

**OPEN SOURCE SOFTWARE ADOPTION BY KENYAN
COUNTIES BASED ON SELECTED LOCAL AUTHORITIES**

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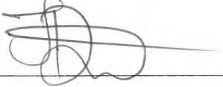
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UNIVERSITY OF NAIROBI, SCHOOL OF BUSINESS IN
PARTIAL FULFILLMENT OF THE REQUIREMENTS FOR THE
MASTER IN BUSINESS AND ADMINISTRATION**

DECLARATION

This research project is my original work and has not been presented for award of any degree in any University.

Signature 

Date: 10/11/2011

This project has been submitted for examination with my approval as University of Nairobi supervisor.

Signature 
Dr. Muranga Njihia - Supervisor

Date: 11/11/11

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Finally, my special thanks go to my parents for their faith in me and for allowing me to be ambitious.

DEDICATION

This research study is dedicated to my parents for their moral support throughout the entire MBA program and especially during this research project.

ABSTRACT

The extensive diffusion of open source software (OSS) is driving discussion among scholars on a set of issues, including its adoption by public administrations. OSS is used the world over, but there is a lot of uncertainty and doubt surrounding decisions to adopt OSS. The objective of this research is to identify the factors that influence OSS adoption by Kenyan local authorities, OSS benefits and inherent risks. This paper determines the adoption factors that are relevant to Kenyan organisations.

The analysis is based on four local authorities; Nairobi, Thika, Kiambu and Mavoko and studies the adoption of Open Source Software by local authorities. Exploratory Factor Analysis is used to identify the pertinent factors that influence OSS adoption, the inherent benefits and risks.

OSS adoption is influenced by individual and organisational technology adoption factors. The research has found that OSS adoption factors identified in literature are relevant in a Kenyan context. The main factors that were resultant were usability, customizability, reliability and compatibility/synergy with existing information systems.

The research concludes with recommendations on OSS adoption decisions when considering the choice between OSS and proprietary software.

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LIST OF ABBREVIATIONS

- BIND - Berkeley Internet Name Daemon
- DOI - Diffusion of Innovation
- DNS - Domain Name Server
- FLOSS - Free/Libre Open Source Software
- FSD - Free Software Definition
- GOK - Government of Kenya
- GPL - General Public License
- HCI - Human Computer Interaction
- ICT - Information and Communication Technology
- IS - Information Systems
- IT - Information Technology
- IDT - Innovation Diffusion Theory
- OSS - Open Source Software
- TAM - Technology Acceptance Model
- TOE - Technology, Organization and Environment

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CHAPTER ONE

INTRODUCTION

It is quite attractive for a developing country to adopt an Information Technology strategy driven by Open Source. This is due to the fact that Open Source Software (OSS) fosters development of local information technology ownership, capacity and autonomy for governments in developing countries. This research explores the potential that open source software presents to the Kenyan counties; and at the same time looking at the level of adoption of open source software in the Kenyan government. The paper also endeavors to analyse the adoption of open source software as a viable alternative to commercial software in Kenyan counties and also discusses why the development of an open source culture within government, education and business will rapidly benefit a country that is developing its in-country information technology skills and resources. Again, a review on previously documented frameworks that could be used as models for the implementation of open source system and their impact on public IT policy is also undertaken.

1.1 Background

Open Source is becoming a major topic in the software industry attracting with it a significant amount of interest. Open Source Software (OSS) is software whose source code is available to the general public or “open”, though the specific licensing agreements vary as to what one is allowed to do with that code. According to (Perens, 1999); (Perens, 2004), Free/Libre and Open Source Software (FLOSS) refers to “software whose licenses give users four essential ‘freedoms’: (i) to run the program for any purpose, (ii) to study the workings of the program, and modify the program to suit specific needs, (iii) to redistribute copies of the program at no charge or for a fee, and (iv) to improve the program, and release the improved, modified version.” The ‘free’ concept of Free Software is not an implication that no cost is involved, rather it implies, “free as in speech, not as in beer”. “Free software” has a meaning that is unintended, that is, “Software you can get for zero price,” which fits the term just as well as the intended meaning, “software which gives the user certain freedoms.” (Stallman, 2007)

Richard Stallman first introduced the concept of OSS in 1984. This was aimed at restoring the “open” setting that existed before software proprietors changed to distributing executable code without the source code. In this regard, Stallman founded the Free Software Foundation whose objective was to develop and draw out a legal framework that could guarantee free access to software built by programmers who were interested in sharing the same freely with others. This would be done by enclosing a license design to the software establishing the rights (Nuvolari, 2004). To achieve this, Stallman developed a General Public License (GPL) also referred to as “copyleft”. This license allows the free modification, distribution and redistribution of the amended versions of the programs it covers. The main distinctive feature of GPL is the “viral” clause which states that modified versions of the programs under the GPL must also be licensed under similar terms, that is, it “infects” all the code bundled with GPL pieces of code.

It is essential to distinguish between Free Software and Open Source Software. The Free Software Definition (FSD) is a little more restricting than the Open Source Definition. As a result of this, free software is open source, but open source software may or may not be “free.” As stated by (Scacchi, Gasser, Ripoche, & Penne, 2003), open source is a development methodology and free software is a social movement. Raymond (1999), states that the adoption of the term 'open source', rather than free software, has helped in the acceptance of open source software by the general computing community.

Open code software has been extensively used to support network critical applications including web interfaces and the internet. The engagement between developers and users allied to the source code readiness allows it to be constantly modified and improved. This continuous improvement process is made possible by sharing of knowledge through communication infrastructures such as: newsgroups, chat rooms, discussion forums, repositories and tutorials (Scacchi, Gasser, Ripoche, & Penne, 2003).

In 1991, Linus Torvalds released the initial version of the Linux operating system, making it freely available to anybody who wanted to improve, modify and add to the project of developing a free operating system (Bretthuaer, 2002). The kernel of the operating system was made available on an FTP (File Transfer Protocol) server on the Internet and was free for anyone to download and modify. Over the years Linux has become the main open source operating system, its success highlighted by the fact that the majority of web servers on the Internet are Linux based, and that high volume Internet sites such as Google and Yahoo are run on Linux servers. The success of open source in general is demonstrated by the Netcraft survey (Netcraft, 2011) which continuously monitors the market share of web servers on the Internet. The April 2011 survey shows 61.13% of web servers across all domains were running the open source Apache web server, with the closest rival being Microsoft IIS being run on 18.83% percent of servers. Recent research has also shown that more than 70% of Domain Name Servers (DNS) servers on the Internet are running the open source software Berkeley Internet Name Daemon (BIND).

1.1.1 OSS and Governments

Various governments the world over have kicked off OSS use as a key part of their strategic plunge in information technology. This has been motivated by the reduction in IT investments costs, a drive for security and autonomy, desire for independence and a means to address intellectual property rights enforcement. Several strategic opportunities that developing countries could exploit by utilization of the OSS phenomenon are recognized by such views as those of President Abdul Kalam's on the IT industry in India, strategies adopted by South Africa and the African region as well as the Japan-China-Korea Open Source Software (OSS) consortium (Weerawarana & Weeratunge, 2004).

The putting into practice of OSS projects is now also a current topic for legislators around the world. The Centre for Strategic and International Studies (CSIS) published a report with a summary of government policies towards the use of OSS. The report shows that there are three hundred and fifty four OSS policy initiatives. From those policies, Europe has 46.0%, Asia has 22.9%, Latin America has 16.1%, North America has 10.5%,

Africa has 2.5% and Middle East has 2.0%. The categories used in the CSIS document to describe the actions suggested by the policies were: Research and Development, Preference, Advisory and Mandatory. The report indicated that only four countries have passed forms of legislation that makes the use of OSS mandatory in the public administration: Belgium, France, Germany and the Bolivarian Republic of Venezuela. The Bolivarian Republic of Venezuela passed legislation (3.390 decree) that gives priority in all governmental systems to software developed under the OSS definition. This legislation counts not only with political support, but with a great amount of revenues originated from the new oil boom. Capital is always needed for a massive shift from one technology to another. In particular, Venezuela is not only seeking a change in the software that public offices use, the legislation also provides a group of actions that contemplate the creation and nurturing of a new generation of IT workers (CSIS, 2010).

1.1.2 County Governance: New Structure for Local Authorities in Kenya

The amendment and promulgation of the Kenyan constitution on 27th August 2010 gave rise to forty seven counties. This number is based on the delineation of administrative districts as created under the Provinces and Districts Act of 1992. The newly formed counties have brought with them much optimism among citizens and investors sighting several opportunities and potential that will be brought about by the implementation of the new governance structures. It is widely mentioned that the counties development focus will center on infrastructure, economic empowerment and technology (Omore, 2011). It is worth noting that these focus points are in one way driven and made efficient by information technology. Open source technologies have a huge contribution in the IT arena and their potential contribution towards the development of counties cannot be ignored, especially while taking into account the scarce resources that are available to the task. The counties will be operating under tight budgets but with a lot of expectations on the deliverables. The adoption and use of OSS will therefore provide a perfect mix than use of expensive commercial products.

The administrative structure of the counties is such that devolution to the county governments is autonomous in implementation of distinct functions as listed in the Fourth

Schedule. (Part 2). As such, the executive authority of the county is vested in and exercised by a county executive committee that consists of the county governor, deputy county governor and members appointed by the county governor with the approval of the national assembly, from among persons who are not members of the assembly. The committee is vested with the responsibility of, among other things, “managing and coordinating the functions of the county administration and its departments.” It may also receive and approve plans and policies for the development and management of its infrastructure and institutions (Constitution of Kenya, 2010). This structure gives freedom for the individual counties to develop comprehensive strategic approaches towards value creation in the economy through IT and in particular OSS. This can be achieved by coming up with a strategy package of IT policy, e-government, advocacy and education, capacity building, industry positioning and building brand equity. The IT policy framework would then naturally have many components including government software procurement policy, which would recognize the role of OSS in the public sector.

1.2 Problem Statement

Like many other firms/organisations, governments are increasingly relying on computers. This puts them in the dilemma of cost cutting while at the same time having the need for developing innovative solutions in addition to being impacted on by the ‘lock-in’ situation. Weber (2003) has used a metaphor to put this situation in perspective when he states that “No national government, if it had alternatives, would have chosen during the 20th century to accept dependence for steel or petroleum on a single or small number of suppliers based in another nation”. Therefore the compelling question is, what can countries do so that they do not depend on a small number of providers in the matters of IT, specifically in the software sector? What is clear is that governments should encourage a more diverse landscape in the software industry to guarantee a smooth path to development. Open Source is a promising solution to the government concerns since it is not tied to providers and the source code is publicly available therefore making it is not susceptible to national security threats.

While there are several studies on Information and Communication Technology (ICT) adoption in varied contexts, such as e-business and e-commerce applications (Taylor and Murphy, 2004), Internet technologies (Shih and Fang, 2004), e-government (Ochara & Van Belle, 2008), and OSS adoption in local governments (Cassell, 2008), the area of OSS adoption by Kenyan local governments and public administrations and the potential that it presents has not been explored. Thus, there is a research gap in the area of OSS adoption by local governments in Kenya. Following the limitations of earlier research on adoption of OSS, it is indeed acknowledged that this is still an emerging research area. The deficiency of proven theories and subsequently a lack of collective understanding of adoption of OSS indicate that there is a gap in theory building research on OSS adoption by local governments. This gap has implications for both theory and practice perspectives. This gap leads us to an important research question: What factors influence OSS adoption by Kenyan local governments? Since at the time of this research the counties are not in place, the local authorities are used as proxies as they draw a striking resemblance to one another.

