# Adoption and Use of Free and Open Source Software (FOSS) Globally: An Overview and Analysis of Selected Countries

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**Abstract**
Institutions, individuals and countries are migrating from commercial software (CS) to FOSS mostly because of two reasons: the increase of costs of purchase and maintenance of commercial software against the backdrop of global economic meltdown, and the increased commitment to open content and technologies in key domains such as research and education. In this regard, some governments have implemented policies that compel government departments, public institutions, and quasi-government institutions to adopt FOSS.
The purpose of this article is to summarise the outcomes of a study of an international team of researchers that explores FOSS adoption and policies in some selected countries across the globe. The study is a desk research and qualitative descriptive in nature. Literature on 13 countries' FOSS policies and adoption was collected and analysed in order to accurately describe the adoption of FOSS in the selected countries.
The study findings show that many countries have adopted FOSS because it is less costly in comparison to commercial software. Furthermore, the study identified that countries have approached FOSS policy formulation and implementation in varied ways. In Europe, countries such as Germany, France, Spain, and Sweden have formulated effective FOSS policies that have influenced many public institutions to migrate to FOSS. In North America, the study reveals that the United States of America (USA) does not have a Federal policy on FOSS. However, some states have formulated policies that support the use of FOSS. Despite not having Federal policy on FOSS, some Federal departments in the USA use FOSS. In South America, Brazil has been found to be a leader in adopting FOSS; the Federal government of Brazil launched its FOSS policy in 2003. This has resulted in many state institutions adopting FOSS. In Asia, governments of China, South Korea and India have launched policies making it mandatory for all state institutions to use FOSS. In Africa, some countries have formulated policies to support FOSS; these include South Africa and Tanzania. FOSS policies in these two African countries give preference to FOSS in the procurement of software in public institutions but these countries still rely on commercial software which is too expensive for their economies to sustain.

**Key words**: Free and Open Source Software, Software Policies, Public Institutions

## 1. INTRODUCTION

The birth of free and open source software (FOSS) has come as a relief to many countries and organizations which for many years have struggled to procure proprietary software because of prohibitive prices. Many countries' economies are facing a nose dive into recession thus having little or no financial resources to procure proprietary software needed for use in various sectors of their economies. Lack of financial resources is more acute in developing countries which are saddled with many competing needs. These countries cannot afford to spend their meagre financial resources on buying computer software instead of providing basic services such as health, education, water and sanitation. Consequently, in the midst of the prevailing harsh economic conditions and skyrocketing prices of proprietary software, governments in various countries have turned to FOSS as alternative.

### 1.1 History and concept of FOSS

The idea of using, sharing and modifying a software freely can be traced back to 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. This changed fundamentally the automobile industry as many cars with different engines emerged. The concept of developing free and open source computer software, however, did not materialize until the year 1983, when Richard Stallman, who was a researcher at the Massachusetts Institute of Technology (MIT) Computer Laboratory, began a project called GNU and the Free Software Foundation. Richard wanted to promote the concept of free software. According to Jeffrey (2009), Stallman grew sceptical of the commercial software packages that were selling for big bucks at computer stores. He advocated for the introduction of free software whose source codes could be copied or hacked by computer programmers and users to modify in order to improve its performance. This implied that users had absolute freedom to use the software in any way they wished. Free software is seen as a matter of liberty (freedom) not price; it is like *freedom of speech*, not *free beer*. According to Kyle (2014), Stallman described free software as having four characteristics (freedoms); namely:-

i. the freedom to run the program for any purpose,
ii. the freedom to study how the program works and adapt it to your needs,
iii. the freedom to distribute copies so that you can help your neighbor, and
iv. the freedom to improve the program and release your improvements to the public so that the whole community benefits.

Stallman, later launched an open source movement whose first task was to develop an operating system called Unix to counter the growth of a commercial operating system that existed at that time. Stallman and other programmers released the new operating system in 1991 and named it GNU, a recursive acronym for GNU Not Unix (Jeffrey, 2009).

