016) on the use of FOSLMS in Kenya, where universities not colleges of education dominated the use of FOSLMS in library automation. Furthermore, the study alluded to above established that TEVET colleges in Kenya were in a second position as regard the adoption of FOSLMS, in library automation. Similarly, studies on the use of FOSLMS in Ethiopia and Uganda showed universities leading other types of HEIs in the use of FOSLMS (Marshall Breeding, 2017; ETHIOKOHA, 2011; Buwule & Ponelis, 2015). The study findings on the use FOSMLS in Zambia by HEIs also show a considerable high number of TEVET colleges using FOLMS; 11 out of 13 of TEVET colleges that have had automated their operations were found to be using FOSLMS (Figure 19). This is remarkable and it is similar to what Marshall Breeding 2017 technology report on the use of FOSLMS in Kenya reported, in which TEVET colleges' libraries were strongly using FOSLMS to automate their operations.

A detailed analysis of the findings on the type of HEIs that have adopted FOSLMS more than others, reveals a pattern in which HEIs that are fully-owned by government dominating the use of FOSLMS. In this regard, 21 exclusively government run HEIs were using FOSLMS compared to 11 and 10 quasi-government and privately-run HEIs, respectively (Figure 19). This pattern was observed in Ethiopia where majority of the HEIs that have adopted FOSLMS were government-run (ETHIOKOHA, 2011). This however is contrary to the findings by Makori and Mauti (2016); Marshall Breeding, (2017) in Kenya, which showed that the use of FOSLMS was not dominated by HEIs from the public sector but from the private sector. Similarly, a check on the website called Ugandan Libraries Forum shows more libraries from privately-owned HEIs using FOSLMS than government run HEIs (Ugandan Libraries Forum, 2017).

In Zambia, the high number of government-run HEIs using FOSLMS could be due to many reasons. This includes the fact that public HIEs are the most automated type of HEIs, hence, their using FOSMLS more than other types of HEIs. Secondly, government or quasi-government HEIs in Zambia are privileged to receive training support from cooperating partners in the name of improving service delivery. For many years now, librarians from government or quasi-government HEIs have been receiving scholarships in FOSLMS from the Indian and Belgian governments through the ITEC programme and VLIR/UOS programmes, respectively. Some cooperating partners such as VLIR/UOS and VVBO have not only provided training to libraries HEIs in Zambia but also financial support. The training scholarships in FOSLMS and financial support have empowered librarians from government-run HEIs, hence many more HEIs that are publicly-owned automating their operations using FOSMLS than their counterparts that are privately-owned. Other reasons that could be driving publicly- owned HEIs to use FOLSMS more than any other type of FOSLMS is decreased funding due to poor performance of the Zambian economy (International Monetary Fund, 2019). Public HEIs in Zambia therefore are receiving little or no funding from government, hence libraries in public HEIs turning to FOLSMS for library automation.

5.3 The Most Used Free and Open source Library Management Systems in Higher Education Institutions

This study also sought to determine the name of FOSLMS that is widely used among HEIs in Zambia. In this regard, the findings have revealed that Koha is the most widely used FOSLMS in HEIs libraries; it was found to be used by 41 (97.61%) of libraries that have automated their operations using FOSLMS. On the other hand, OpenBiblio was found to be used by only one HEI; in this case, a government-owned TEVET HEI. These findings are significant because they confirm the findings of many studies reviewed in chapter 2, that found Koha to be the most used FOSLMS in libraries today. For example, in Nigeria, Koha was found to be widely used by 66.7 per cent of the 36 surveyed academic libraries (Kari & Baro, 2014). Further, Koha was found to be used by 28 (48.2%) of the 58 surveyed university libraries in Nigeria (Uzomba, Oyebola & Izuchukwu, 2015). Studies in Kenya also showed that Koha was widely used as 67 per cent of libraries surveyed indicated (Adera, 2013). Similarly, in Ethiopia, Koha was found to be widely used (ETHIOKOHA, 2011; Marshall Breeding, 2017). Nine (9) public HEIs in Ethiopia have

automated their operations using Koha as depicted by Table 11. Very few HEIs in Ethiopia are using other FOSLMS such as ABCD in library automation. However, in India, Koha is battling dominance with NewGenlib. Both Koha and NewGenlib are widely used in India (Kampa, 2018). This is contrary to the study findings in HEIs in Zambia where Koha is the widely used FOSLMS.

There are several reasons that could explain why Koha is widely used among HEIs in Zambia. Principal among them is the fact that many librarians from HEIs have received training on how to automate library operations using Koha. As already indicated, the Indian government through the ITEC programme has long been providing an international short training on how to automate library operations using Koha for librarians from HEIs in developing countries, and Zambia has benefited from this training. This has made Koha to be adopted by many libraries in HEIs in Zambia. Furthermore, Koha has been well publicised by many stakeholders; literature and videos on Koha have been uploaded on the Internet by many people and organisations that promote Koha. For instance, Koha community.org and ByWater Solutions have been publishing videos and other materials on the Internet, explaining how Koha works, thus making Koha a well-known FOSLMS. Another reason that has made Koha to be widely used FOSLMS in HEIs in Zambia is because it is taught to the Bachelor's degree students in LIS at the University of Zambia, hence helping marketing it. Furthermore, Koha has a big community of users in Zambia, thus continuing attracting more libraries. According to Rankin (2014), a good free and open source software should have a large community of users and developers. Koha has a good number of users in Zambia. This makes many libraries in HEIs to be comfortable with Koha, hence adopting it more than any other FOSLMS. The other reason is that Koha is perceived to perform better, compared to other FOSLMS, as it has more modules compared to OpenBiblio and other FOSLMS available on the market. These modules mirror the functions of HEIs libraries. Further, Koha's modules are needed by large libraries from HEIs, hence its adoption by many libraries in HEIs in Zambia.

As captured in Figure 21, the peak year for Koha adoption in HEIs in Zambia was in 2016, when 10 HEIs adopted Koha. However, the number of libraries in HEIs adopting Koha is declining. This reduction could be attributable to many factors, which include the economic meltdown the country is facing. Prior to 2016, the Zambian economy was growing above 4 per cent Gross Demotic Products (GDP) and government had money to spend even on social sectors such as libraries. After 2016, the economy began shrinking, and in 2019, the International Monetary Fund (IMF) reported

that the Zambian economy would grow at 2 per cent and that the debt stork for the country had risen to USD 18 billion (International Monetary Fund, 2019). This has squeesed public spending, as budgets have been cut in many sectors of the economy, including libraries. Even if Koha is FOSLMS, for a library to implement library automation with Koha, it has to buy necessary infrastructure such as servers and computers. Further, in many cases, libraries need to engage a consultant to help them install, customise Koha and train staff on how to use it. Since there is little money in circulation, very few libraries are now implementing library automation in HEIs in Zambia.