1.3 Research Objectives

Based on the research question and its exploratory and explanatory characteristics, the aim of this study is stated as the following: To identify the factors that influence OSS adoption by Kenyan local governments. The research aim focuses on identifying factors that influence adoption of OSS by local governments. These exploratory and explanatory aspects of the research aim leads to three key research objectives, which are stated as follows:

- i. To identify the factors that influence adoption of OSS by local governments.
- ii. To identify benefits of adoption of OSS by Kenyan local governments.
- iii. To identify risks of OSS adoption by Kenyan local governments.

1.4 Significance of the Study

The findings of this study would be of value and interest to the various groups. Theoretically the study could prove valuable to researchers working in various fields, as it would serve as a background material for further research in this area as it will contribute to the knowledge of OSS adoption by local governments.

From a practical standpoint, this study will be beneficial to local governments, county governments, public institutions and government agencies particularly of developing countries as it provides a framework towards provision of better public service delivery while addressing the concerns of software security, trusted computing platforms, costs and skills development. This study should also help IS practitioners and national policy makers better formulate strategies with the opportunities and threats raised by the OSS phenomenon.

1.5 Research Outline

This research consists of five chapters. Chapter 1 provides an overview and background of the research. This chapter also identifies the research problems by delineating the gap found in the literatures of Open Source and the software industry. Research aim and objectives together with the significance of the study are also discussed in this chapter.

Chapter 2 presents an overview of concepts in Open Source, as well as outlining the potential that Open Source presents to the Kenyan counties based on the relevant literatures. In addition, this chapter provides the theoretical foundation, and empirical studies to support this study. With reference to the literature review in Chapter 2, Chapter 3 illustrates the research methodology of the research. A few areas of methodologies are discussed in this chapter, including research design, data collection and data analysis methods. Furthermore, description of how IS professionals are selected for participation in the study, and definitions of operationalisations and measurements of variables are also discussed in this chapter. Chapter 4 discusses the data analysis and result discussions, and Chapter 5 presents a conclusion for this research.

CHAPTER TWO

LITERATURE REVIEW

2.1 Introduction

The robust functioning of open-source products in the marketplace and its novel modes of operation pose important and exciting new questions for scholars in various fields. Yet literature in this area is still in its infancy, probably reflecting the distributed and emerging nature of this phenomenon. The argument for the use of open source software as opposed to proprietary software is significantly different in developing countries versus developed countries. Developing countries have many different social, economic and geographic forces that impact on the decision of businesses and governments to adopt open source over proprietary software. In essence, developing countries and in particular Kenya have a lot to gain from adoption of OSS. As a consequence, open source projects are becoming a significant economic and social phenomenon (von Hippel & von Krogh, 2003).

2.2 Open Source Software (OSS) vs Proprietary Software

The two models for software licensing and development, open source and commercial software, each serve specific needs and circumstances of the environment where the software is being deployed. While considering developing countries, commercial software has limitations, which have implications of greater significance. Neumann (1999), notes that closed source proprietary software has risks associated with its use. First, unavailability of source code reduces onsite adaptability and repairability making it difficult to customize the software to local needs and maintain it. Secondly, inscrutability of code prohibits open peer analysis and masks the reality that state of the art development methods do not produce adequately robust systems. Thirdly, lack of interoperability and composability often induces inflexible monolithic solutions making the software inefficient and incompatible with available solutions. Fourthly, where software bloat exists, it often hinders sub-setting, thereby making the software

unnecessarily huge and system hungry. Finally, proprietary interface standards complicate system integration due to lack of standards.

Another issue with proprietary software is the *price*. While often not a significant portion of the total cost of ownership in developed countries, it can be a significant startup cost for users in developing countries. As has been experienced by developers, the no cost license for open source software allows for project managers and developers to rapidly build and test prototype systems that can then be quickly moved into production without the overhead caused by problems associated with software availability and licensing. The vast majority of open source software is freely available for download from the Internet, which makes the software and documentation readily accessible to anyone with an adequate Internet connection.

Licensing of commercial software has also become a major issue for the information technology industry. (Griffith, 2003), reports that the change by Microsoft to an annual license fee 'brought into sharp focus how much large organisations with a substantial Microsoft presence on the desktop were paying for licenses'. This also has consequences for businesses and organisations that do not manage their licensing correctly and leave themselves exposed to prosecution for using pirated software. (Garfinkel, 2003), takes this further and proposes that 'the pervasive use of Microsoft Office combined with a staunch antipiracy program, amounts to economic colonialism'. (Gillmor, 2003), makes a much more definite statement that '...especially in the developing nations open source is looking like the best way to usher in the information age. Money, flexibility and plain old independence from a monopolist's clutches are a powerful combination.' Further, intellectual property rights are having a negative impact on the economies of developing countries. A report by the Commission on Intellectual Property Rights states that "Developing countries and their donor partners should review policies for procurement of computer software, with a view to ensuring that options for using low cost and/or open source software products are properly considered and their costs and benefits carefully evaluated" (Story, 2002).

Vendor support for proprietary software in developing countries is often poor, and international phone calls to vendor help desks are often prohibitive. The impact of this type of cost on the support of proprietary software was observed by (Reese, 2004) in the Solomon Islands, where a major hotel was required to pay for 15 hours of international phone calls to support the billing management system of the hotel. This was of course very specialised software, but is indicative of the impact that the support of software has on the cost of IT management in developing countries, (Johnson, 2001)

2.3 Benefits of OSS

Open Source software offers solutions to the proprietary software ills and presents with it a lot of potential especially to the growth and development of Kenyan counties which run under tight budgets, with little developed infrastructures. Open source software adoption presents the following benefits for the Kenyan government and specifically counties. (Zwollo, 2003), through his study identified the several benefits of Open Source to governments. The flexibility of having different providers means that there is the ability to take advantage of competition amongst providers and there is less exposure to the risk of a provider going out of business and not being able to support their product. Also open source software is more reliable than proprietary software and often performs better on the same hardware, not to mention the ability to view the source code means that governments are able to check for security holes. Open source software fosters economic growth with less start-up costs and job creation as many organizations can provide the service which promotes competition and lowers costs for governments. Consequently this eliminates the problems that are associated with the licensing costs and structures that are associated with proprietary software. (Zwollo, 2003) also notes that the governments have a responsibility to ensure perpetual access to the information that it maintains. Storing information in open source architecture with open standards is a more robust model for the maintenance of this information. The possibility of customizing the software due to the availability of source code (customizability) and to run it on older computer systems (scalability) is also an important benefit of OSS. Last but more importantly, Open Source Software fosters the development of local information technology ownership, capacity and autonomy

2.4 Potential risks to OSS adoption

There are several risks associated to Open Source Software adoption, however not all organizations consider them, as there are organizations which adopt Open Source Software without performing any cost/benefit analysis (Verelst, Mannaert, & Ven, 2008). There are no papers that explicitly focus on potential risks of OSS adoption, but some literature mentions several possible drawbacks of OSS Adoption. To begin with, hidden costs are considered. Adoption of OSS products is not without costs. Though it may be time-consuming to evaluate them, adoption may involve user training and configuration (Morgan & Finnegan, 2007) (Tiango, Stockwell, Sapsford, & Rainer, 2003), spent resources on community participation (Jaaksi, 2007) as well as premium professional support (Fitzgerald, 2009) (Verelst, Mannaert, & Ven, 2008). Secondly, lack of products is another potential risk. While there are many OSS products available, there may still be a lack of products with specific functionality (Brink, Roos, Weller, & Van Belle, 2006) (Morgan & Finnegan, 2007). The quality of these products can also be questionable (Fitzgerald, 2009) (Verelst, Mannaert, & Ven, 2008) if not well evaluated. OSS products may furthermore suffer from limited standardization and compatibility with document formats or with versions of other software products (Morgan & Finnegan, 2007).

Lack of providers, expertise, and support is the third potential risk. Despite the significant adoption of OSS, there may still be a lack of expertise and support for specific products (Verelst, Mannaert, & Ven, 2008). The lack of professional providers may also introduce unclear liability and uncertainty about the longevity of OSS project as OSS projects may lack roadmaps and documentation (Morgan & Finnegan, 2007). Holck et al. hypothesized that this lack of traditional vendor-customer relationship could stop the adoption of OSS (Holck, Larsen, & Pedersen, 2005). Fourthly, customization needs is another potential risk. It may be necessary to customize the OSS products to fit them into the context in which they are going to be used. When changing an OSS product we may get a maintenance responsibility as these changes must be updated when more recent versions of the software are adopted. When these situations arise, the adopter must decide to follow the new releases or ensure backward compatibility with his own changes (Jaaksi, 2007). Finally, licensing issues pose another potential risk to OSS adoption. The variety

of OSS licenses available is confusing, as there is a lack of guidance on how to interpret them. When adopting OSS and in particular when integrating OSS into derivative software systems, it may be challenging to combine code under an OSS licenses with proprietary licenses and application program interfaces (Jaaksi, 2007).

2.5 Constraints to OSS adoption

Open Source Software is not without problems despite the enthusiasm of the open source movement proponents. Most of the OSS constraints can be broadly classified under inadequate *user centered design*. User centered design is a design methodology in which the user's needs, wants and limitations are given extensive attention during the design process. Levesque (2004) identifies five OSS problem areas:

i. *Neglected User Interface Design*

Numerous open source programs have a poor user interface – one that is unintuitive. Given that users tend to judge a program on the quality of the user interface, this problem is a key issue to solve if open source software is to flourish.

ii. *Lack of (or poor) documentation*

Lack of documentation for OSS usually inhibits the uptake of the programs. Those who release open source software often assume a certain level of technical expertise for the potential users.

iii. *Feature-centric development*

The best software programs are usually the ones that do one thing very well and interface cleanly with other programs. The nature of open source software appears to encourage development of feature rich programs that lack some basic refinements such as user interface and documentation.

iv. *Narrow philosophical stance*

A majority of individuals join the open software movement for strong ethical and philosophical motives. At the extreme, this appears to lead to a lack of learning across the open source and proprietary divide.

v. *Programming for the technocrat*

Several OSS programs are written by programmers for other programmers. They hence fail to appreciate that what might be natural to them is not so natural to the general public.

As much as the above highlighted issues are significant, there are a number of ways of overcoming them. OSS developers need external help to cater for the average user in terms of coming up with a user centered design. The Human Computer Interaction (HCI) community has developed several tools and techniques for the purpose of building user centered systems. These include “usability inspection methods, participatory design, interface guidelines, testing methods, inter-disciplinary teams among others” (Nielsen, 1993). Frishberg et al.(2002) suggest that Open Source may be going through a similar phase as that of commercial software in the 1980s due to the increasing attention paid to usability of Open Source products. As software users became varied and technically inexperienced, software vendors started to take up user-centred techniques to ensure that their new users adopted the products successfully. Over the years HCI specialists have greatly improved user's experiences. Similarly, as open source software user base widens to include many non-technical users, OSS projects will need to apply HCI techniques if their software is to achieve high user acclaim and appeal to the average user. Of late application developers for Open Source projects are also adopting techniques from proprietary works (Benson et al., 2002; Biot, 2002).