GNU operating system lacked a central component found in all operating systems called kernel. However, Linux Torvalds, who by that time was pursuing a Master's degree in Computer Science at the University of Helsinki in Finland wrote the first kernel as his project and release it under a free license and named it Linux. Linux kernel was paired with the GNU project's development tools and Operating systems (OS) and with the graphical windowing system called X (Kyle, 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 that 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. As a result, Eric S. Raymond and others in consultation with Richard Stall developed the term *open source* as a more business-friendly term than *free software (*Kyle, 2014*)*. Open Source had a more inclusive meaning, in that licenses 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 to the community to coalesce around the term Free Open Source Software (FOSS) to bring the original visions of Stallman and Raymond back together. Others call free software as *Free-Libre Open Source Software* (FLOSS).

### 1.2 Reasons for adopting FOSS

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 the Common Market for Eastern and Southern Africa (COMESA, 2009), one major reason advanced by governments in the adoption of FOSS is the low cost of ownership of the software. COMESA (2009) further points out that members' states such as Mauritius are looking at reducing the cost of ownership of the software and that FOSS is well placed to enable them achieve that. Other reasons cited by COMESA (2009) for the adoption of FOSS are the freedoms associated with FOSS and its secure nature. 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 the 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 are easily identified and fixed. This makes FOSS more secure than proprietary software. Other Scholars such as Sanjeev (2011) argue that FOSS helps countries avoid using unlicensed (pirated) software. This ultimately enables countries to avoid copyright infringement on commercial software owners.

### 1.3 Open Source Software Foundations and Open License Models

FOSS is released under various open source licenses. To coordinate and approve open license models, an organization called Open Source Initiative (OSI) has been established. Open source license models approved by OSI include Apache 2.0, GNU General Public License (GPL) , GNU Library or “Lesser” General Public License (LGPL), BSD 3-Clause "New" or "Revised" license , BSD 2-Clause "Simplified" or "FreeBSD" license BSD, MIT, Mozilla Public License 2.0, Common Development and Distribution License and Eclipse Public License (Open Source Initiative, 2019). There are also foundations that have been set to support specific free and open source software. These include the Free Software Foundation (FSF) started by Richard Stallman in 1985, Linux Foundation (established by Linux Torvalds in 2000 to support Linux Kernel and other Linux software), Ubuntu Foundation (founded in 2005 to promote the other flavor of Linux called Ubuntu) and Free and Open Source Software for Africa, established in 2003 to spearhead the use of free and open source software in Africa (Opensource.com, 2015).

### 1.4 Common Open Source Software

Since the launch of GNU in 1991, FOSS has sprung up. Some of this software is horizontal in nature as they are applicable to many industries (Stephen, Maeve and Army, 2007). Horizontal FOSS includes Apache Server software, Linux operating systems (Ubuntu, Red Hat, Suse etc), Open Office, LibreOffice, and Mozilla FireFox (an Internet browser). On the other hand, vertical FOSS that only applies to specific industries exists. These include MySQL (database Management systems), Koha (library management systems), Dspace (institutional repository software), and xTuple (finance, sales and inventory management software). It is conceivable to find FOSS substitutes for every commercial software today. Below is the table of common FOSS software against commercial software.

***Table 1**: Commonly used FOSS cross-referenced with Commercial software*

| Type of software | Commercial | FOSS |
|---|---|---|
| Word processing | Microsoft Office | LibreOffice and OpenOffice |
| Web browser | Internet Explorer | Mozilla Firefox etc. |
| Music player | Windows Media player | VLC etc. |
| Server | Windows Server | Apache, Lighttpd, etc. |
| Content management system | Dreamweaver | Drupal, Wordpress, Joomla, etc. |
| Library management system | Liberty, SirsiDynix, etc. | Koha, Evergreen, SLIMS etc. |
| Database management system | Oracle | MySQL, PostgreSQL, etc. |
| Operating system | Windows, Macintosh, etc. | Linux (Ubuntu, Red Hat, etc.) |

### 1.5 Research objectives

The study's main objective was to highlight FOSS adoption and policies on some selected countries around the globe. In doing so, the study sought to:-

i. establish the extent to which FOSS is used in the countries under study,
ii. establish if they have been specific savings realized by countries that have adopted FOSS,
iii. determine the existence of FOSS policies in countries under study,
iv. establish if countries under review have FOSS initiatives/projects.