5.4 Factors Influencing the Adoption of Free and Open source Library Management Systems

As indicated in the proposed theoretical framework, five variables, taken from various theories on technology adoption were considered to be the main factors influencing the adoption of FOSLMS in HEIs in Zambia. These were ease of use, low cost of adoption, management support, system performance and social influence. The research findings in Table 40 of chapter 4 showed that four (4) factors have had a bearing on the adoption of FOSLMS in HEIs in Zambia. The variable (factor) cost stood out to be the key factor motivating libraries in HEIs to adopt FOSLMS. For instance, all (42) respondents in the study indicated that their libraries decided to adopt FOSLMS because they were cheaper than commercial library management systems. This is in line with the proposed theoretical framework in which low cost of adoption was purported to be a factor influencing the adoption of FOSLMS in HEIs in Zambia. As observed in the proposed theoretical framework, economic factors which include the cost of adopting any technology influences its adoption. The lower the adoption cost, the more people and organisations are likely to adopt the technology (Al-Ghaith, Sanzogni & Sandhu, 2010). The low cost of adoption explains the increase in the number of libraries in HEIs that have adopted FOSLMS. The fact that many libraries in Zambia and other countries do not have enough financial resources to spend on building collections and pay for commercial library automation systems, the adoption of FOSLMS is the only alternative left for them (Nagia, 2012; Kisanjara & Tossy, 2014). Commercial library automation systems are expensive for many libraries in developing countries to afford, hence, switching to FOSLMS. This is true in the case of HEIs in Zambia in the sense that many HEIs are failing to sustain paying the subscription fees for commercial library systems, and are now switching to FOSMLS. The research

findings have shown that out of the 12 HEIs libraries that were found to be using commercial library systems, six of them expressed their intention to migrate to FOSLMS. The main reason cited is the high cost of licence fees for commercial library management systems. This entails that the number of libraries in HEIs in Zambia switching to FOSLMS will keep on increasing. For example, one public university library, which for many years had been using a named commercial library management system, and that at the time of data collection for this study was still using the said commercial system has completely migrated to Koha. This is because it has become unsustainable for the library to continue paying licence fees of not less than USD 50,000.00 per year.

It has also been observed that many libraries in HEIs that wish to automate their operations for the first time, are opting for FOSLMS because the cost of adoption is much lower than that of commercial library management systems. As articulated in chapter 2, the use of FOSLMS is not accompanied by licence fee payments as the systems are devoid of such charges (Rankin, 2014). A library may only pay consultancy fee if it has no in-house staff with skills to install and configure FOSLMS. In this regard, many HEIs in Zambia are automating their operations for the first-time, using Koha and not commercial library system.

Other factors proposed in the theoretical framework such as perceived ease of use, management support, and social influence were also found to be influencing the adoption of FOSLMS in HEIs in Zambia. On the variable perceived ease of use, many libraries (36) that have adopted FOSLMS indicated that they had adopted FOSLMS because they considered them (FOSLMS) to be easy to use. A Chi-square test of independence on this variable returned a p-value of .000 which prompted the rejection of the null hypothesis. This entails that librarians who manage libraries in HEIs in Zambia believe that FOSLMS were easy to use, hence, adopting them. As observed by Rodgers (2005), a trailable of innovation reduces uncertainty among adopters. In this regard, it can be argued that libraries in HEIs tested FOSLMS and established that the systems were user-friendly before adoption. This however seems to contradict the widely held belief that it was difficult to use any free and open source software because its complex and lack technical support. According to Invest Northern Ireland (2018), many FOSLMS lack ease to use graphical user interfaces, making it difficult for people to use them with ease. The research findings that FOSLMS are easy to use could be true in the sense that the current versions of FOSLMS such as Koha and OpenBiblio

are easy to use as compared to the free library software that existed in the early 1990s. For instance, CDISIS, which is the first free library system was considered to be complicated to use; librarians needed to create different tables, mirroring the functions of a library and that its graphical user interface was complex, making it problematic for system users to navigate. This is not the case with Koha and OpenBiblio. Once a system is installed, all the tables called modules are created. The graphical user interfaces too are user-friendly.

Management support also received favourable responses as a factor influencing the adoption of FOSLMS in HEIs in Zambia. As indicated in the proposed theoretical framework and the reviewed theories on the adoption of technology, management support influences the adoption of any given technology (Al-Ghaith, Sanzogni & Sandhu, 2010; Mamary, Shamsuddin & Aziati, 2014). Management decides or endorses the adoption of any technology and provides the necessary support. A Chi-square test of independence on this factor returned 0.000 P-value, thereby rejecting the null hypothesis which assumed that the adoption of FOSLMS in HEIs is without management support. As observed in the proposed theoretical framework and in the theory of information systems adoption in Yemen by Mamary, Shamsuddin and Aziati (2014), organisational factors such top management support has a bearing on the adoption of any technology in an organisation. There is overwhelming evidence in this study that management support has a strong influence in the adoption of FOSLMS in HEIs in Zambia. Management support in this regard was expressed by purchasing of computer hardware, hiring a consultant to help implement FOLSMs in libraries where local skills were a challenge by management. Management of HEIs also supported librarians to attend training locally and abroad on the use of FOSLMS to automate library operations (MESVTEE and VVOB, 2013).

The research findings have further shown that social influence is playing a big role in the adoption of FOSLMS by HEIs in Zambia. Many respondents (28) felt that they adopted FOSLMS because other libraries in the country were using FOSLMS. This variable was tested and a 0.00 p-value was obtained, thereby rejecting the null hypothesis. Like suggested in the proposed framework and argued in UTAUT 2 by Venkatesh, Thong and Xu (2012), social influence helps in the adoption of new technology. In this regard, it can be contended that libraries in HEIs in Zambia network, and share information with each other. In this regard, if one library adopts FOSLMS, other libraries will get to know and, follow suit. More importantly, older and bigger libraries have influence on

new and small HEIs libraries in Zambia. New HEIs learn from the old HEIs and copy the technologies and systems in use by the old libraries. Further, social influence in Zambia is indirectly being actualised through the Library and Information Science Association of Zambia (LIAZ), which for many years has been conducting workshops on the use of FOSLMS such as Koha in library automation. In this case, many libraries in HEIs feel compelled to adopt the technology recommended by their Association. This was true in the case of HEIs libraries adoption of FOSLMS in Uganda. According to Adoma and Shama (2015), the Consortium of Uganda University Libraries (CUUL) recommended and encouraged the adoption of Koha in all Ugandan libraries and arranged training for its members in 2011.

The findings in chapter 4 however refute the assertion that libraries adopted FOSLMS because they perform better than commercial library management systems. In this regard, over 71 per cent of the respondents did not believe that FOLSMS performed better than commercial library management systems, hence their adoption in HEIs in Zambia. The p-value of the Chi-square test of independence obtained on this variable was higher (0.751) than the 0.05 level of significance set for the test, hence, failing to reject the null hypothesis. This nullifies the assertion made in the proposed theoretical framework that system quality influences the adoption of FOSLMS in HEIs in Zambia. The implication of this finding is that the adoption of FOSLMS in HEIs in Zambia is not influenced by the fact that they perform better than commercial systems. One could agree with this finding because some FOSLMS face many problems, which hamper their performance. These problems include bugs. According to Handy (2012), free and open- source software has more bugs than commercial software. Open source software such as Linux kernel, PHP and PostgreSQL were reported to have bugs that affect their performance. This was also one of the reasons advanced by some of the 12 respondents who had indicated that they were still using a commercial library management system not FOSLMS; they thought FOSLMS were unreliable. This however does not imply all FOSLSMS perform badly; some FOSLMS are mature and their performance is at par with renowned commercial library management systems in the industry. Koha is one of FOSLMS that has matured and has earned a good performance record as it has a huge community of users and developers, who quickly identify and attend to any bugs identified; usually patches are created which are installed to resolve the problems.