2.6 OSS Adoption

Open Source Software adoption by governments has been profoundly debated by both public administrators and scholars (Von Krogh & Spaeth, 2007; Federspiel & Brincker, 2010). For example, Lewis (2004, 2006, 2007, 2008) delivers an empirical account of policies that public administrators put in place and aimed at supporting OSS. Three findings in particular are notable: (i) European countries experience the highest number of proposed and approved initiatives concerning OSS adoption by public administrations; (ii) the most widely diffused policies are advisory policies, preference policies and research policies; and (iii) policies targeting mainly local public administrations are gaining momentum. In the scientific literature, the focus has been on the role of public administrations relative to OSS. Its main concern is to understand why public administrations should adopt OSS solutions and how migration to OSS should be implemented. In this regard, Mukerji et al. (2006) provide a literature review highlighting the main benefits and challenges relating to the adoption of OSS by governments in both developed and developing countries. Its main contribution is in providing a list of the perceived benefits and challenges of using OSS. In terms of benefits, reduced licence fees are the most popular. Also, reduced dependence on suppliers of proprietary software is a popular argument for the adoption of OSS by public administrations. Finally, the possibilities to customize the software due to the availability of source code (customizability) and to run it on older computer systems (scalability) are among the most prominent advantages. In terms of challenges, public administrations are usually very concerned about efficient customer support and accountability, at least in relation to OSS not supported by private companies. Also, the total cost of ownership (TCO) of OSS solutions compared to proprietary ones, is not always clear. Finally, lack of in house high-level technical skills is often a barrier to the adoption of OSS by public administrations.

Though it provides some important insights on the topic, the work referred to above is descriptive in nature and quite general in scope. A more specific work by Waring & Maddocks (2005) studies the use and implementation of OSS in the UK public sector, through case studies of six local governments and two central public administrations.

Although the authors find a high degree of variability in OSS adoption and implementation, they find support for the claim that adoption of OSS by public administrations is related to both long and short-term cost savings, and greater scalability and customizability. In line with these findings, Cassell (2008) investigates why local governments choose to migrate to OSS and the factors affecting the implementation process. This is a comparative case study based on migration to Linux by four municipal administrations in Europe. The reasons driving the migration decisions are reduction in dependence on private software suppliers and lower licence costs. Cassell (2008) finds that the organizational structure of the public administrations and the views and perspectives of personnel are the greatest influences in the implementation of OSS. Results are similar for the adoption and use of OSS in health care organizations, including lower software acquisition costs and the possibility to modify, combine and tailor the software to the specific needs of the organization (Fitzgerald & Kenny, 2004; Valdes et al., 2004). One notable exception refers to the increased interoperability among different data standards seen as an additional determinant of OSS adoption (Kantor et al., 2003).

An additional reason for the adoption of OSS is provided by a more generalizable study that provides empirical data collected through a survey and interviews (Munoz-Cornejo et al., 2008). The authors investigate the reasons for OSS adoption in 30 hospitals in the US and show the positive role played by software vendors in health system procurement decisions. Contrary to the common argument related to the dependence on suppliers of proprietary software, the authors find that software vendors are the initial factors facilitating the adoption of OSS in hospitals. Finally, another important aspect in the decision to adopt OSS by public administrations is highlighted in work that takes the Belgian government as the unit of analysis (Ven et al., 2007; Huysmans et al., 2008). In particular, Ven et al. (2007) study migration from desktop operating systems based on proprietary software to OSS, in the Belgian federal government department of justice. This study points to the important function of government guidelines. This refers to the recommendations of the Belgian government for greater use of open standards and OSS in the procurement decisions of government departments. In a study of the decision by

the Belgian federal public service economy about whether to adopt OSS as the main office suite, a similar argument is made (Huysmans et al., 2008).

2.7 Theories on OSS/IS Adoption

Several frameworks have been established to describe technology adoption. These include:

2.7.1 Diffusion of Innovation

Diffusion of Innovation (DOI) theories of innovation by (Rogers, 1983; Tornatzky and Klein, 1982; Tornatzky and Fleischer, 1990; Davis, 1989) offer extensive explanations of how new systems are adopted, and how decisions to adopt are influenced by perceptions of the technology itself and the character of the adopters, that is, the organizations and/or the individuals and their environment. Therefore borrowing from diffusion of innovation theory, there are several factors influencing OSS adoption decisions. These include:

i. Technology Factors

These include *relative advantage* which is perceived by IS professionals almost entirely in terms of cost advantages and reliability of the system; *compatibility* of the new technology or system with current technologies, skills and tasks; *complexity* of the system and *trialability*, that is the ability to try out the system a low or no cost.

ii. Organizational Factors

Several organizational factors also influence OSS adoption decisions. These include the organization's general stance toward *IT/IS innovation*, that is whether they are early adopters, fast followers or late adopters; the *strategic importance of the system* to the organisation; the presence of *boundary spanners* in the organization in terms of a staff with previous open source experience; and the nature of *slack resources* available, both financial and human.

iii. Environmental Factors

Open Source is a standard that is not supported by any one firm, inferring a greater level of risk than one that is directly being controlled and sponsored by a major Information

Technology (IT) firm. As result, several analysts have suggested that risk would greatly be reduced by third party sponsorship by independent distributors e.g. SuSE, Red Hat or hardware firms e.g. HP, Dell, IBM that supplied the remaining layers of open source platforms, including hardware and support services (Wagner 2000, West and Dedrick 2001). Therefore two environmental factors also influence the adoption of OSS namely; *perceived availability of OSS skills and services* either for hire or for contracting from IT services companies and secondly, the importance of *support for OSS* by major vendors not only for the services they provide, but also for the legitimacy they offer on OSS investments within the organization.

2.7.2 Technology Acceptance Model (TAM)

Another technology adoption model is technology acceptance model (TAM) popularized by Davis (1989). This model is based on four constructs; “perceived usefulness (PU), perceived ease of use (PEOU), intention to use and the usage behaviour of technology.” The four constructs predict the actual behaviour (AB) of a user to adopt a new technology and their relation. Perceived ease of use has a direct influence on perceived usefulness. Perceived ease of use and perceived usefulness are both determined by external factors and have a direct influence on the intention to adopt a new technology.

2.7.3 Technology, Organization and Environment (TOE) Model

The TOE model (technology, organization and environment) describes organisational technology adoption as indicated in Tornatzky and Fleischer’s book *The Processes of Technological Innovation*. Technology factors considered are cost, perceived reliability and compatibility with existing technologies and skills. In taking into account organisational factors, the model emphasizes on boundary spanners, innovativeness of the organization and financial and human resources. Employees with prior experience on the technology are what are referred to as boundary spanners and they help to positively influence the adoption decision and boost an organisations confidence in the potential technology. The main environmental factors considered under the TOE model are the organisation’s industry, the availability of key assets and the fear of adopting a standard that is considered trailing (Dedrick& West, 2008).

2.8 Kenyan Local and County Governments

The constitution of Kenya creates 47 county governments. This number is based on the delineation of administrative districts as created under the Provinces and Districts Act of 1992. However, the county governance structure is currently not fully in place and such for the purposes of this research, a comparison will be made with the functionalities of the local authorities in which the counties draw a striking resemblance. Kenya has 175 local authorities including 67 county councils, 43 municipal councils, 62 town councils, and three city councils (Local Government System in Kenya, 2011). They operate through administrative and legal power delegated by the Central Government, under the Local Government Act. The Minister of Local Government, through the Act, is empowered to approve revenue sources within local authorities, budgets; dissolve a council and replace it with a commission if it is not functioning properly (CLGF, 2011).

Local authorities are currently facing a myriad of challenges. These among others include poor public service delivery, inefficient revenue and expenditure documentation and tracking system, unpaid land rates and bills, inefficient mobilization and management of resources, corrupt practices and lack of records. This has been caused of lack of/inefficient information systems. Kenyan local governments can greatly improve public service delivery through appropriate and successful implementation of Information Systems (IfG, 2011). In service delivery, information systems are critical and it can greatly transform local governments by promoting good governance through an increased capacity to deliver. Adoption of IS has the potential of reversing the trend of ineffective governance and improving participation, responsiveness, transparency, accountability, effectiveness and efficiency which are among the major governance constructs. Therefore IS and specifically OSS present a huge potential in improving governance constructs in the local authorities.

Misuraca (2006) argues that in Africa the prospect for ICT to complement effective government remains uncharted and unexploited in academic research. The few known success stories are Kinondoni Municipal Council (KMC) in Tanzania and Cape Town's "Smart City" project in South Africa which are recognized as the region's pace setters in initiating e-government services in local governments (IfG, 2011). The Government of

Kenya (GOK) has in the last few years initiated programs to integrate ICT into government operations, undertake training in ICT and implement tax incentives on both computer hardware and software as well as review the legal framework to encourage adoption and use of e-commerce and e-government. These are steps in the right direction as supported by the Government of Kenya's e-government strategy 2004-2007 (GOK, 2004)

The change to county governance is expected to bring with it much optimism and expectations among the Kenyan citizens. Therefore there will be enormous demand on the counties for efficient and effective public service delivery, however, due to the challenge of lack of or poor legacy systems, successful adoption of e-government initiatives in the council requires a lot of investment in IT infrastructure, ICT skills and knowledge. If such ICT training needs can be addressed, more so in OSS, then the counties stand to gain from ICT due to the potential benefits presented by adoption of OSS. OSS can fully consolidate the gains made by the counties in modernizing their service offerings in a number of ways, namely: reducing costly physical interactions; improving accessibility of the county services; integrating back and front-end services; making service provision processes faster; reducing corruption through audit trail; reducing data redundancy; facilitating error free processes; and improving the scalability of the counties' public service delivery system, all at a low cost.

2.8.1 Summary

The literature review reveals a large body of research which relates to IS adoption in organisations the world over. Regardless of the type of organisation, a number of factors have emerged that influence decisions around adoption of Information Systems and specifically OSS. From the literature review, it is apparent that the factors influencing IS adoption decisions more often than not involve a trade-off among various factors. Cassell (2008) points out that among the greatest factors that influence OSS adoption are the organizational structure and the views and perspectives of the IS professionals in the organization. These factors are most relevant to local authorities. Others include the external environment within which the organization operates, the type of organisation, the IT policy and guidelines as well as the type of software being implemented.

With rising inflation, a myriad of expected infrastructural developments and a volatile economy, the counties will be operating under tight budgets but with a lot of expectations on the deliverables. With reduced cost of Open Source products through reduced licensing costs, the counties can save on costs that would otherwise have been spent on acquiring proprietary licenses or paying for vendor support and upgrades (Zwollo, 2003). Also adoption of OSS reduces the risk of prosecution when licenses are not managed properly. This can result to counties spending a huge sum of resources in the legal settlements hence eating up on the already constrained budget. Therefore OSS provides the best alternative when making decisions on software to acquire for county governments.

To date no study has focused on the factors influencing adoption of OSS, their benefits and risk to the Kenyan local authorities. These present important gaps in our current knowledge of the OSS phenomenon and this study aims at filling these. In the study local authorities are used as proxies since the county governments are not fully in place.