## 2. RESEARCH METHODOLOGY

This study was qualitative in design and employed content analysis method in which literature on national FOSS adoption and policies from the Internet was downloaded and analysed. In this regard, data from 13 countries was collected and analysed (Table 2). Data focusing on the use of FOSS, financial savings emanating from the use of FOSS, the existence of FOSS policies, type of FOSS policies, FOSS initiatives or projects were collected and analysed. The 13 countries were

included in the study because of the availability of information on the Internet on their use of FOSS and policies. Furthermore, the countries selected have been identified to be active in the use and promotion of FOSS (Sanjeev, 2013; Simon and Samuel, 2012; Center for Strategic and International Studies, 2010).

***Table 2**: Selected countries for the study*

| SN | Name of country | Continent of a country |
|---|---|---|
| 1 | Brazil | South America |
| 2 | China | Asia |
| 3 | France | Europe |
| 4 | German | Europe |
| 5 | Great Britain | Europe |
| 6 | India | Asia |
| 7 | Japan | Asia |
| 8 | South Africa | Africa |
| 9 | South Korea | Asia |
| 10 | Spain | Europe |
| 11 | Sweden | Europe |
| 12 | Tanzania | Africa |
| 13 | United States of America (USA) | North America |

## 3. FINDINGS AND DISCUSSIONS

FOSS has for many years suffered from negative publicity by commercial software vendors. Many 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. The negative perception about FOSS has, however, begun to change as more countries are realizing that FOSS is a genuine product that has

both social and economic benefits to society. In this regard, countries are switching to FOSS from proprietary software.

### 3.1 Global perspective of FOSS policies, adoption and initiatives

In some countries, the switch to FOSS is backed by policies. According to the Center for Strategic and International Studies in Samuel and Simon (2012), there are three types of FOSS policies namely: -

*a)* *mandatory*- where the use of FOSS is required or compulsory,

*b)* *preference*-where the use of FOSS is given preference and

*c)* *advisory*- where the use of FOSS is permitted.

There is also another type of FOSS policy which is for research and development (R & D); allows the use of FOSS for research and development.

It is however imperative to mention that FOSS prioritization 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 (Table 3).

***Table 3****: FOSS policy initiatives by world region from 2000–2009*

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

***Source:*** *Government Open Source Policies Center for Strategic and International Studies, 2010*

The above statistics about FOSS policy initiatives were taken nine years ago; they are however valid although there have been negligible dynamics on regions FOSS policies. However, Europe

still leads the rest of the continents. With regards to who uses FOSS the most globally, Github (a web-based repository for open source software) in Yuri and Adrew (2010) shows 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 (Yuri and Adrew, 2010). Africa is trailing behind in these areas as shown in table 4 below. As already indicated, within these continents and regions, there are disparities in the appreciation and support for FOSS among countries.

***Table 4**: Github participation by region (%)*

| **SN** | **Continent/ region name** | Users | Contributors | Contributions | Receivers | Received contributions |
|---|---|---|---|---|---|---|
| 1 | North America | 42.9 | 43.0 | 47.5 | 44.3 | 50.9 |
| 2 | W & N Europe | 25.7 | 27.4 | 27.3 | 26.6 | 26.5 |
| 3 | E & S Europe | 10.6 | 10.5 | 8.4 | 9.9 | 7.4 |
| 4 | Asia | 10.2 | 9.0 | 8.6 | 9.2 | 7.3 |
| 5 | Latin America | 6.4 | 5.5 | 3.6 | 5.4 | 3.2 |
| 6 | Australia & New Zealand | 3.6 | 3.9 | 4.1 | 4.0 | 3.9 |
| 7 | Africa | 0.6 | 0.6 | 0.5 | 0.6 | 0.7 |

***Source:** Yuri and Andrew, 2010*

### 3.2 European countries

Europe is among the top continents which have actively participated in the development, adoption and use of FOSS as evidenced by a large number of FOSS public policies. European society and governments have been supportive of FOSS. As a result, many successful FOSS projects are

domiciled in Europe. For instance, the project to write the Linux Kernel started in Finland. Furthermore, famous content management systems such as TYPO3 and Drupal started in Germany and Belgium, respectively. The support towards FOSS began with its regional body, the European Commission which in 2000 defined a strategy concerning the internal use FOSS and recommended the use of Apache to power its servers in Brussels (Sanjeev, 2013). This bold decision by the European Commission provided the impetus that member countries needed to formulate public policies on the adoption of FOSS. Further, between 2007 and 2011, the European Commission established and approved the European Union Public License (EUPL) which formed the basis for the development of various FOSS foundations such as the Open Source Observatory and Repository for European public administration (OSOR.eu) (Sanjeev, 2013). OSOR.eu has coordinated and promoted the development of FOSS in public sector in Europe.