5.5 Benefits Accrued to Libraries in Higher Education Institutions for Using Free and Open Source Library Management Systems

One of the major benefits of using FOSLMS, which is documented in literature, is that of saving financial resources. In this regard, many (71.4%) respondents positively agreed that the use of FOLSMS had resulted in them saving some money which otherwise would have been spent on paying licence fees if they had been using commercial library management systems. As observed Morshed (2008), the use of commercial library management systems by libraries subjects them to an endless spending of money to pay commercial software vendors. Failure to do so, results in a library being barred from using the system. Definitely, any library that has automated with FOSLMS saves money; and the benefit of saving money could be claimed by libraries that have been using commercial library management systems before migrating to FOSLMS because they ceased paying annual subscription fees. It should be stated here that the use of FOSLMS does not mean a library stops investing in the system. There is need to invest in maintenance of the system by upgrading the infrastructure to support the ever-changing FOSMLS. There is also need to continuously train staff because FOSLMS such as Koha are released every six months, therefore, staff have to be abreast of the features of the newly released FOSLMS. Alternatively, a library can enter into support agreement with a company or individual for the provision of support to FOSLMS, to ensure smooth running of the system. In the USA, big companies such as ByWater Solutions have been established to provide support at a fee to libraries using Koha. The fact that there is continued investment is FOSLMS implies that libraries will continue to spend some money to ensure smooth running of FOSLMS. However, the maintenance cost of FOSLMS is still far much lower than that of commercial library systems.

It has also emerged that the use of FOLSMS in libraries in HEIs in Zambia has resulted in efficiency and effectiveness in the provision of library services. Majority of the respondents (71.4%) attested to the fact that their libraries had witnessed change as regards the efficiency and effectiveness. One may submit that library automation using either commercial or FOSLMS could result in efficiency and effectiveness in the manner a library manages its operations. However, for many librarians in HEIs in Zambia, who for long have been operating manually, could not shy from highlighting this benefit because library automation with FOSLMS has enabled them to be effective and efficient.

Many respondents indicated that since the time their libraries automated their operations, they were able to know materials that were overdue and due for weeding. According to Ngozi, Nwachukwu and Uloma (2014), library automation enables libraries to carry out many other things, including weeding of the collection. Further, library automation in HEIs in Zambia has enabled libraries to track the movement of library materials because circulation is no longer done manually, as check-in and check-out of library materials are done through the system, and in this case, FOSLMS. Further, libraries in HEIs in Zambia are able to generate various reports when needed. Reports on various issues that pertain to library operations are generated at the stroke of the button. FOSLMS such as Koha and OpenBiblio provide for the generation of various reports; these include usage, acquisition, overdue and users' reports. This has resulted in the libraries providing better and improved services to their user communities.

The research findings in chapter 4 show that more than 50 per cent of libraries have begun the provision of online library services because of the implementation of library automation with FOSLMS. As observed by Ngozi (2012), the birth of open source software in the present age has made the transition from traditional to technology-based library services. Many FOLSMS such as Koha allow for the provision of online library services. Many libraries in HEIs in Zambia claim to provide online library service such as online reservation, self-circulation, online current awareness and online references services after automating their operations using FOSMLS. However, follow-up interviews with libraries that claimed to be providing online library services revealed that not all online services were provided by HEIs in Zambia. For instance, no library that has automated its operations with FOSLMS provides self-circulation; they all do not allow their users to serve themselves by checking out and checking in the library materials without assistance of library staff. This is because library staff in HEIs do not think their clients are disciplined enough to exercise such latitude. Library officials fear that library users can be abusing the system by perpetuating the use of a particular library resource if deemed useful to their studies. Follow-up interviews also revealed that many libraries in HEIs in Zambia did provide online reference and current awareness services. It has however also been established that online reservation service is provided by some libraries in HEIs. In this case, libraries have enabled functionality in FOSMLS such as Koha to allow their users to reserve a library material that is out or loaned to another user.

Implementation of copy cataloguing is another benefit of library automation with FOSLMS such as Koha. With library automation, it is also feasible for a library to provide external services such as Google maps and Amazon book images. The findings in chapter 4 show that over 60 per cent of libraries provide such services. Further, investigations on some libraries revealed that copy cataloguing and external services were not implemented by many libraries in HEIs in Zambia. Follow-up interviews revealed that some libraries do not import bibliographic records from bigger libraries using Z39.50 protocol; they were still cataloguing library materials from the scratch. Others went to the Web OPAC of bigger libraries such as British Library and Library of Congress, to search for bibliographic records and then manually enter the records into the Koha system. It was also discovered that the provision of external library services such as Amazon book images in HEIs in Zambia is limited to a few libraries that have enabled such as service in Koha. This entails that many HEIs libraries that have automated with FOSLMS such a Koha, have not maximised on the benefits of using Koha to automate their operations.

5.6 Challenges Libraries in Higher Education Institutions Face in the Use of Free and Open Source Library Management Systems

The research findings in chapter 4 have shown that the use and adoption of FOSLMS in HEIs in Zambia is not without challenges. More than half (54.76%) of the respondents that have adopted FOSLMS indicated having challenges. From the challenges listed by respondents, the issue of library staff struggling to use FOSLMS came out prominently. Many library staff in HEIs seemed to have difficulties using the modules found in the installed FOSLMS to facilitate the management of their libraries. Modules that were cited to pose challenges to library staff include budgeting, serials and reporting. This seems to contradict the findings in the same chapter 4, in which many respondents indicated that they adopted FOSLMS because it was easy to use. It follows that if the system is easy to use, many people cannot have difficulties to grasp how it works. For one to use installed FOLSMS to manage his or her library, he or she requires just basic computer skills. The issue of having difficulties in using FOSLMS can only arise if the library staff was not sufficiently trained on how to use the new system. Surprisingly, many (78.57%) respondents whose libraries have adopted FOSLMS, indicated having received training after the installation of FOSLMS by either the hired company or person. Some indicated that they had received training on FOSLMS, especially Koha, when they were doing their academic studies in the university or through

workshops. However, the fact that many people still have challenges to operate or use FOSLMS may suggest that probably the training was not adequate or the trainees themselves never took the training seriously. This is a bad state of affairs as regards the adoption of FOSLMS in HEIs in Zambia. Failure by many library staff to have sufficient skills on how to use FOLSMS installed in their libraries risks making FOSLMS white elephants. This definitely results in underutilisation of FOSLMS, HEIs in Zambia may not fully benefit from FOSLMS, as some of the services that come with FOSLMS have not been enabled.