2.9 Theoretical Framework

A number of frameworks have been established to describe technology adoption. Fundamentally, technology adoption is illustrated by the diffusion of innovations (DOI) or innovation diffusion theory (IDT), popularized by Rogers in 1962. The technology diffusion process consists of pre-decision, in-decision and post-decision steps. During the pre-decision step consumers look for and obtain information that shapes their beliefs around an innovation. The in-decision stage involves making the decision on whether to adopt or reject the specified technology. The post-decision stage starts right away after the decision has been made. During this stage non-adopters might find information that drives them to adopt an innovation whilst adopters might find reasons to reject the innovation. Innovation adopters are described by a bell-curve divided into innovators, early adopters, early majority, late majority and laggards. All innovations have features that influence a decision to adopt or reject, including the relative advantage of the innovation, complexity, trialability, compatibility and observability (Rogers, 1995). Out

of the five features relative advantage, complexity and compatibility have been constantly associated to technology adoption (Tornatzky & Klein, 1982).

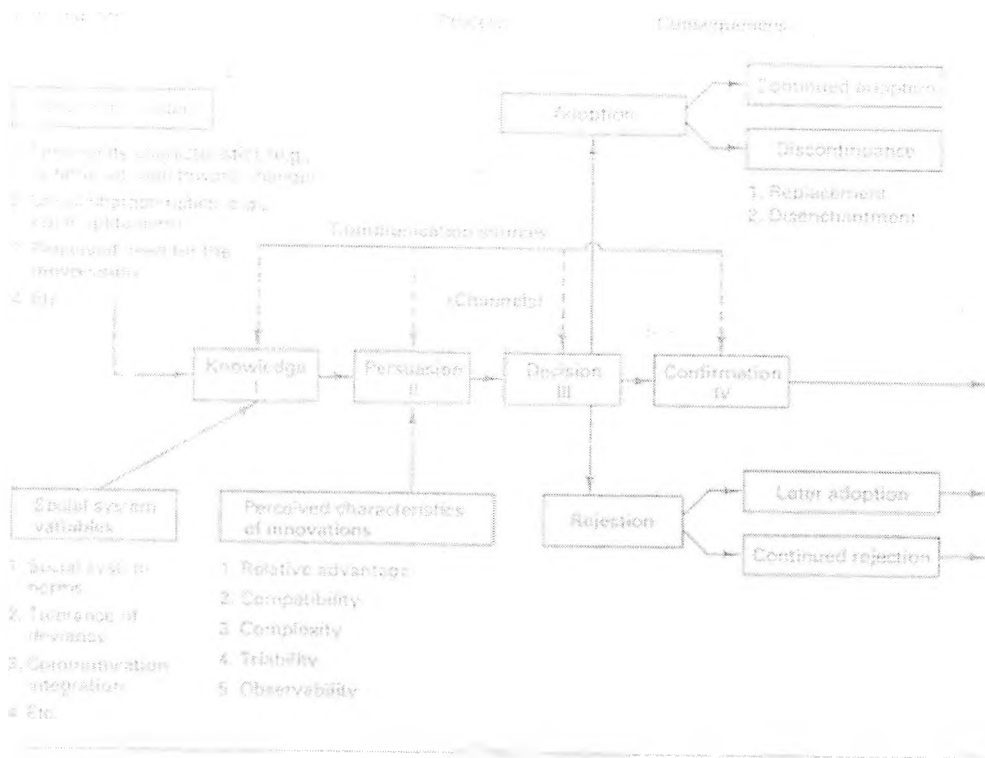


Fig 1. Diffusion of innovation model (Rogers, 1995 pg. 191)

The Diffusion of Innovation (DOI) model is used to frame research questions.

CHAPTER THREE

RESEARCH METHODOLOGY

3.1 Research Design

The research is an exploratory survey conducted in two separate stages: the first stage investigates what factors influence the adoption of OSS by local authorities while the second stage investigates the immediate benefits of OSS adoption by local governments and the inherent risks.

3.2 The Population

All Information System (IS) professionals in local governments were initially chosen, using the *Ministry of Local Government* website (Ministry of Local Government, 2011) listing to outline all the 175 local authorities in the country as a guide for the entire population.

3.3 Sampling

Four local authorities were selected using convenience sampling namely Nairobi, Kiambu, Mavoko and Thika. There were a total of 59 Information Systems professionals in the four local authorities. The distribution was as follows: Nairobi – 26, Thika – 17, Kiambu – 11 and Mavoko - 5. A census was done for entire sample.

3.4 Data Collection Methods

This study used Primary data which was collected using questionnaires that contained both open and close ended questions. Personal interviews were conducted and in cases where this was not possible , a “drop-and-pick-later” method was used. Questionnaires were given to the IT/IS professionals at the local authorities who are entrusted with the information systems. The Questionnaire was pre-tested to find out its appropriateness and workability.

The questionnaire was divided into two parts as follows:

Part A consisted of open-ended and close-ended questions, derived from the literature review and the Diffusion of Innovation model, aimed at obtaining general information on the local governments

Part B consisted of likert type questions, derived from the literature review and the Diffusion of Innovation model, aimed at obtaining general information on factors that influence adoption of OSS and the benefits and risks of OSS adoption by local authorities in Kenya.

3.5 Data Analysis Techniques

Completed questionnaires were edited for completeness and consistency across respondents and to locate omissions. They were then coded and keyed into the computer to facilitate statistical analysis with the help of the SPSS computer package. The data collected for the first objective; factors influencing OSS adoption, was analyzed using exploratory factor analysis (EFA). Exploratory Factor Analysis is a data reduction technique used to reduce many variables to a few underlying ones. This was to tell us what factors influence open source software adoption in local authorities in Kenya. Descriptive statistics such as mean scores, frequency tables, pie charts, graphs, percentages, means, and standard deviation were used to analyze the data for objectives 2 and 3 on the risks and benefits of OSS.

CHAPTER FOUR

DATA ANALYSIS, RESULTS AND DISCUSSION

4.1 Introduction

This chapter contains summaries of data findings together with their possible interpretation and provides an in-depth analysis and interpretation of findings of data collected via questionnaires. Some interview questions are not discussed separately as part of the findings as they were used only to set the context of the interviews. The use of tables, graphs and pie-charts are incorporated for ease of understanding and to present summarized information. Analysis and results presented are according to the study's objectives that include; to identify the factors that influence adoption of OSS by Kenyan local governments; and to identify benefits and constraints to OSS adoption by Kenyan local governments. The chapter concludes with a summary on the research findings as obtained during the structured interviews.

4.2 General Analysis

The information provided tends to seek a deeper insight in the adoption of Open Source Software by local authorities.

Table 1: Respondents Summary

Local Authorities

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Nairobi	20	40.8	40.8	40.8
	Thika	15	30.6	30.6	71.4
	Kiambu	10	20.4	20.4	91.8
	Mavoko	4	8.2	8.2	100.0
	Total	49	100.0	100.0	

A total of 59 questionnaires were prepared and presented to a number of IS professionals in four local authorities. The distribution was as follows: Nairobi – 26, Thika – 17, Kiambu – 11 and Mavoko - 5. Fourty nine questionnaires were duly completed and analyzed indicating an 83% response rate considered satisfactory.

Table 2: Organisational IT Budget

The study sought to establish the IT budget in the respondents’ organization and 6.1% said between 100000-1M KES, 10.2% said 1-10M KES, 10.2% said 10-20M KES, 34.7% said 20-30M KES and 32.7% said more than 30M KES while the rest said they did not have any idea.

What is IT Budget in your Organization

	Frequency	Percent	Valid Percent	Cumulative Percent
Valid 100000 - 1M KES	3	6.1	6.1	6.1
1- 10M KES	5	10.2	10.2	16.3
10 - 20M KES	5	10.2	10.2	26.5
20 - 30M KES	17	34.7	34.7	61.2
More than 30M KES	16	32.7	32.7	93.9
I don't know	3	6.1	6.1	100.0
Total	49	100.0	100.0	

The budget is quite high with 67.4% of the respondents quoting a figure of over Kes. 20 Million. These could be significantly reduced by adoption of OSS due to reduced licensing costs, vendor support fees and upgrades.

Chart 1: Organisational IT Budget

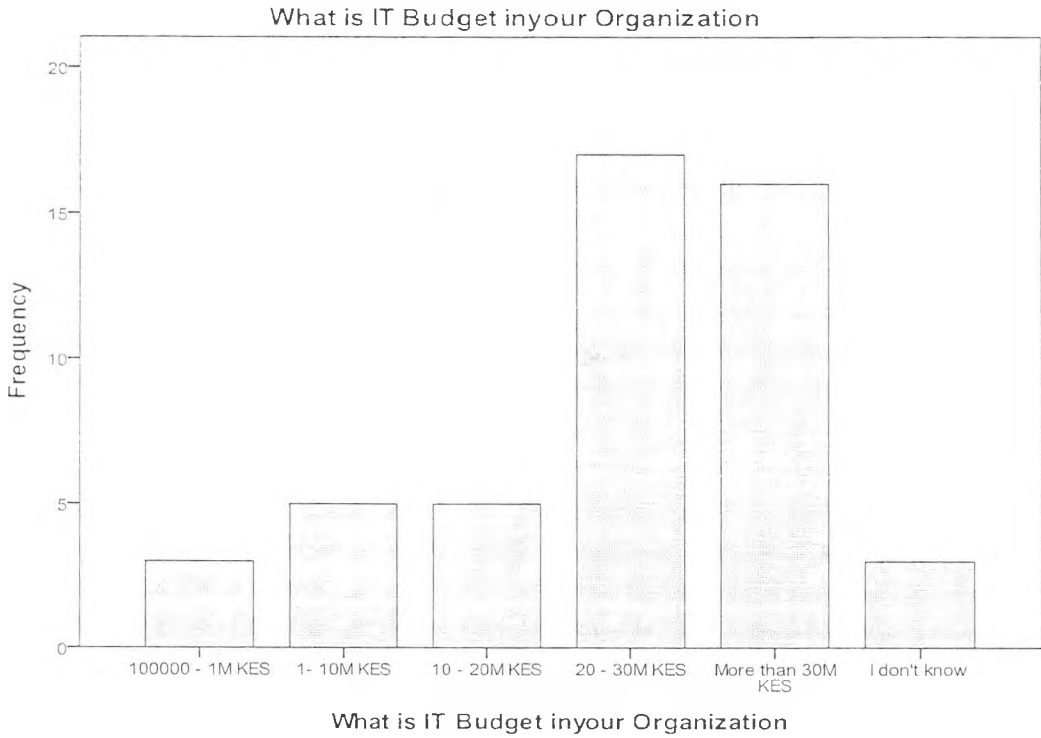


Table 3: License fee in relation to IT budget

The table overleaf shows the proportion of license fee in relation to IT budget. From the table 4.1% said less than 5%, 12.2% said 6-20%, 12.2% said 21-40%, 34.7% said 41-60%, and 34.7% said more than 60% while the remaining 2% did not have any idea about the issue.

What is License fee in relation to IT budget

	Frequency	Percent	Valid Percent	Cumulative Percent
Valid Less than 5%	2	4.1	4.1	4.1
6% - 20%	6	12.2	12.2	16.3
21% - 40%	6	12.2	12.2	28.6
41% - 60%	17	34.7	34.7	63.3
More than 60%	17	34.7	34.7	98.0
I don't know	1	2.0	2.0	100.0
Total	49	100.0	100.0	

The license fees as a component of the IT budget is quite substantial. 69.4% of the respondents noted that it was more than 40% of the entire IT budget. OSS adoption can help shift this scenario.

Table 4: Reasonable License fee

Asked whether the license fee is reasonable, 71.4% said the fee is too high, 10.2% said it is too low, 10.2% said it reasonable while 8.2% did not know.