It is important to mention that despite the European Commission's strong support for FOSS, very few member countries in Europe have explicit policies on FOSS (OSEPA, 2011). 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; individual government departments and units have their FOSS policies which are preference, advisory and R & D in nature. Similarly, the French government has allowed government departments and agencies to determine their FOSS policies. Many of the FOSS policies in France are preference and R & D; however, some departments such as the Paris City Council, and the French Police have mandatory FOSS policies (Centre for Strategic and International Studies, 2010).

In Spain, the promotion and implementation of FOSS is left to individual autonomous governments while the Central government has provided guidelines. Other European countries which are striving to promote FOSS include Sweden which has R & D FOSS policies. Many government departments in Sweden are using FOSS. According to Christos, Vasileios and Tselion (2012), 50% of local authorities in Sweden use FOSS.

The United Kingdom (UK) is not doing well in the promotion and use of FOSS because it has lukewarm policy on FOSS; preference policy. Its FOSS policy states that Government will actively and fairly consider Open source solutions alongside proprietary ones in making procurement

decisions (Cabinet office-UK, 2012). The Government in the UK does not compel state institutions to use FOSS but just encourages them to consider them. This is the reason why the UK does not rank well in the adoption and use of FOSS.

Ubuntu, both Server and Desktop is widely used in Europe. For instance, the Spanish school system has 195,000 desktop computers running on Ubuntu Desktop. Further, the French Police in 2006 replaced Windows operating systems with Ubuntu and a year earlier (2005), it had migrated from Microsoft Office to OpenOffice. This migration by the French Police resulted in serving over 70% of its IT budget. In 2013, Westcliff High School for Girls in the United Kingdom successfully moved from Windows to OpenSUSE (Wikipedia, 2019).

### 3.3 United States of America

North America has been 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 still remains the biggest contributor to the growth of FOSS in the world. Many successful FOSS projects are domiciled in the USA. These include Red Hat, Apache and Evergreen. Cenatic (2010) observes that the USA contributes a large percentage of FOSS initiatives and projects in Northern America than Canada and other countries. Cenatic (2010) further argues that North America suffers from a lack of firm national commitment in the promotion of FOSS; 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. Furthermore, individual Federal departments have FOSS policies which range from advisory to mandatory in nature (Center for Strategic and International Studies, 2010). For instance, the Department of Defense (DoD) had its FOSS policy approved in 2006. Departments within states have the latitude to implement their FOSS policies. It has been observed that most of the FOSS policies in the USA are advisory in nature; meaning that the policies advise the use of FOSS. Other policies promote the use FOSS for research and development (R & D) only.

Many government departments in the USA use FOSS; these include the White House, which migrated its website contents to Drupal from a commercial content management system. The Department of Defence (DoD) also has been reported by MITRE in Sanjeev (2013) to have been using more than 115 FOSS in its operations. Further, 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 their operations too. According to Cenatic (2010), 41% of private companies in the USA use FOSS. The commonly used FOSS are Apache (43%), Tomcat (31.5%) and MySQL (30.7%).

### 3.4 Brazil

In Latin American, Brazil stands out from the rest of 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, 2010). Government launched its mandatory FOSS policy in 2003 thereby compelling all government departments to use FOSSS. The ecosystem of FOSS in Brazil is health with major stakeholders including 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 and that favour the growth and use of FOSS. For instance, 27 states and many cities have passed laws to encourage the adoption and use of free software mainly to build up computer infrastructure (Dominik, Hangjung and Michael, 2009). In addition, the Brazilian government has been initiating FOSS projects ranging from inventory systems to agricultural network and solutions like messenger tools and grid computing tools. Major examples, include CACIC (inventory systems), CONTRA (access control system), SISAU, SACI LIVRE (administration for institutional contents) and Agrolivre (Agriculture network). Furthermore, the Brazilian government has been preaching FOSS by encouraging government departments and units to use it. For example, the Ministry of Education has adopted Linux Debian with its educational applications packages from KDE (Dominik, Hangjung and Michael, 2009). Bank of Brazil adopted Linux servers in 2001. Moreover, the current voting system in Brazil runs on Linux servers (Edgy, 2009).