The issue of network problem emerged in the study as another major challenge to the adoption of FOSLMS in HEIs in Zambia. This challenge is not only applicable to libraries that have adopted FOSLMS but also to libraries that are using commercial library management systems. There is a persistent problem of failure of computer networks; both the Internet and Intranet have been cited not to be stable, thereby posing a challenge to the library staff and users in accessing FOSLMS installed on the servers. As Chisenga (2006) observes, sub-Saharan Africa still has Internet connectivity challenges. Despite Zambia having many Internet Service Providers (ISPs), the quality of service provided is still not very good, it becomes unreliable during the rainy season. Some of the HEIs in Zambia that have adopted FOSLMS have campuses which have branch libraries. The installation of Koha in these HEIs has been done at the Centre and the branch libraries are connected to the Centre through the Internet. This implies that in case the Internet fails, the libraries in branches will fail to access the library system, thus, unable to transact with the system (FOSLMS).

Other challenges cited are difficulties in upgrading and backing up of FOSLMS. The issue of upgrading and backing up of FOSLMS especially Koha, requires, library staff to have some technical skills. Like observed by Kurmar and Thomas (2009), many libraries do not have staff with technical skills to be able to administer FOSLMS such as Koha. Many respondents in HEIs in Zambia complained that they have had difficulties in upgrading and backing up FOSLMS. For one to be able to upgrade FOSLMS, especially Koha, which is widely used in HEIs in Zambia, he or she has to have Linux command skills. Many librarians in Zambia do not have Linux skills because the Library Science curricular does have ICTs courses and they are devoid of modules in Linux. This makes it difficult for the library staff that are ill-qualified to upgrade Koha and manage the backups. As a result, many HEIs have failed to upgrade their Koha installations in many years;

they are still using the old versions. A physical check on some Koha installations in HEIs in Zambia, has revealed that many libraries were still using the old version of Koha installed (versions 3.10 and 3.12) when the latest version as at 17 February 2020 was Koha 19. 11, released on 19 December, 2019. Further, failure by libraries to learn how to back-up Koha has resulted in some libraries in HEIs losing their library records when the system crashes. As a result, some libraries have ended up starting all over again after the system crashes or remains without a library management system in place.

Many respondents that reported to be using FOSLMS in chapter 4 also pointed out that they had difficulties seeking technical support when they had problems with FOSLMS. This was in line with what was reported by Adoma and Ponelis (2015), Muruli and Kumar (2014) in their studies on the adoption of Koha among academic libraries in Uganda and India; their findings highlighted the lack of technical support as one of the challenges the adopters of Koha were facing. Many respondents cited lack of technical support, both during and after the implementation of the system. It is common for the developers of free and open source software not to provide technical support to the users, and this is one of the major weaknesses of FOSLMS. However, technical support for various FOSLMS can be obtained from forums of such systems. For instance, Koha has an active forum where one could ask for technical assistance if he/she is facing problems. Further, Koha and other FOSLMS have sufficient documentation and videos on how to trouble-shoot some aspects of the system if it is not working well. In other countries, companies have been established to provide technical support at a fee to who will be users of FOSLMS such as Koha.

5.7 Summary of Chapter 5

In this chapter, it has emerged that the use of FOSLMS in HEIs in Zambia is widespread as 78 per cent of libraries in HEIs that have automated their operations have done so using FOSLMS. These findings have contradicted the study findings in Kenya that revealed that the use of FOSLMS was at par (50%) with the use of commercial library management systems in library automation. It has also emerged that the high number of libraries in HEIs in Zambia using FOSLMS is due to among other reasons, high-level of awareness on the existence of FOSLMS among library staff in HEIs, and increased training (local and international) on how to use FOSLMS in library automation.

It has also become clear that colleges of education use more FOSLMS than any other type, and that publicly-owned HEIs lead the way in the use of FOSLMS in library automation, partly because government-owned HEIs have been the recipients of many international training scholarships on FOSLMS. The fact that colleges of education dominate the use of FOLSMS in HEIs in Zambia departs from studies conducted in Kenya and in which universities not colleges of education were found dominating the use of FOSLMS.

It has further emerged that Koha has been the most popular FOSLMS among libraries in HEIs in Zambia. These findings collaborate with the findings of other researchers in Kenya, Ethiopia and Nigeria in which they established that Koha was the most used FOSLMS in those countries. Koha was not only popular among HEIs but also among other types of libraries. The reasons educed for Koha's popularity in Zambia among HEIs include good marketing strategies of Koha by its promoters. Further, Koha is popular in Zambia because it is seen by many organisations as being a mature library management system, and that it has modules that mirror the operations of many HEIs libraries. In Zambia, Koha is taught to LIS undergraduate students at the University of Zambia, which has also pushed up Koha's popularity. It has also been established that the reduction in the number of libraries in HEIs in Zambia adopting Koha is partly due to the poor performance of the Zambian economy, which has resulted in lack of funding to HEIs, thus affecting projects in libraries such as library automation.

In this chapter, it has become clear that the adoption of FOSLMS is influenced mainly by the fact that the adoption cost of FOSLMS is much lower compared to commercial library management systems. However, the use of FOSLMS does not imply that an organisation ceases investing in the adopted library management system. In this regard, even HEIs that initially were using commercial library management systems are migrating to FOSLMS.

On the benefits of using FOSLMS, it emerged that some of the benefits claimed to have accrued to the adopters of FOSLMS had not taken place. For instance, it was established that many libraries in HEIs did not provide online services such as self-circulation, online reference services and current awareness. Further, limited external services such as Amazon Book Images had been implemented by some libraries after the installation of FOSLMS. However, some services such as

online reservation, copy and cataloguing had been actualised by some libraries that were using FOSLMS such as Koha.

The challenges discussed in this chapter include library users having difficulties using FOSLMS. Considering the high number of respondents who indicated having problems using FOSLMS such as Koha, it was concluded that maybe the trainings to library staff after the installation FOSLMS were not adequate or the library staff did not take the trainings seriously as they were expected. Further, challenges such as poor network being faced by libraries in HEIs in their use of FOSLMS was attributed to unstable Internet service being provided by Internet Service Providers to HEIs in Zambia. Other challenges such as difficulties in upgrading and backing up of FOSLMS being experienced by libraries in HEIs were attributed to the lack of in-depth ICT skills among librarians. It was established that many library staff in HEIs in Zambia lacked Linux skills, which are required to back-up and upgrade FOSLMS such as Koha.

CHAPTER 6: CONCLUSIONS AND RECOMMENDATIONS

6.0 Overview of the Chapter

This chapter seeks to draw conclusions on various research objectives of the study. The chapter also presents recommendations in light of the research findings for possible implementation in the higher education sector in Zambia.

6.1 Conclusions Drawn on Various Objectives

As indicated in chapter 1, this study had six specific objectives that sought to address the problem of the study. These were to establish the extent to which libraries in higher education institutions (HEIs) use free and open source library management systems (FOSLMS), establish the type of HEIs that have adopted FOSLMS, determine factors that influence the adoption of FOSLMS in HEIs, establish the benefits accrued to libraries in HEIs for using FOSLMS, identify challenges HEIs libraries face in the use of FOSLMS and develop a module to explain the successful adoption of FOSLMS in HEIs.

The study was quantitative in design, which employed a complete census of all 154 HEIs with functioning libraries. However, data was collected from only 142 HEIs, out of the 154 HEIs. On all the above objectives, the following conclusions have been drawn.