Is the license fee reasonable

	Frequency	Percent	Valid Percent	Cumulative Percent
Valid Too high	35	71.4	71.4	71.4
Too Low	5	10.2	10.2	81.6
Reasonable	5	10.2	10.2	91.8
I don't know	4	8.2	8.2	100.0
Total	49	100.0	100.0	

71.4% of the respondents were of the opinion that the license fees are too high. This implies that they appreciated the fact that licensing of software products is quite costly.

Table 5: Use of Open Source at local authority

From the table below 55.1% of respondents said they use open source software system in their respective local authority and 30.6% do not use the system while 14.3% said they do not know.

Do you use open source software systems in your local authority?

	Frequency	Percent	Valid Percent	Cumulative Percent
Valid Yes	27	55.1	55.1	55.1
No	15	30.6	30.6	85.7
I don't Know	7	14.3	14.3	100.0
Total	49	100.0	100.0	

A majority of the respondents, 55.1%, indicated that they use OSS in their local authority. This implies that OSS is used in the organisations in one way or another.

Table 6: Areas of OSS use

Asked where they use OSS, the table below shows the responses of the participants. From the table 10.2% said on desktop exclusively, 12.2% said on desktop partially, 10.2% said on server exclusively, 32.7% on servers partially, while 34.7% said they experiment with OSS in pilot projects.

Where do you use OSS?

	Frequency	Percent	Valid Percent	Cumulative Percent
Valid On desktop Exclusively	5	10.2	10.2	10.2
On desktop Partially	6	12.2	12.2	22.4
On server Exclusively	5	10.2	10.2	32.7
On servers Partially	16	32.7	32.7	65.3
We experiment with OSS in Pilot Projects	17	34.7	34.7	100.0
Total	49	100.0	100.0	

A majority of the respondents, 67.4%, indicated that they use OSS on servers partially, 32.7%, and while experimenting on pilot projects, 34.7%. This implies that as much as OSS is used by the local authorities, its full potential has not been harnessed.

Chart 2: Areas of OSS use

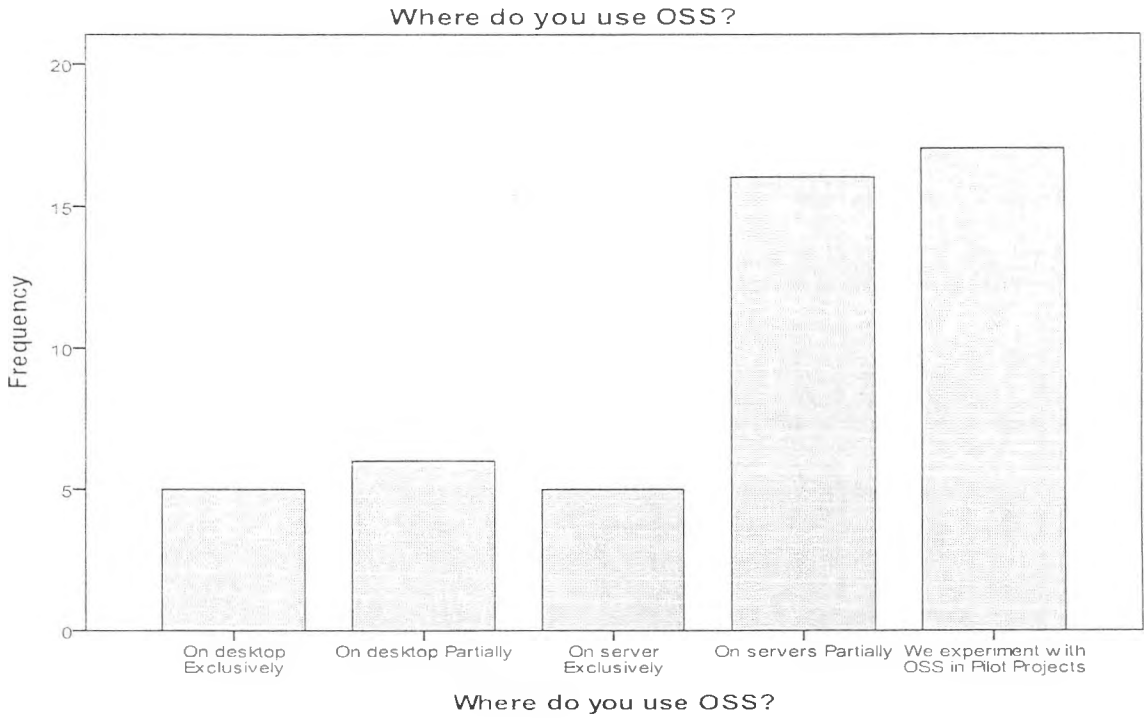


Table 7: OSS systems used in the organisation

The table below shows the OSS systems used in the four counties. From the table 56.5% of respondents said they use Apache, 32.4% use Linux, 58.6% use MySQL while 62.4% use Mozilla.

Which Software Systems do you use in your organization?

	Frequency	Percent	Valid Percent	Cumulative Percent
Valid Apache	13	56.5	26.5	26.5
Linux	11	32.4	22.4	49.0
MySQL	14	58.6	28.6	77.6
Mozilla	11	62.4	22.4	100.0
Total	49	209.9	100.0	

This implies that the OSS products indicated are all used to an extent by the local authorities.

Table 8: Usefulness of OSS share increase

Asked whether they would find it useful to increase the share of open source in their organization, 75.5% said yes, 14.3% said no while the rest do not know.

Would you find it useful to increase the share of open source software in your organization?

	Frequency	Percent	Valid Percent	Cumulative Percent
Valid Yes	37	75.5	75.5	75.5
No	7	14.3	14.3	89.8
I don't Know	5	10.2	10.2	100.0
Total	49	100.0	100.0	

75.5% of the respondents were of the opinion that it would be useful to increase the share of OSS at the local authorities. This shows that the professionals want and are willing to have more OSS products in their organization.

Table 9: What to replace

From the table overleaf 12.2% of respondents said they would like to replace some components, 81.6% said they would replace all components while 6.1% said they have no idea.

What would you like to replace?

	Frequency	Percent	Valid Percent	Cumulative Percent
Valid Some components	6	12.2	12.2	12.2
All Components	40	81.6	81.6	93.9
I don't know	3	6.1	6.1	100.0
Total	49	100.0	100.0	

The majority of the respondents, 81.6%, were of the view that they would like to replace all of the IS components. This gives an implication that they are willing to have an all OSS IS environment, most likely due to the benefits to be derived from large scale OSS adoption.

Table 10: Access to source code

From the table below 79.6% of respondents said they would find having access to source code beneficial to the IT department while 14.3% said do not support the assertion.

Would you find having access to source code beneficial to the IT department?

	Frequency	Percent	Valid Percent	Cumulative Percent
Valid Yes	39	79.6	79.6	79.6
No	7	14.3	14.3	93.9
I don't Know	3	6.1	6.1	100.0
Total	49	100.0	100.0	

This implies that they appreciate the freedom that comes with access to source code.

Table 11: Decision makers regarding software purchases

From the table below 30.6% of the respondents said it is IT professional who make important decision regarding software purchases. in their organization. 12.2% said users. 4.1% said finance department, 34.7% said other management, 8.2% said external consultants. and 6.1% said others while 4.1% do not know.

Who makes important decision regarding software purchases in your organization

	Frequency	Percent	Valid Percent	Cumulative Percent
Valid IT professionals	15	30.6	30.6	30.6
Users	6	12.2	12.2	42.9
Finance Department	2	4.1	4.1	46.9
Other management	17	34.7	34.7	81.6
External Consultants	4	8.2	8.2	89.8
Others	3	6.1	6.1	95.9
I don't know	2	4.1	4.1	100.0
Total	49	100.0	100.0	

This asserts that the IT professionals and other management are the parties that make important decisions regarding software purchases at the local authority.

4.3 Factors influencing OSS adoption by Kenyan local authorities, benefits and constraints

Open Source Software are by far the most valuable and yet under-utilized software category. The IS professionals gave feedback on the relevance of OSS at the local authorities. The use of OSS is rated on a 5 point likert scale.

Exploratory Factor Analysis

The table shows Kaiser-Meyer-Olkin Measure of Sampling Adequacy of 0.755, chi-square of 1629.875 and significance level of 0.000. Since Kaiser-Meyer-Olkin Measure of Sampling Adequacy is 0.755, the analysis is a good factor analysis because Kaiser-Meyer-Olkin Measure of Sampling Adequacy is more than 0.6. Bartlett's Test of Sphericity leads to rejection of the null hypothesis since the p value was established to be 0.000, which is less than α value.

Table 12: KMO and Bartlett's Test

Kaiser-Meyer-Olkin Measure of Sampling Adequacy.	.755	
Bartlett's Test of Sphericity	Approx. Chi-Square	1629.875
	Df	325
	Sig.	.000

Table 13 shows three columns of communalities, initial and extraction. Communalities represent proportion of different variables' variance whereas initials represent values of correlation with other variables. Since extraction has high values, it means that the variables are well represented.

The table 14 below show different attributes of the factor analysis such as factor, initial Eigenvalues, extraction sums of squared loadings and rotation sums of squared loadings. Factors are considered as the variables that were used in the factor analysis. The table shows 26 factors and not all the 26 factors were retained but only 4 factors were retained. The first four factors are the only variables that are retained. The column of initial Eigenvalues indicates the variances of the factors that were used in the analysis. Values of extraction sums of squared loadings are based upon common variance of the factors that have been retained. The values in the column of rotation sums of squared loadings

are distribution of variance of the factors that have been retained after the varimax rotation.