The private sector in Brazil has been active in the growth of its FOSS ecosystem. According to Dominik, Hangjung and Michael (2009), 73% of private companies in Brazil use FOSS because FOSS is deemed to cheaper. One of the major users of FOSS in the Brazilian private sector is Casas Bahia (a large retail chain store) which uses SUSE Linux Enterprise server. Other private sector players have migrated from commercial software to FOSS. For instance, most companies have migrated from Oracle to MySQL and PostgreSQL database management systems.

Universities in Brazil have contributed significantly to the development of FOSS by teaching FOSS. Many computer and ICT learning institutions in Brazil encourage their students to develop programmes and applications using open source technologies such as JAVA, PHP and Python and

release their programmes under the general public license. In addition, higher institutions of learning in Brazil promote the concept of open access not only to software but also to scholarly works. According to UNESCO (2014), Brazil is the only country in the world with 97% of scholarly works (journals) that are published under open access philosophy.

### 3.5 Asian countries

According to the Centre for Strategic and International Studies (2008), Asia in 2008 had a total of 70 FOSS approved and proposed initiatives. Asia is home to numerous FOSS projects which include Asianux, jointly developed by Red Flag Software of China, Miracle Linux of Japan, Haansoft of South Korea and other Asian countries (Sanjeev, 2013). In Asia, China is not only leading 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. 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 (Sanjeev, 2013).

India has not been left behind, and 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) has launched an ambitious project of turning India into a digital country through the implementation of e-governance. In this regard, the Indian Government considers Open Source software as a means to actualize the concept of digital India. In a bid to support the growth of FOSS, the Indian Government in March, 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. These include BOSS (an Indian version of GNU/Linux), NewGenLib, Creative Computing@ School (an Educational e-journal). Further, 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 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 $16.67 million USA (Opensourcecom, 2016).

South Korea is also doubling its efforts in promoting FOSS through various departmental FOSS policies; all FOSS policies in departments in South Korean are preferential in nature. There is widespread use of FOSS in South Korea. For example, 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 US $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 enabled South Korea to save US$300 million per year (Nir and Andreea, 2007). The development and use of FOSS in South Korea are spearheaded by Korea IT industry promotion Agency (KIPA). KIPA has been supporting the development and use of local FOSS such as Linux. Further, KIPA is funding the development of various FOSS projects such as the National Education Information System (NEIS) used by schools in South Korea to manage students' information. KIPA is also promoting the use of FOSS in universities such as Gangwon University.

Japan has laggard a bit behind in the promoting and use of FOSS. However, it is catching up quickly because the Government has committed itself to promoting FOSS. In 2008, the Central government of Japan announced its R & D FOSS policy aimed at setting in motion the collaboration between the Government of Japan and Linux Foundation to raise awareness on Linux and other open source applications. The Japanese government further announced that it intended to adopt Linux servers as a measure to reduce dependence on Microsoft, thus, reducing costs associated with software procurement in the country (Centre for Strategic and International Studies, 2010).

### 3.6 African countries

According to CENATIC Foundation (2010) cited by Simon and Samuel (2012), Africa is lagging behind in the development and use 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 (Table 5).

***Table 5**: Some African countries and FOSS policy initiatives*

| SN | Country | Availability of FOSS policy | Year policy was adopted | Policy type |
|---|---|---|---|---|
| 1 | Angola | No policy; recommends FOSS in its ICTs policy | 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; 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; ICTs policy mentions the use of FOSS | N/A | N/A |

***Source**: Center 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) under the auspices of the African Union was formed. 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 near the world average (Simon and Samuel, 2012). The SA government and non-government organisations such as ShuttleWorth Foundation support FOSS. SA is home to some important FOSS projects such as Ubuntu (a popular version of Linux). The use of FOSS is backed by FOSS policy which was launched in 2007; the policy recommends consideration of FOSS in the procurement of software in government departments. The policy is not mandatory but preferential in nature. After Cabinet approved the FOSS policy, Government of SA announced that it would migrate its current software to free and open source software with a view to lowering the administration costs and enhance local IT skills (Tectonic, 2007).