6.1.1 The Use Free and Open Source Library Management Systems in Higher Education Institutions

The research findings have shown that the use of FOSLMS in HEIs in Zambia is relatively wide spread. This is because out of the 54 HEIs that had automated their operations, 42 (78%) of the libraries that had automated their operations were using FOSLMS. The fact that 78 per cent of libraries that have automated their operations have done so using FOSLMS entails that the use of FOSLMS in HEIs in Zambia is widespread. The findings have further shown that many libraries in HEIs had not automated their operations; 88 (62%) libraries in HEIs have not automated their operations. This entails that a large number of libraries in HEIs operate manually.

Further, it has been established that colleges of education and universities use FOSLMS more than other types of HEI. In this regard, 15 colleges of education and 14 universities, respectively were found to have automated their operations using FOSLMS. Nursing schools are the least in terms

of adoption of FOSLMS with only five (5) libraries using FOLSMS in library automation. Further, the findings have concluded that more government-owned HEIs have automated their operations than their counterparts that are quasi-government and privately-owned. As captured in chapter 4, 21 (50%) of government-run HEIs libraries were reported to be using FOSLMS; and 11 (26.19%) of quasi-government HEIs were found to be using FOSLMS while 10 (23.80%) of libraries in privately- owned HEIs were found to be using FOSLMS. These findings have been partly attributed to the fact that librarians in government-owned HEIs were privileged to receive training scholarships in library automation with FOSLMs from cooperating partners such as the Indian and Belgian governments.

6.1.2 The Most Used Free and Open Source Library Management Systems in Higher Education Institutions

On which FOSLMS is widely used in library automation in HEIs in Zambia, it has been established that Koha is the most used FOSLMS; 41 out of the 42 HEIs that have automated their operations use Koha. It has been revealed that Koha is popular because it is well publicised because both local and international workshops and training are centred on it. Other reasons contributing to Koha's popularity include the fact that Koha is taught to under-graduate students pursuing a Bachelors of Art degree in library and information science at the University of Zambia, and that Koha is believed to have all the basic modules needed for the operations of libraries in HEIs. It has been also established that OpenBiblio is not widely used; it is used only by one HEI in the country. Other FOSLMS such as ABCD, Evergreen, NewGenLib, PMB and SLiMS are not used in HEIs in Zambia.

6.1.3 Factors Influencing the Adoption of Free and Open Source in Library Management Systems in Higher Education Institutions

On the factors influencing the adoption of FOSLMS in HEIs, cost has been cited to be the principal factor. All the 42 respondents indicated that FOSLMS were cheaper than any commercial library management system. As a result, many libraries in HEIs are adopting FOSLMS. Other factors cited to have influence on the adoption of FOSLMS and have been tested using Chi-square test of independence are perception that FOSLMS were ease to use, management support towards the adoption of FOSLMS and social influence. Many respondents thought that FOSLMS were ease to use and that management support influenced the adoption of FOSLMS. It also emerged that some

HEIs in Zambia have adopted FOSLMS because of influence of other libraries that earlier adopted FOSLMS. However, the assumption that libraries adopt FOSLMS because they perform better than commercial library management systems was not supported by the research findings and Chi-square test of independence.

6.1.4 Benefits Accrued to Libraries in Higher Education Institutions for Using Free and Open Source Library Management Systems

Numerous benefits have accrued to libraries that have automated their operations using FOSLMS. Principal among the benefits is financial saving and improved efficiency in the management of libraries. Many (71.4%) respondents believed that the use of FOSLMs had resulted in the libraries saving some financial resources which otherwise could have been spent on paying subscription fees if they were using commercial systems. They also indicated the use of FOSLMS had resulted in efficiency and effectiveness in the way library resources were managed. Other benefits identified to have accrued to libraries in HEIs for using FOSLMS include the provision of some online library services such as online reservation and copy cataloguing. However, it was established that FOSLMS were not fully being utilized. Many modules found in FOSLMS such as Koha were not being used. As a result, many online services are not being provided by HEIs libraries.

6.1.5 Challenges Libraries in Higher Education Institutions Face in Using Free and Open Source Library Management Systems

It has been established that more than half of the libraries in HEIs in Zambia face challenges in their use of FOSLMS. It emerged that many library staff had problems using FOSLMS. This could arise because of inadequate training received after the installation of FOSLMS. The findings of the study have also shown that intermittent Internet connectivity is affecting libraries in HEIs in Zambia that have branch libraries connected to FOSLMS installed on servers at centres. In case of Internet connectivity failure, library staff and users in branch libraries are unable to access library management systems and services provided by their respective libraries. Other challenges established include difficult in upgrading and backing up FOSLMS.

6.2 Recommendations

There are many stakeholders of libraries found in HEIs. These include the Ministry of Higher Education (Higher Education Authority (HEA), Technical and Vocation Training Authority (TEVETA), Ministry of General Education (Teaching Council of Zambia (TCZ)), the Ministry of Health (Nursing Council of Zambia (NCZ)), Library and Information Association of Zambia (LIAZ) and Library Information Science Schools in Zambia. Other important stakeholders of libraries in HEIs are individual management teams that run HEIs. In view of the various stakeholders identified, recommendations are specifically addressed to these stakeholders as follows:

6.2.1 Government Ministries in Charge of Higher Education Institutions

The Ministry of Higher Education, Ministry of General Education and Ministry of Health and their authorities and councils such as HEA, TEVETA, TCZ and NCZ, should implement the following recommendations**:**

(i) Since Zambia as a country does not have a national policy regarding the use of free and open source software (FOSS), the ministries of Higher Education, General Education and Health should lobby for the development and implementation of a national policy that promotes the use of FOSS as it is the case in countries such as Brazil and India. This will increase the use of FOSS in the country, thus, accelerating the use of FOSLMS in library automation in libraries in HEIs.

(ii) HEA, TCZ, NCZ and other institutions that accredit training institutions in the higher education sector should ensure that all libraries in HEIs are automated. Library automation should be one of the requirements for accreditation of programmes offered by HEIs in Zambia. This will help in increasing the use of FOSLMS in library automation in HEIs in Zambia, thereby improving efficiency in the provision of library services.

(iii) The ministries of Higher and General Education (The Government) in Zambia should consider opening up international training scholarships to librarians from privately-owned HEIs. Currently, only librarians serving in government HEIs are allowed to apply for various international training scholarships the government of the Republic of Zambia receives from cooperating partners. This will empower librarians in privately-owned HEIs to take up library automation with FOSLMS, hence increasing library automation footprints in HEIs.

6.2.2 Management of Higher Education Institutions

As observed in the research findings, management in various HEIs plays a vital role in ensuring that projects such as library automation with FOSLMS are successfully implemented. In this regard, management in HEIs should:

(i) Ensure that whoever is contracted to provide consultancy on the installation of FOSLMS in libraries does not only install the system but also adequately trains the end-users, who are library staff on how the system works and how to upgrade and back-up the system.

(ii) Retrain library staff on how to operate the installed FOSLMS in their libraries on regular basis. This will enable the library staff to utilise fully the installed FOSLMS.