Table 13: Total Variance Explained

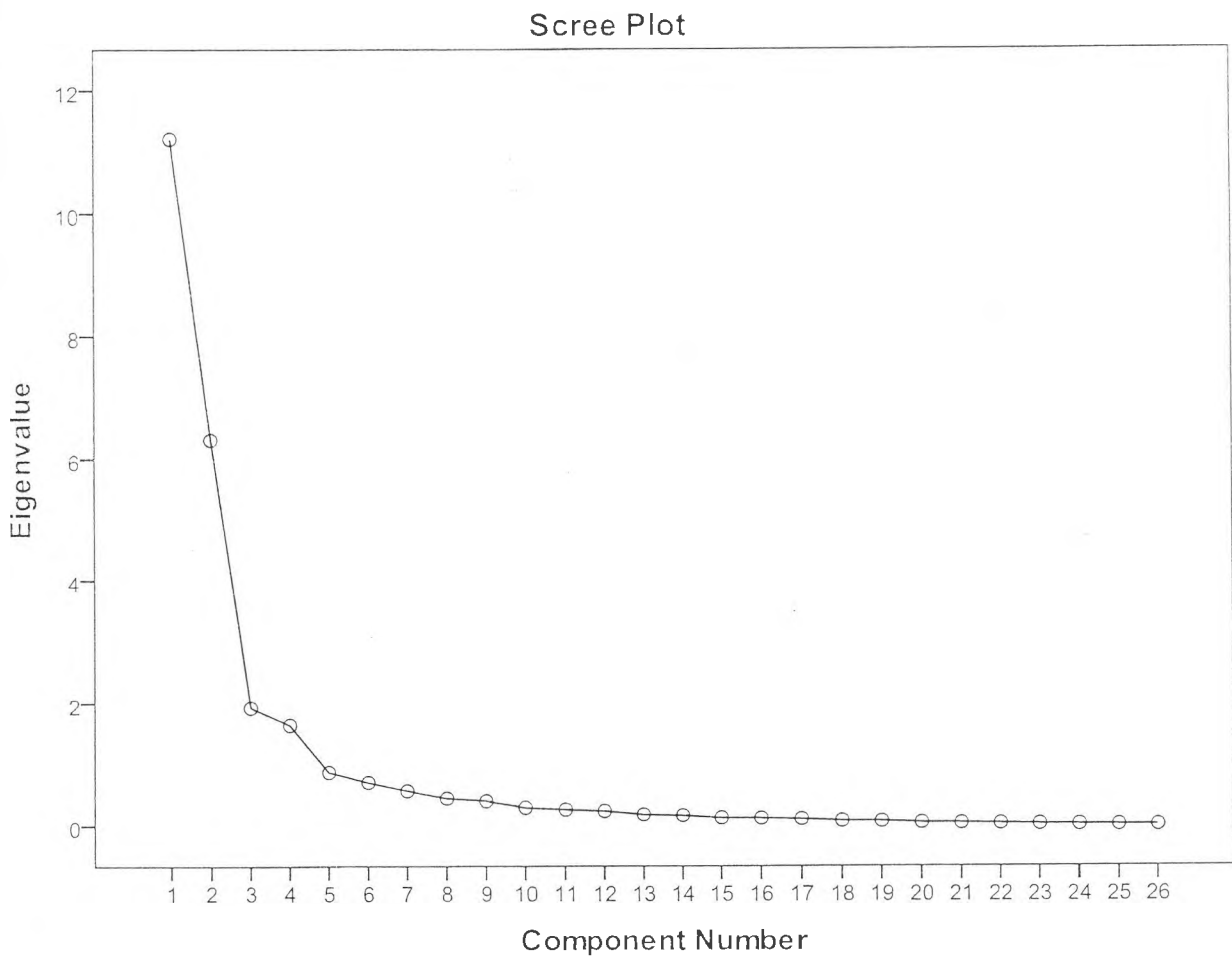
Total Variance Explained

Component	Initial Eigenvalues			Extraction Sums of Squared Loadings			Rotation Sums of Squared Loadings		
	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %
1	11.212	43.124	43.124	11.212	43.124	43.124	7.821	30.079	30.079
2	6.314	24.285	67.409	6.314	24.285	67.409	5.949	22.880	52.960
3	1.930	7.423	74.832	1.930	7.423	74.832	4.160	16.000	68.960
4	1.652	6.353	81.185	1.652	6.353	81.185	3.178	12.225	81.185
5	.878	3.378	84.563						
6	.714	2.746	87.309						
7	.575	2.211	89.519						
8	.451	1.736	91.255						
9	.406	1.562	92.817						
10	.298	1.147	93.964						

Extraction Method: Principal Component Analysis.

The graph overleaf shows a plot of eigenvalue against factor number. From the graph, after the first four factors the line is almost flat depicting that every successive factor accounts for very small amount of the overall variance.

Chart 3: Scree Plot



The main factors that were resultant were ease of use, customizability, reliability and synergy with existing software

The table below shows the level of correlation between factor and variable and the values are expected to be between -1 and +1. The component column shows the four factors that were extracted.

Table 14: Component Matrix

Component Matrix^a

	Component			
	1	2	3	4
Migrating to open source software is most likely to be successful in our organisation if championed by senior officers or top IS professionals	.837	.355	-.056	-.127
Government IT policy plays a major role in influencing migration to open source software in our organisation	.800	.422	-.092	-.116
A software's strategic importance to our organisation is key	.784	.446	.077	.132
If there is lack of human and financial resources our organisation would not adopt open source software	.783	.419	-.049	.260
Presence of staff with previous open source software experience in the organisation is important when considering migration to open source software	.778	.447	-.088	.094
Migrating to open source software makes more sense if the software functions have been tried and tested	.770	.259	.023	-.324
I prefer open source software because it gives me more freedom with the software	.755	.240	-.131	-.396
My organisation can significantly reduce the risk of prosecution for using pirated software by using Open source software	.748	.277	-.020	-.426
Our organization's approach toward IT/IS innovation is not conducive for taking up open source software at the moment	.736	.389	-.145	.174
Open source software is more scalable than proprietary software	.729	.478	-.244	.274
It is too hard for my organisation to find companies that provide technical support for open source software	.723	-.251	.415	.197
Open source software has poor documentation than proprietary software	.709	.459	-.090	.345

Open source software users require above average technical skills	.691	.494	-.164	.326
Open source software is easier to use than proprietary software	.685	-.565	.258	.177
I prefer open source software because it is less susceptible to security attacks such as malware and viruses	.651	-.284	.568	-.050
Software warranties are very important to our organisation	.631	-.284	.531	.017
Open source software can significantly reduce the expenditure for software in our organisation	.556	-.343	.506	-.192
Open source software can very easily be combined with proprietary software within the same IT system	-.471	.765	.298	.045
Migrating to open source software makes sense only if other organisations like mine do it first	-.483	.722	.298	.080
The IT policy in place in our organisation makes it difficult to migrate to open source software platform	-.434	.709	.222	.091
Open source software is complex to use	-.423	.709	.293	.062
Open source software is easier to customize than proprietary software	.479	-.653	.289	.244
Training people in my organisation to use open source software will be too expensive or take too much time	-.412	.648	.324	-.097
If open source software would only provide access to the source code, but would not be cheaper than proprietary software, my organisation would not use it	-.482	.627	.395	.102
Open source software is more reliable than proprietary software	.555	-.600	-.109	.322
IT vendors are too powerful I wish I could get more control over my software	.615	.169	.021	-.664

Extraction Method: Principal Component Analysis.

a. 4 components extracted.

These are rotated factor loading, which depict correlation between factor and variable. Varimax with Kaiser Normalization is used. The component column shows the factors that were extracted.

Table 15: Rotated Component Matrix

Rotated Component Matrix^a

	Component			
	1	2	3	4
Open source software is more scalable than proprietary software	.936	-.057	-.009	.115
Open source software users require above average technical skills	.922	.009	.042	.055
Open source software has poor documentation than proprietary software	.908	.012	.124	.038
If there is lack of human and financial resources our organisation would not adopt open source software	.896	-.024	.195	.136
Presence of staff with previous open source software experience in the organisation is important when considering migration to open source software	.849	-.016	.132	.290
Our organization's approach toward IT/IS innovation is not conducive for taking up open source software at the moment	.833	-.075	.094	.191
A software's strategic importance to our organisation is key	.831	.063	.277	.255
Government IT policy plays a major role in influencing migration to open source software in our organisation	.767	-.040	.124	.484
Migrating to open source software is most likely to be successful in our organisation if championed by senior officers or top IS professionals	.745	-.087	.191	.497
Open source software can very easily be combined with proprietary software within the same IT system	.025	.921	-.201	-.090
Migrating to open source software makes sense only if other organisations like mine do it first	.008	.893	-.188	-.134
If open source software would only provide access to the source code, but would not be cheaper than proprietary software, my organisation would not use it	-.055	.868	-.074	-.172
Open source software is complex to use	.037	.856	-.164	-.097

Training people in my organisation to use open source software will be too expensive or take too much time	-.058	.825	-.131	.040
The IT policy in place in our organisation makes it difficult to migrate to open source software platform	.057	.825	-.225	-.127
Open source software is more reliable than proprietary software	.229	-.742	.381	-.185
I prefer open source software because it is less susceptible to security attacks such as malware and viruses	.166	-.185	.844	.236
Software warranties are very important to our organisation	.188	-.197	.811	.168
It is too hard for my organisation to find companies that provide technical support for open source software	.369	-.273	.764	.047
Open source software can significantly reduce the expenditure for software in our organisation	.024	-.220	.754	.320
Open source software is easier to use than proprietary software	.201	-.577	.716	-.002
Open source software is easier to customize than proprietary software	.027	-.548	.688	-.157
IT vendors are too powerful I wish I could get more control over my software	.255	-.087	.159	.866
My organisation can significantly reduce the risk of prosecution for using pirated software by using Open source software	.512	-.086	.174	.720
I prefer open source software because it gives me more freedom with the software	.533	-.173	.100	.690
Migrating to open source software makes more sense if the software functions have been tried and tested	.550	-.089	.236	.632

Extraction Method: Principal Component Analysis.

Rotation Method: Varimax with Kaiser Normalization.

a. Rotation converged in 6 iterations.

Component transformation matrix is the matrix used to multiply unrotated matrix to be able to obtain rotated factor matrix

Table 16: Component Transformation Matrix

Component Transformation Matrix

Component	1	2	3	4
1	.711	-.398	.437	.381
2	.532	.763	-.324	.175
3	-.220	.509	.832	-.012
4	.403	-.027	.110	-.908

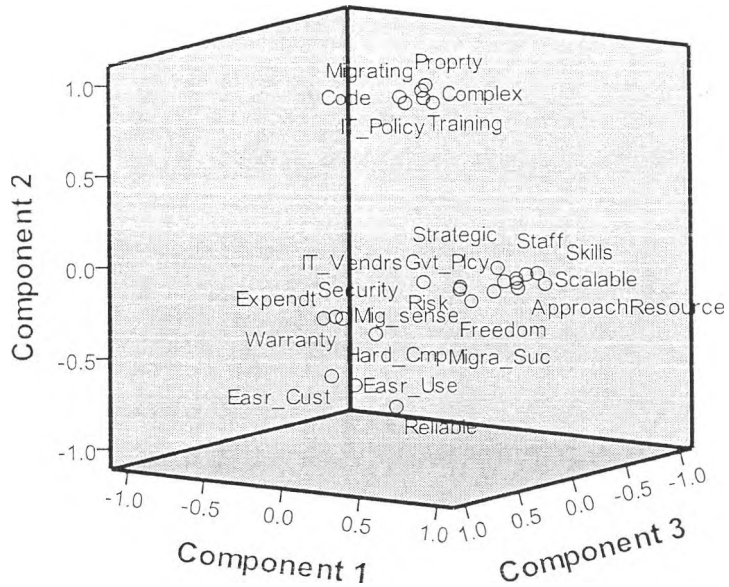
Extraction Method: Principal Component Analysis.

Rotation Method: Varimax with Kaiser Normalization.

The plot below shows different variables in rotated factor space as well as how they are organized.

Chart 4: Component Plot in Rotated Space

Component Plot in Rotated Space



The first factor consists mainly of usability, but documentation, availability of slack resources, presence of staff with prior experience on the technology also loads high on this factor. This could mean that for software to be considered usable, proper documentation is important. The presence of slack resources is also necessary to be directed towards making the software more user friendly. Again presence of staff with prior experience is important since it smoothens the learning and implementation process making the system more usable. The second factor is customizability; the access to source code measures correlate positively to customizability. This implies that with access to source code, OSS can easily be customized to fit desired specification. In the third factor, insusceptibility to security attacks loads highly. This could be mean that a reliable software should be less susceptible to attacks. In the fourth factor, more control

and freedom over software loads highly. This could imply that more freedom and control makes it easier to combine OSS with the existing systems

4.4 Discussion

The main aim of the study was to determine the factors that influence adoption of OSS and the benefits and risks of OSS adoption by local authorities in Kenya. The use of OSS is growing rapidly presenting with it numerous benefits to businesses and organisations that cannot be ignored. Trends especially in the developed countries show that OSS is increasingly being used for public service delivery and running government systems.