Since the launch of FOSS policy in SA, many organisations both public and private have switched to FOSS. For instance, 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 (Wikipedia, 2019). Despite the SA 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 (3014) further argues that the SA 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 Gopalakrishnan cited in Kamau and Namuye (2012), SA, expenditure for proprietary software licenses amounted to R6 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 SA, 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 creation of Free and Open Source Software Foundation Africa (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).

Further, in the library sector, FOSS as compared to commercial software is used 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 are reported to be using Koha, a free and open source integrated library management systems (Samzugi, 2016). Furthermore, ABCD, a free and open source library management system is reported being used by Mzumbe University and Sokoine University of Agriculture. Dspace and e-print, the two major free and open source institutional repositories have been reported to be used in universities and colleges across Tanzania. Tanzania is also home to various FOSS projects which include among others the student academic registration information system (SARIS).

## 4. CONCLUSION AND RECOMMENDATIONS

It is clear that FOSS is widely being used in many counties. European countries lead the adoption and use of FOSS. This is because there are FOSS policies at state and institutional levels that support the use of FOSS in government departments. Further, Brazil and India are have embraced FOSS in a much stronger way by implementing mandatory FOSS policies to outlaw the use of commercial software in government departments in order to reduce the cost of running governments. African countries are still lagging behind in the use of FOSS. This is partly due to the lack of FOSS policies in many African countries. However, even countries like SA that have FOSS policies are still yoked to commercial software as many government department still use commercial software such as Windows operating systems and MS Office suite.

In view of the study findings, there is a need for countries lagging especially African countries to:-

i. implement FOSS policies to outlaw the use of commercial software,
ii. initiate local FOSS projects,
iii. raise awareness about the existence of FOSS, and
iv. incorporate FOSS in the school curricula for Computer Studies

**REFERENCES**

Centre for Strategic and International Studies. (2010). *Government Open Sources policies*. [Online Available] at https://www.csis.org/analysis/government-open-source-policies. Accessed on [29/05/2016]

Cpbotha .(2014). *South Africa, why are you not running Linux*? Retrived from https://cpbotha.net/2014/05/31/south-africa-why-are-you-not-running-linux/. Accessed on [01/09/19]

Cenatic. (2010). *Report on the International Status of Open Source Software 2010. Available At* http://www.slideshare.net/anatrejo/international-status-ofopensourcesoftwareweb. Accessedon [12/01/206]

David, B. (1998). *Why open source software is better for society than proprietary closed source software*: Available at http://benpfaff.org/writings/anp/oss-is-better.html . Accessed on [14/09/2016]

David, T. (2005). *Open Source Software: Opportunities and Challenges.* Available at Egypt FOSS (2016) .*Brazil FOSS country experience*. Available at https://egyptfoss.org/en/wiki/Brazil_FOSS_country_experience. Accessed on [22/04/2017]

Egbert de Smet. (2009). *ABCD: a new FOSS library automation solution based on ISIS.* Available at http://journals.sagepub.com/doi/abs/10.1177/0266666908101265. Accessed on [22/04/2017]

Kamau, J and Namuye, S. (2012). A Review of Users Adoption of Open Source Software in Africa. Retreived from https://www.mku.ac.ke/research/images/publications/OSS%20Adoption%20Published.pdf. Accessed on [02/09/2019]

Karume, M.S and Mbugua, S. (2012). "Trends in adoption of Open Source Software in Africa". *Journal of Emerging Trends in Computing and Information Sciences*. 3, (11), 1509-1515

Kisanjara, S and Tossy, T. (2014). "Investigating Factors Influencing the Adoption and Use of Free and Open Source Software (FOSS) in Tanzanian HEI: Towards an Individual-Technology-Organizational-Environmental (ITOE) Framework". *International Journal of Research in Business and Technology*. 5 (2), 645-653

Kshetri,N and Schiopu,A.(2007). "Government Policy, Conteinental Collaboration and

diffusion of Open Source Software in China". *Journal of Asia Business*, vol. 8, no. (1), pp.61-77. [Online]. Available at http://ssm.com/abstract=979580. Accessed on [30/05/2016]