(iii) Improve the Internet services provision to HEIs in Zambia. In this regard, management in HEIs should strive to provide Internet service that is reliable and stable in order to ensure continuous access to FOSLMS installed at the centre by branch libraries.

(iv) Continue investing in the adopted FOSLMS. There is need to continue upgrading both the hardware and software. Further, there is need to continue investing in the retraining of library staff because FOSLMS keep on improving and changing.

6.2.3 Library and Information Association of Zambia and Library Science Schools

Library and Information Association of Zambia (LIAZ) and Library Science Schools in Zambia are some of the major stakeholders in the library sector, as such they play a very pivotal role. They provide training to librarians on various issues, which include library automation. In order to increase the uptake on FOSLMS in library automation in HEIs, LIAZ and Library Science Schools in Zambia should implement the following:

2.15.1.1 Raise awareness about the existence of other FOSLMS such as ABCD, Evergreen, NewGenLib, PMB and SLiMS. The findings of the study have shown that Koha is the most widely known and used FOSLMS in library automation in Zambia. Other FOSLMS that are as good as Koha are not known because there is a lack of publicity about them in Zambia. These will enable libraries in HEIs to have a wider choice of FOSLMS for library automation.

2.15.1.2 Library schools that have no modules on FOSLMS in their curriculum should revise their curricular to incorporate FOSLMS. This will ensure that all LIS graduates (Certificate, Diploma and Degree holders) have knowledge about FOSLMS.

2.15.1.3 LIAZ should intensify its Continuous Professional Development (CPD) programmes by conducting training workshops among librarians in Zambia on how to use Koha and other FOSLMS to automate library operations.

6.3 Model for Successful Adoption of FOSLMS in Higher Education Institutions in Zambia

After testing of factors that were purported to drive the adoption of FOSLMS by libraries in HEIs in Zambia, four variables have emerged to be key drivers. These are low cost of adoption, perceived ease of use, management support, and social influence. In this regard, libraries in HEIs in Zambia are choosing to adopt FOSLMS because they perceive FOSLMS to be cheaper than commercial library systems in terms of adoption cost. The adoption of FOSLMS among libraries in HEIs in Zambia is also being influenced by the perception that FOSLMS are relatively easy to use. Furthermore, libraries in HEIs are adopting FOSLMS because management in HEIs provides support. Social influence is also playing a big role in the adoption of FOSLMS among libraries in HEIs in Zambia as libraries are being influenced by other libraries or the association of librarians in Zambia to adopt FOSLMS.

The findings of the study have also shown that the adoption of FOSLMS in HEIs is marred with a number of challenges which include inadequate training of staff, lack of technical support, and unreliable internet connectivity. These are adoption environmental factors which if not provided or made available could negatively affect the adoption of any technology. For the successful adoption of FOSLMS to place in HEIs, there is a need to adequately pay attention to the adoption environmental factors. In this regard, the successful adoption of FOSLMS in HEIs in Zambia is dependent on adequate training of end-users (the library staff) for them to successfully use all the modules found in FOSLMS. There is also a need for HEIs to ensure the provision of reliable internet connectivity to ensure that FOSLMS installed on servers is accessed by client computers. Furthermore, for HEIs in Zambia that do not have adequate ICT staff who are competent in FOSLMS, there is a need to seek FOSLMS technical support from local companies and individuals offering consultancy services in library automation with FOSLMS. It is also imperative to state that the first two (2) adoption environmental factors are mandatory; all HEIs have to ensure adequate training and provision of reliable internet connectivity to ensure ease access and use of FOSLMS installed on servers. Technical support environmental factor is

optional; it is optional if the HEI has ICT staff with technical skills in FOSS and in particular FOSLMS. Having identified and tested the drivers of FOSLMS adoption in HEIs in Zambia, and challenges (environmental factors) that affect the adoption of FSOLMS by libraries in HEIs, a model in Figure 25 below has been developed to explain the successful adoption of FOSLMS in HEIs in Zambia.

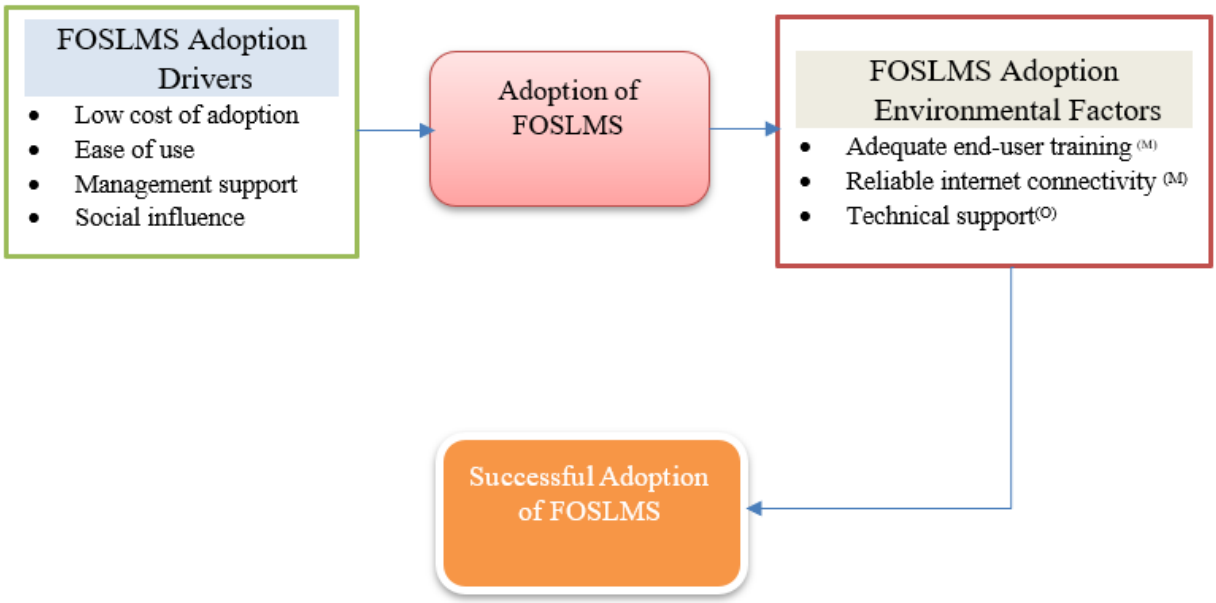

Figure 25: Model for the Adoption of FOSLMS in HEIs in Zambia

6.4 Summary of Chapter 6

It has been concluded that free and open source library management systems (FOSLMS) are widely used among libraries in higher education in Zambia that have automated their operations and Koha is the most used FOSLMS. It has also been concluded that the major driver for the adoption of FOSLMS in HEIs is the lower cost of adoption and that among other benefits that have accrued to libraries that have automated their operations include financial savings and improved service provision. It has further been concluded that many libraries that have automated their operations using FOSLMS face challenges which include difficulties using FOSLMS and unreliable internet connectivity.

Given the challenges established, several recommendations have been advanced which include urging the Government of Zambia to formulate a policy that promotes the use of FOSS in Zambia. Other recommendations include the provision of adequate user training to librarians by HEIs

management and the Library and Information Association of Zambia (LIAZ) on how to use FOSLMS. It has also been recommended that Library Science Schools that do not have modules FOSLMS review their curricula to incorporate such a module. Furthermore, a model to ensure the successful adoption of FOSLMS in HEIs has been developed; this will guide libraries that wish to adopt FOSLMS.