To answer the primary research question it was first necessary to look at factors influencing technology adoption by individuals and organisations. In its most basic form the OSS adoption decision remains a technology adoption decision and the factors influencing individual and organisational technology adoption decisions apply. Several technology adoption models and frameworks were described and technology adoption factors were found that resonated with adoption factors used to describe OSS adoption globally. From the factor analysis, the adoption factors can be classified into four categories below.

4.4.1 Customizability/Access to source code

Access to source code was found to be a relevant adoption factor as it is at the core of the OSS development methodology and produces software that is of high quality, adheres to open standards and runs on multiple platforms with 63.3% of the respondents supporting the fact that OSS is more scalable. However from previous studies, the lack of relevance that access to source has to some organisations has been found by both Dedrick and West (2004) and Ven, Verelst and Mannaert (2008). This is mostly true in an enterprise environment. The large number of developers involved in the development effort and the different platforms that OSS runs on means that software is also considered to be more efficient in terms of hardware resources. In general, users of OSS are not expected to change the source code unless they want to become part of the OSS development community. Software vendors and organisations with a software development capability use source code in their software development process to improve products and reduce

development time by reusing existing code. 71.4% of the respondents agreed that OSS is easier to customize than proprietary software.

4.4.2 Compatibility, Freedom, options and control

The OSS development methodology produces software that adheres to open standards and runs on different platforms. Organisations are therefore not bound to specific hardware and software vendors. From the findings, 67.3% of the respondents agree that commercial IT vendors are too powerful and wish they could get more control over their software. Consistent with Rogers (2003) and Dedrick and West (2003) the decision to adopt OSS was greatly influenced by the compatibility of the software with their current technology, skills and tasks. In addition, access to source code allows organisations to determine the quality of the software they are using and switch vendors if quality or functionality is not up to standard. OSS provides organisations with the choice to modify software to suit their specific needs as and when required, or use it as is. 69.4% of the respondents also echo that OSS gives them more freedom with the software. The availability of support is an important factor in technology adoption decisions. Vendor based OSS provides support similar to proprietary software solutions. Using certified OSS enables organisations to get support from both software and hardware vendors. Organisations choosing to use community based OSS should realise that they take the responsibilities of the software vendor onto themselves and they should have the appropriate skills and resources to fulfill that role. It is in this regard that 67.3% of the respondents were of the opinion that it is difficult to find companies that provide technical support for OSS.

4.4.3 Reliability/Technological factors

The OSS development methodology allows a large development community to access and improve the source code of the software they produce. Mature OSS is considered to be stable and reliable. Rogers (2003) argues that technologies are more likely to be adopted if they can be tried and assimilated in small chunks over time. All the same, 65.3% of the respondents were of the opinion that OSS is more reliable than proprietary software. As with any technology adoption choice the adopter has to take into account the maturity of the organisation providing the technology, as viewed by 65.3% of the

respondents. (whether it is a proprietary software vendor or an OSS project) and the support that can be expected from the organisation providing the technology. Opinions were divided. 55.1% on whether access to source code improves or degrades the security of OSS. OSS proponents argue that security problems are more visible (and fixable) in OSS as the possibility of finding security holes increase as the number of people looking at the source code increase. The lack of relevance that access to source code has to some organisations has been found by both Dedrick and West (2004) and Ven, Verelst and Mannaert (2008). The usability of OSS is considered to be either better or worse than proprietary software, depending on the application. In some cases the usability of OSS is better suited to technically oriented individuals rather than the general public as observed by 65.3% of the respondents who were of the opinion that serious OSS users require above average technical skills.

4.4.4 Usability

Organisational factors influencing technology adoption are also relevant to OSS adoption decisions. A change management process is important to overcome problems associated with the adoption of new technology. To support this, 61.3% of the respondents concurred that it is neither too expensive nor too time consuming to train people to use OSS. It is important that users of the technology are equipped with the needed skills through training. Getting management buy-in is an essential factor that has to be taken into account in the adoption decision, 65.3% of the respondents share the view. OSS adoption is typically championed in organisations by technical employees that understand the advantages of the OSS development model. 63.2% of the respondents are of the opinion that presence of staff with previous OSS experience in the organisation is important when considering migration to OSS. Previous IS adoption research has shown that the impact of boundary spanners or product champions can be important (e.g., Rai & Patnayakuni 1996, Srinivasan & Lilien & Rangaswamy 2002). Evidence of successful OSS adoption is an important factor in OSS adoption decisions, whether it is internal or external to the organisation. Organisations viewed as being the first adopter are considered risky and to be avoided at all costs. 57.1% of respondents concurred with this observation.

4.4.5 Benefits and risks OSS adoption

From the findings, the benefits of OSS adoption were identified to be scalability of OSS since it can run on different platforms, customizability with existing information systems, robust security due to reduced susceptibility to attacks, reliability, cost effectiveness and freedom. Zwollo (2003), through his study identified the several benefits of Open Source to governments. The OSS development methodology produces software that adheres to open standards and can be run on different platforms, reducing the reliance on a single vendor, increases competition and reduces adoption costs. OSS also has the additional potential to reduce costs as compared to proprietary software as it uses hardware more efficiently.

The inherent constraints were found to be poor documentation in some developments. It was also perceived that OSS use required above average skills and that finding technical support for OSS products was not that easy. Despite the significant adoption of OSS, there may still be a lack of expertise and support for specific products (Verelst, Mannaert, & Ven, 2008). The lack of professional providers may also introduce unclear liability and uncertainty about the longevity of OSS project as OSS projects may lack roadmaps and documentation (Morgan & Finnegan, 2007)

CHAPTER FIVE

SUMMARY, CONCLUSION AND RECOMMENDATIONS

5.1 Introduction

This chapter gives a summary of the findings as well as the conclusions drawn from the analysis of the data as well as recommendations of the study. It addresses the research questions and outlined objectives and gives suggestions for further research.

5.2 Summary of the findings

The factors identified in the Literature Review have been found to be relevant not only to OSS adoption decisions in the Kenyan local authorities' context but to any software adoption decisions. Interview answers and factors from the analysis also revealed that software adoption decisions are rarely about choosing between OSS and proprietary software. Software adoption decisions are about using sound IT governance and business principles to make decisions that enable companies to be successful through the right software choices. The benefits and constraints as identified in the literature review were also found to be relevant while adopting OSS by Kenyan local authorities.

The OSS development model results in software that inherently adheres to principles that help organisations avoid vendor lock-in and the costs associated with vendor lock-in. Common misperceptions that OSS is always free and that you have to depend only on the OSS community for support have been found to be false. OSS vendors compete in the software space with other OSS vendors and proprietary software vendors.

A key finding of the quantitative research process is that OSS and proprietary software adoption decisions take the similar factors into account. OSS provides organisations with the freedom to choose if they want to use a software vendor or become the software vendor. Organisations can choose if they want to become part of the OSS development community by modifying source code or if they only want the benefits of the OSS development methodology and never look at the source code. The adoption factor that

becomes relevant when considering OSS is the fact that it provides more freedom. not to change the source code or to download software from the Internet, but the freedom to choose.

5.3 Conclusion

OSS adoption in Kenyan public and private sector organisations is not widespread despite the inherent benefits. All of the factors found to be relevant in literature were also found to be relevant in the Kenyan context. From the exploratory factor analysis done, four predominant factors were resultant that influence adoption of OSS. These were ease of use, customizability, reliability and compatibility/synergy with existing system. Typical concerns around the support and technological capabilities of OSS were raised in interviews with some local authorities and addressed during interviews with others. If one considers the wide range of available OSS it is inevitable that future software adoption decisions will include both proprietary software and OSS options. The general consensus of the adoption factors investigated as part of this research is that OSS provides a viable alternative to proprietary software. The key differentiator of OSS lies not in the ideological reasons for adopting free software, but in the power of the OSS development methodology.

The study was carried out on local authorities since the county governments were not in place at the time of the research. The county governments however draw a striking resemblance from the local authorities' structures and the findings can easily be mapped to the counties. Open Source technologies present a lot of opportunities for counties. This is because OSS can easily be customized to suit the local context due access to source code. Also due to OSS compatibility, freedom, options and control, the counties can be able to run the software in different platforms, thereby not bound by vendors and having the options of choosing quality software. The reliability of OSS also presents a significant opportunity to the counties because of increased up times, robust and secure systems. Open source technologies have a huge contribution in the IT arena and their potential contribution towards the development of counties cannot be ignored, especially while taking into account the scarce resources that are available to the task. The counties will be

operating under tight budgets but with a lot of expectations on the deliverables. The adoption and use of OSS will therefore provide a good mix for a superior system at a reasonable cost.

5.4 Recommendations

It has been shown that the same factors apply when considering an OSS alternative as when adopting any new technology. Organisations considering OSS should also take into account the advantages of the OSS development methodology as opposed to proprietary software, specifically the inherent use of open standards and the capability of running software on multiple operating systems and multiple hardware platforms. Through these factors, OSS provides organisations with the possibility to choose vendor independent software, significantly reducing the risks associated with new technology adoption. Increased software efficiency and the possibility of reusing existing hardware result in organisations using hardware more efficiently and lowering hardware costs. It is important to take into account not only the software costs, but all the costs relevant to a specific IT solution.

5.5 Limitations of the Study

The research was constrained by a number of factors that may have affected the results. The study faced challenges of time resources limiting the study from collecting more information for the study particularly where the respondent delay in meeting appointments and travelling for collection of the filled questionnaires.

5.6 Suggestions for further research

This study serves to improve the knowledge of OSS in Kenya and has contextualised some of the international research by interviewing representatives from local organisations. However, further room for research into OSS, an increasingly important aspect of ICT adoption and growth in Kenya is suggested. Further research on OSS adoption in Kenyan organisations could include the following: a quantitative study of OSS adoption in Kenyan organisations; a study into the availability and perception of OSS vendors in Kenya; case studies investigating OSS adoption successes and failures in Kenya.

REFERENCES

- Benson, C., Elman, A., Nickell, S., & Colin, Z. (2002). *GNOME Human Interface Guidelines 1.0*. Retrieved August 29, 2011, from The GNOME Usability Project: <http://developer.gnome.org/hig-book/3.0/hig-book.html#principles-people>
- Biot, S. (2002). *KDE Usability Project*. Retrieved August 29, 2011, from KDE Usability — First Steps: <http://dot.kde.org/2002/05/14/kde-usability-team-takes-first-steps?page=1>
- Bretthuaer, D. (2002, Mar). Open Source Software: A History. *Information Technology and Libraries*, 21(1), pp. 33-7.
- Brink., D., Roos, L., Weller, J., & Van Belle, J.-P. (2006). Critical Success Factors for Migrating to OSS-on-the-Desktop: Common Themes across Three South African Case. *2nd IFIP Working Group 2.13 International Conference on Open Source Software (OSS2006) - Open Source Systems* (pp. 287-293). Como, Italy: Springer.
- Cassell, M. (2008). Why Governments Innovate: Adoption and Implementation of Open Source Software by Four European Cities. *International Public Management Journal*, 11(2), 193-213.
- CLGF. (2011). *Local Government System in Kenya*. Retrieved August 03, 2011, from CLGF (Commonwealth Local Government Forum): http://www.clgf.org.uk/userfiles/CLGF/File/2008_Country_Files/KENYA.pdf
- Constitution of Kenya. (2010). *Constitution of Kenya 2010*. Retrieved May 10, 2011, from Kenya Law: http://www.kenyalaw.org/klr/fileadmin/pdfdownloads/Constitution_of_Kenya__2010.pdf
- CSIS. (2010). *Government Open Source Policies 2010*. Retrieved May 10, 2011, from Centre for Strategic and International Studies (CSIS): https://csis.org/files/publication/100416_Open_Source_Policies.pdf
- Davis, F. D. (1989, September). Perceived Usefulness, Perceived Ease of Use, and User Acceptance of Information Technology. *MIS Quarterly*.
- Dedrick, J., & West, J. (2008). Movement Ideology vs. User Pragmatism in the Organisational Adoption of Open Source Software. In: Kraemer, K., Elliott, M. Computerization Movements and Technology Diffusion: From Mainframes to Ubiquitous Computing. *Medford: Information Today*, 1.