National Open Business Software Alliance. (2007). *Open Source and Commercial Software-WIPO.* Available at www.wipo.int/edocs/. Accessed on [04/07/2016]

Orloff, J. (2009). *How to do everything in Ubuntu.* New Delhi. Tata McGraw-Hill

Ukoln .(2005). Top Tips for Selecting Open Source Software. Available at http://www.oss-watch.ac.uk/. Accessed on [12/06/2013]

Rankin, K. (2014). *The Official Ubuntu Server Book*. London: Prentice Hall

Richter,D. Zo, H. and Maruschke, M.(2009). *A Comparative Analysis of Open Source Software in Germany, Brazil and India*. Available at https://www.computer.org. Accessed on [14/03/2016].

OSEPA. (2011). *FOSS European and National Policies and practices: Analysis and Recommendations.* Available at http://www.osepa.eu/. Access on [02/06/2016]

Open Source Initiative. (2015). *Licenses & Standards.* Available at https://opensource.org/licenses. Accessed on [28/12/2015]

Opensource.com, (2015). *Discover an Open Source World.* Available at https://opensource.com/resources/organizations. Accessed on [28/12/2015]

Opensource. com. (2016). By the numbers: India saves and grows with Free and Open Source Software.[Online Available] at https://opensource.com/goevrnment/12/9/economic-impact-open-source-india.Accessed on [28/05/206]

Samzugi, A.S. (2016). *Status of Library automation in Tanzania. Retrieved from* https://www.google.com/url? Accessed on [01/09/2019]

Tectonic .(2007). *SA government to switch to open source*. Retrived from http://www.tectonic.co.za/?p=1377. Accessed on [01/09/2019]

The Economic Times. (2016). *Open Source Software*. Available at http://articles.economictimes.indiatimes.com/keyword/open-source-software. Accessed on [25/05/2016]

Twaakyondo, H. (2012).*Speech by TAFOSSA patron Dr. Hashim Twaakyondo at the seminar on software freedom day held on 15th September 2012 at COSTECH*. Retrieved from

https://fosstz.files.wordpress.com/2012/09/freedom-speech-2012-11.pdf. Accessed on [01/09/2019]

United Kingdom-Cabinet Office. *(2012). All about Open Source: An Introduction to Open Source Software for Government IT.* Available at https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/78959/All_About_Open_Source_v2_0.pdf. Accessed on [21/01/2016*]*

Riewe, L.M (2008). *Survey of open source integrated library systems Linda* (Thesis) . Available at http://scholarworks.sjsu.edu/cgi/viewcontent.cgi?article=4477&context=etd_theses . Accessed on [07/01/2018]

UNESCO, (2014). *Global Open Access Portal*. Available at www.unesco.org/new/en/communication-and-information/portals-and-platforms/goap/access/-by-region/latin-america-and-the-caribbean/brazil/ . Accessed on [15/03/2016]

United Nations University. (2011). *Free and Open Source Software in Sub-Saharan Africa*.

Takhteyev, Y and Hilts, A. (2010). *Investigating the Geography of Open Source Software through Github.* Available at http://takhteyev.org/papers/Takhteyev-Hilts-2010.pdf. Accessed on [16/01/2016] Available at unu.edu/publications/articles/free-and-open-source-software-in-sub-sahran-africa.html. Accessed on [20/11/2017]

Reddy, T.R and Kumar, K. (2013). "Open source software's and their impact on library and information centre: An overview". *Academic Journal. Vol. 5, issue no. 4, pp. 90-96.* Available at http://www.academicjournals.org/article/article. Accessed on [21/03/2017]

Wikipedia. (2016). *List of Free and Open Source Software Packages*. Available at https://en.m.wikipedia.org/wiki/list_of_free_and_open-source-software-packages. Accessed on [03/09/2016]

Wikipedia (2019). *List of Linux adopters.* Retrieved from https://en.wikipedia.org/wiki/List_of_Linux_adopters#Africa. Accessed on [01/09/2019]

Wheeler, D. A. (2011). How to Evaluate Open Source Software / Free Software (OSS/FS) Programs, available at http://www.dwheeler.com/oss_fs_eval.html. Accessed on [23/17/ 2015]