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APPENDIXES

Appendix 1: Information and Communication Technologies Courses in Selected Library Science Degrees in Southern and Eastern Africa

Name of University	Country	ICTs Courses Available
Makerere University	Uganda	• Information Technology I • Information Technology II • Database Management and Information Retrieval • Web Document Management • Multimedia Librarianship • Automation of Library and Information Systems • Management of Electronic Resources
Moi University	Kenya	• Introduction to Information Technology • Computer Applications • E-Business • ICTs in Records and Archives Management I • Structured Programming • Systems Analysis and Design • Operating Systems Theory • Data Communication • Database Construction and Management • Web Design and Development • Management Information Systems • Digital Library Management • Management of Information and Communication Technology
University of Namibia	Namibia	• Desktop Publishing • Web Development • Systems Analysis, Design and Evaluation • Specialised Information Systems • Digital Librarianship
University of Zambia	Zambia	• Introduction to Information and Communication Technologies • Application of ICTs in Information Management
University of Zulu Land	South Africa	• Computer Literacy for Information Studies • Electronic Publishing • Computer Literacy for Information Studies 2
University of Western Cape	South Africa	• Information Technology and Computer Literacy

		• Databases and Networks • ICT Application in LIS • World Wide Web
University of Botswana	Botswana	• IT tools and Applications • Digital Libraries • Databases and Information Retrieval • Principles of Data Communication • Advanced IT Applications • Database Management Systems and Design • Global Information Systems
Zimbabwe Open University	Zimbabwe	• Introduction to Computers • Information Retrieval and Database Management Systems Database Management Systems • Management of Electronic Resources • Production and Publishing • ICT Tools and Applications for Libraries and Information Centres

Appendix 2: Questionnaire

Dear Respondent,

My name is Tuesday Bwalya, currently pursuing a Doctoral degree of Philosophy in Library and Information Science (PhD) at The University of Zambia. I am carrying out a research on the use of Free and Open Source Library Management Systems in Higher Education Institutions in Zambia.

You have been selected to participate in this study by answering this questionnaire. I would be very grateful if you could attempt to answer all the questions to the best of your knowledge. You must also be assured that the information that will be collected through this questionnaire, will be kept confidential and used purely for academic purpose.

Note: For multiple choice questions, just **tick** the answers of your choice.

Thanking you in advance,

Bwalya Tuesday

SECTION A: BACKGROUND INFORMATION OF THE RESPONDENT

1. Gender

   (a) Male [ ] (b) Female [ ]

2. Age

   (a) 15 – 24 [ ] (b) 25 – 34 [ ] (c) 35 – 44 [ ]

   (d) 45 – 54 [ ] (e) 55+ [ ]

3. What is the name of your Organisation?

   ……..

4. What is your current job title?

   …….

5. How long have you been working for your Organisation/Library?

   ……..

6. Do you have any academic qualification in Library and Information Science?

   (a) Yes [ ] (b) No [ ]

7. If Yes to Q6, what is your highest academic qualification?

   (a) Certificate [ ] (b) Diploma [ ] (c) Bachelor's Degree [ ]

   (d) Master's Degree [ ] (e) Doctoral Degree [ ]

8. If No to Q6, what qualification do you hold?

   ……

SECTION B: BACKGROUND INFORMATION OF THE HIGHER EDUCATION INSTITUTION/LIBRARY

9. In which Province of Zambia is your Organisation found?

……

10. What type of higher learning institution is your Organisation?

(a) TEVET College [ ] (b) College of Education [ ]

(c) School of Nursing [ ] (d) University [ ]

11. Who owns the higher education institution you work for?

(a) Government [ ] (b) Private [ ]

(c) Government/Private [ ]

12. How long has the library been in existence in this higher learning institution?

……

13. How many people work in the library?

(including yourself) ……..

14. What is the estimated number of the library users?

(including staff and students) …….

15. What is the estimated size of the library collection?

……

16. In what format is your collection?

(a) Print [ ] (b) Electronic [ ] (c) Both [ ]

17. How would you describe your collection?

(a) Very current [ ] (b) Current [ ] (c) Outdated [ ]

18. What is your major source of acquiring library materials?

(a) Purchase [ ] (b) Donations [ ] (c) Both [ ]

19. Do you have computers reserved for use by library users?

(a)Yes [ ] (b) No [ ]

(If No to Q19, skip Q20 and Q21)

20. If Yes to Q19, how many computers do you have?

……..

21. Are the computers for library users connected to the Internet?

(a) Yes [ ] (b) No [ ]

22. How would you describe the funding of the library by the parent Organisation?

(a) Excellent [ ] (b) Very good [ ] (c) Good [ ]

(d) Fair [ ] (e) Poor [ ]

SECTION C: ADOPTION OF FREE AND OPEN SOURCE LIBRARY MANAGEMENT SYSTEMS

23. Are you aware that there are library management systems that you can use without paying license fees?

(a) Yes [ ]

(b) No [ ]

(If No to Q23 skip Q24 and Q25)

24. If Yes to Q23, tick from the listed library management systems that you can use without paying license fees? **(Please tick as many as apply)**

(a) Liberty5 [ ]

(b) Koha [ ]
(c) OpenBiblio [ ]
(d) Evergreen [ ]
(e) SirsiDynix [ ]
(f) ABCD [ ]
(g) Alice [ ]
(h) Others specify……

25. How did you get to know about the existence of Free and Open Source Library Management System?

……

26. Are you using any library management system to manage your library?

(a) Yes [ ]
(b) No [ ]

*(*If NO to Q26, stop answering the questionnaire*)*

27. If Yes to Q 26, what is the name of the library management system you are using in your library?

(a) ABCD [ ]
(b) Evergreen [ ]
(c) Liberty 5 [ ]
(d) Koha [ ]
(e) OpenBiblio [ ]
(f) Unicorn [ ]
(g) Others (specify……..

28. How long have you been using the mentioned library management system?

……..

29. Tick the library housekeeping activities you have automated using the said library management system.

(a) Circulation [ ]
(b) Cataloguing [ ]
(c) Acquisition [ ]
(d) Reports generation [ ]
(e) Budget tracking [ ]
(f) Catalogue [ ]
(g) Serial management [ ]

Others (specify) ……

30. What type of library management system do you use?

(a) Commercial [ ]
(b) Free and Open Source [ ]
(c) Others Specify…….

(If Commercial, answer Q31, Q32, Q33 and Q34 and stop answering the questionnaire)

31. If commercial, how much did you pay for your last subscription in US Dollar?

……..

32. Explain why you preferred to use commercial library management system instead of a Free and Open Source Library Management System.

……

33. Are you contemplating switching to a Free and Open Source Library Management System?

(a) Yes [ ]
(b) No [ ]

34. Please explain the reasons for your answer to Q33

……

SECTION D: REASONS AND BENEFITS OF USING FREE AND OPEN SOURCE LIBRARY MANAGEMENT SYSTEMS
*(***The following sections should be answered only by libraries that have adopted Free and Open Source Library Management Systems***)*

35. Answer **ALL** of the following statements about the reasons for adopting Free and Open Source Library Management System (FOSMLS) at your Library.

Reasons your library adopted FOSMLS	YES	NO
i. FOSMLS is cheap compared to commercial system		
ii. FOSMLS performs better than commercial system		
iii. FOSMLS is widely used among big libraries in Zambia		
iv. FOSMLS is easy to use		
v. Resources for adopting FOSMLS were provided by management		

36. Before you started using the current Free and Open Source Library Management System, was the Library using any other library management system?

(a) Yes [ ]
(b) No [ ]

37. If Yes to Q 36, what was the name of the library management system?

……

38. Who was engaged to install the Free and Open Source Library Management System at your Library?

(a) Local Staff [ ]
(b) Private Individual [ ]
(c) Private Company [ ]
(d) Others (specify)……

39. Did you receive any training on how to use the Free and Open Source Library Management System?

(a) Yes [ ]

(b) No [ ]

40. If Yes to Q 39, how did you receive the training?

(a) Company/person engaged to install the system trained us [ ]

(b) Attended workshop/s [ ]

(c) Attended international training/s [ ]

(d) Learnt the software in University/College [ ]

(e) Others specify……

41. Answer **ALL** the statements below about the benefits accrued to your Library for the use of Free and Open Source Library Management System (FOSLMS).

Statement	Strongly Disagree	Disagree	Agree	Strongly Agree
i. The use of FOSLMS has resulted in saving money as no subscription is paid				
ii. FOSLMS has enabled the provision of online library services				
iii. FOSLMS has brought about efficiency and effectiveness				
iv. FOSLMS has enabled the library to control its bibliographic records				
v. FOSLMS has facilitated the implementation of copy-cataloguing				
vi. FOSLMS has resulted in the provision of reliable library services				
vii. The use of FOSLMS has resulted in the provision of external services such Book Images from Amazon, and Google maps				

42. How do you rate the performance of FOSLMS you are using?

(a) Very satisfied [ ] (b) Satisfied [ ] (c) Not satisfied [ ]

SECTION E: CHALLENGES FACED BY LIBRARIES IN USING FREE AND OPEN SOURCE LIBRARY MANAGEMENT SYSTEMS

43. Have you ever had any challenges in using Free and Open Source Library Management System?

(a) Yes [ ]
(b) No [ ]

44. If Yes to Q43, state the challenges you have been encountering in the use of Free and Open Management System?

……..

45. To what extent do you agree with the following statements about Free and Open Source Library Management Systems (FOSLMS)?

Statement	Strongly Disagree	Disagree	Agree	Strongly Agree
i. My library has difficulties using FOSLMS because of lack of trained personnel				
ii. It is difficult to get technical support for FOSLMS				
iii. FOSLMS are complex and user-unfriendly				
iv. FOSLMS are not reliable and lack warranty				
v. FOSLMS have high maintenance and hidden costs				
vi. FOSLMS are easily discontinued				
vii. Many FOSLMS do not have adequate documentation				
viii. It is difficult to migrate bibliographic data to FOSLMS				

46. What would you recommend to the challenges you face in using Free and Open Source Library Management System?

……...

Thank you for your cooperation

Appendix 3: Ethical Clearance Letter

THE UNIVERSITY OF ZAMBIA

DIRECTORATE OF RESEARCH AND GRADUATE STUDIES

Great East Road | P.O. Box 32379 | Lusaka 10101 | **Tel:** +260-211-290 258/291 777
Fax: +260-1-290 258/253 952 | **Email:** director@drgs.unza.zm | **Website:** www.unza.zm

Approval of Study

1st March, 2019

REF. No. HSSREC: 2018-AUG-031

The Principal Investigator

Dear Mr Tuesday Bwalya

RE: "The Use of Free Open Source Library Management Systems (FOSLMS) in Higher Education Institutions (HEI) in Zambia: Current Adoption Footprints, Opportunities and Challenges"

Reference is made to your submission. The University of Zambia Natural Sciences Research Ethics Committee IRB resolved to approve this study and your participation as Principal Investigator for a period of one year.

Review Type	Ordinary Review	Approval No. HSSREC:2018-AUG-031
Approval and Expiry Date	Approval Date: 1st March, 2019	Expiry Date: 29th March, 2020
Protocol Version and Date	Version-Nil	-
Information Sheet, Consent Forms and Dates	English.	To be provided
Consent form ID and Date	Version	To be provided
Recruitment Materials	Nil	Nil

There are specific conditions that will apply to this approval. As Principal Investigator it is your responsibility to ensure that the contents of this letter are adhered to. If these are not adhered to, the approval may be suspended. Should the study be suspended, study sponsors and other regulatory authorities will be informed.

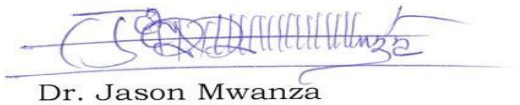
Conditions of Approval

- No participant may be involved in any study procedure prior to the study approval or after the expiration date.
- All unanticipated or Serious Adverse Events (SAEs) must be reported to the IRB within 5 days.
- All protocol modifications must be IRB approved by an application for an amendment prior to implementation unless they are intended to reduce risk (but must still be reported for approval). Modifications will include any change of investigator/s or site address or methodology and methods. Many modifications entail minimal risk adjustments to a protocol and/or consent form and can be made on an Expedited basis (via the IRB Chair). Some examples are: format changes, correcting spelling errors, adding key personnel, minor changes to questionnaires, recruiting and changes, and so forth. Other, more substantive changes, especially those that may alter the risk-benefit ratio, may require Full Board review and approval. In all cases, except where noted above regarding subject safety, any changes to any protocol document or procedure must first be approved by the IRB before they can be implemented.
- All protocol deviations must be reported to the IRB within 5 working days.
- All recruitment materials must be approved by the IRB prior to being used.
- Principal investigators are responsible for initiating Continuing Review proceedings. Documents must be received by the IRB at least 30 days before the expiry date. This is for the purpose of facilitating the review process. Any documents received less than 30 days before expiry will be labelled "late submissions" and will incur a penalty.
- Every 6 (six) months a progress report form supplied by The University of Zambia Humanities And Social Sciences Research Ethics Committee IRB must be filled in and submitted to us. There is a penalty of K500.00 for failure to submit the report.
- The University of Zambia Humanities And Social Sciences Research Ethics Committee IRB does not "stamp" approval letters, consent forms or study documents unless requested for in writing. This is because the approval letter clearly indicates the documents approved by the IRB as well as other elements and conditions of approval.

Should you have any questions regarding anything indicated in this letter, please do not hesitate to get in touch with us at the above indicated address.

On behalf of The University of Zambia Humanities and Social Sciences Research Ethics Committee IRB, we would like to wish you all the success as you carry out your study.

Yours faithfully,



Dr. Jason Mwanza
Vice - CHAIRPERSON
The University Of Zambia Natural Sciences Research Ethics Committee IRB

Cc Director - Directorate of Research and Graduate Studies
Assistant Director – Directorate of Research and Graduate Studies
Assistant Registrar – Research
Senior Administrative officer - Research