- Federspiel, S. B. & B. Brincker (2010). Software as Risk: Introduction of Open Standards in the Danish Public Sector. *The Information Society* 26 (1), 38-47.
- Fitzgerald, B. & Kenny, T. (2004). Developing an Information Systems Infrastructure with Open Source Software. *IEEE Software* 21(1), 50-55.
- Fitzgerald, B. (2009). Open Source Software Adoption: Anatomy of Success and Failure. *International Journal of Open Source Software & Processes*, 1(1), 1-23.
- Frishberg, N., Dirks, A., Benson, C., Nickel, S., & Smith, S. (2002). Getting to know you: open source development meets usability. In *Extended Abstracts of the Conference on Human Factors in Computer Systems* (pp. 932-933). New York: ACM Press.
- Garfinkel, S. (2003, Feb). The Free-Software Imperative. *Technology Review*, p. p.30.
- Gillmor, D. (2003, Sept 14). Dan Gillmor Column. *San Jose Mercury News*.
- GOK. (2004). Retrieved from E-government Strategy: <http://www.e-government.go.ke>
- Griffith, B. (2003, Oct 28). Public Sector IT Chiefs favour Open Source. *Computer Weekly*.
- Holck, J., Larsen, M. H., & Pedersen, M. (2005). Managerial and Technical Barriers to the Adoption of Open Source Software. In Xavier Franch and Daniel N. Port, editors, *Proceedings of the 4th International Conference on Component-Based Software Systems (ICCBSS 2005)* (pp. 289-300). Bilbao, Spain: Springer.
- Huysmans, P., Ven, K. & Verelst, J. (2008). Reasons for the non-adoption of OpenOffice.org in a data-intensive public administration. *First Monday* 13(10).
- IfG. (2011). *How ICT can change local government*. Retrieved August 03, 2011, from Institute for eGovernment: http://www.ifg.cc/index?option=com_content&task=view&id=35281&Itemid=93
- Jaaksi, A. (2007). Experiences on Product Development with Open Source Software. In Feller et al. [11], pages 85-96. *3rd IFIP Working Group 2.13 International Conference on Open Source Software (OSS2007) - Open Source Development, Adoption and Innovation* (pp. 85-96). Limerick, Ireland: Springer.
- Johnson, J. (2001). Economics of Open Source Software. *mimeo*, p.27.
- Kantor, G.; Wilson, W. & Midgley, A. (2003). Open-source software and the primary care EMR. *Journal of the American Medical Informatics Association* 10(6), 616.

- Lewis, J. (2004). Global Policies on Open Source Software. Technical report, Center for Strategic and International Studies (CSIS).
- Lewis, J. (2006). Global Policies on Open Source Software. Technical report, Center for Strategic and International Studies (CSIS).
- Lewis, J. (2007). Global Policies on Open Source Software. Technical report, Center for Strategic and International Studies (CSIS).
- Lewis, J. (2008). Global Policies on Open Source Software. Technical report, Center for Strategic and International Studies (CSIS).
- Levesque, M. (2004). *Fundamental issues with open source software development*. Retrieved 08 01, 2011, from First Monday:
<http://firstmonday.org/htbin/cgiwrap/bin/ojs/index.php/fm/article/viewArticle/1484/1399>
- Ministry of Local Government. (2011). *Local Authorities*. Retrieved August 23, 2011, from Ministry of Local Government:
http://www.localgovernment.go.ke/index.php?option=com_content&view=article&id=191&Itemid=305
- Misuraca, G. (2006). *LOG-IN Africa local governance and ICTs research network for Africa*. Retrieved August 03, 2011, from <http://www.informatik.uni-trier.de/~ley/db/conf/dgo/dgo2006.html#Misuraca06a>
- Morgan, L., & Finnegan, P. (2007). Benefits and Drawbacks of Open Source Software: An Exploratory Study of Secondary Software Firms. In Feller et al. [11], pages 307–312. *3rd IFIP Working Group 2.13 International Conference on Open Source Software (OSS2007) - Open Source Development, Adoption and Innovation* (pp. 307-312). Limerick, Ireland: Springer.
- Mukerji, B., Kumar, V. & Kumar, U. (2006). The Challenges of Adopting Open Source Software in Promoting E-government. In Bhattacharya (Eds). *Technology in government*. GIFT Publishing.
- Munoz Cornejo, G., Seaman, C. & Koru, A. (2008). An empirical investigation into the adoption of open source software in hospitals. *International Journal of Healthcare Information Systems and Informatics* 3(3), 16-37.

- Netcraft. (2011, Apr). *April 2011 Web Server Survey*. Retrieved May 11, 2011, from Netcraft: <http://news.netcraft.com/archives/2011/04/06/april-2011-web-server-survey.html>
- Neumann, P. G. (1999, Feb). Inside Risks: Robust Open-Source software. *Communications of the ACM*, p. 128.
- Nielsen, J. (1993). Usability engineering life cycle. *IEEE Computer*, 12-22.
- Nuvolari, A. (2004). *Open Source Software Development: Some Historical Perspectives*. Retrieved July 14, 2011, from CiteSeerX: <http://citeseerx.ist.psu.edu/viewdoc/download?doi=10.1.1.13.6438.pdf>
- Omore, O. C. (2011, March 8). *The challenges and opportunities facing new-fangled county forums*. Retrieved August 23, 2011, from Daily Nation: <http://www.nation.co.ke/oped/Opinion/-/440808/1121284/-/item/1/-/xjdbgbz/-/index.html>
- Perens, B. (1999). The Open Source Definition. In M. Stone, S. Ockman, & C. Dibona, *Open sources: Voices from the open source revolution*. Sebastopol, California: O'Reilly & Associates.
- Perens, B. (2004, May 4). *The open source definition*. Retrieved May 4, 2004, from Open Source Initiative: http://opensource.org/docs/def_print.php
- Raymond, E. (1999, June 28). *Shut Up And Show Them The Code*. Retrieved May 11, 2011, from <http://www.catb.org/~esr/writings/shut-up-and-show-them.html>
- Reese, N. (2004). *An Analysis of the Adoption of Open Source Software in Developing Countries*. Sydney.
- Rogers, E. M. (1995). *Diffusion of Innovations (Fourth Edition)*. New York: Free Press.
- Scacchi, W., Gasser, L., Ripoche, G., & Penne, B. (2003). Understanding continuous design in F/OSS Projects. *16th International Conference On Software and Systems Engineering and its Applications (ICSSEA-03)*. Paris, France.
- Shih, Y., & Fang, K. (2004). The use of a decomposed theory of planned behavior to study Internet banking in Taiwan. *Internet Research*, 14(3), 213-223.
- Stallman, R. (2007). *Why "Free Software" is better than "Open Source"*. Retrieved May 10, 2011, from GNU Operating System: <http://www.gnu.org/philosophy/free-software-for-freedom.html>

- Story, A. (2002). *Copyright, Software and the Internet - Commission Background Paper 5*. Retrieved May 11, 2011, from Commission on Intellectual Property Rights: http://www.iprcommission.org/papers/pdfs/final_report/Ch5final.pdf
- Tiangco, F., Stockwell, A., Sapsford, J., & Rainer, A. (2003). Open-source software in an occupational health application: the case of Heales Medical Ltd. In Scotto and Succi [26], pages 130–134. In E. Rogers, *Diffusion of Innovations* (pp. 130-134). New York: Free Press.
- Taylor, M., & Murphy, A. (2004). SMEs and e-business. *Journal of Small Business and Enterprise Development*, 11(3), 280-289.
- Tornatzky, L., & Fleischer, M. (1990). *The Processes of Technological Innovation*. Lexington, MA: Lexington Books.
- Tornatzky, L., & Klein, K. (1982). Innovation Characteristics and Innovation Adoption - Implementation: A Meta-Analysis of Findings. *IEEE Transactions on Engineering Management*, 29(1).
- Valdes, I., Kibbe, D., Tolleson, G., Kunik, M. & Petersen, L. (2004). Barriers to proliferation of electronic medical records. *Informatics in Primary Care* 12(1), 3-9.
- Ven, K., Huysmans, P. & Verelst, J. (2007). The Adoption of Open Source Desktop Software in a Large Public Administration. *Proceedings of the 13th Americas Conference on Information Systems (AMCIS2007)*, 9-12.
- Verelst, J., Mannaert, H., & Ven, K. (2008). Should You Adopt Open Source Software? *IEEE Software*, 25(3), 54-59.
- von Hippel, E., & von Krogh, G. (2003). Open Source Software and the “PrivateCollective” Innovation Model: Issues for Organizational Science. *Organizational Science*, Vol. 14, No. 2.
- Von Krogh, G. & S. Spaeth (2007). The open source software phenomenon: Characteristics that promote research. *The Journal of Strategic Information Systems* 16 (3), 236-253.
- Wagner, M. (2000). The Credibility Factor — Giants Get Linux Religion. *Internet Week*, 1.
- Waring, T. & Maddocks, P. (2005). Open Source Software implementation in the UK public sector: Evidence from the field and implications for the future. *International journal of information management* 25(5), 411-428.

- Weber, S. (2003). *Open Source Software in Developing Economies*. Retrieved November 2006, 20. from SSRN:
http://www.ssrn.org/programs/itic/publications/ITST_materials/webernote2.pdf
- Weerawarana, S., & Weeratunge, J. (2004). *Open Source in Developing Countries*.
Department for Infrastructure and Economic Cooperation.
- West, J., & Dedrick, J. (2001). Open Source Standardization: The Rise of Linux in the Network Era. *Knowledge, Technology & Policy*, 14(2), 88-112.
- Zwollo, A. (2003). *Why should Governments embrace Free/Open Source Software*.
Retrieved June 4, 2004, from
<http://www.codigoabierto.gob.mx/govfoss/GovFOSS.pdf>

APPENDICES

APPENDIX I: LETTER OF INTRODUCTION TO RESPONDENTS

October, 2011

MBA RESEARCH PROJECT

RE: INTRODUCTION LETTER

I am a student at University of Nairobi pursuing a Masters of Business Administration program.

Pursuant to the pre-requisite course work, am supposed to undertake a research project on investigating Open Source Software Adoption by Kenyan Counties Based on Selected Local Authorities. The focus of my research will be the factors that influence Open Source Software adoption by Kenyan local authorities, Open Source Software benefits and constraints and this will involve use of interview questionnaires administered to IS professionals.

I kindly seek your authority to conduct the research at the local authority through questionnaires and use of relevant documents. I have enclosed an introductory letter from the University. Your assistance is highly valued.

Thank you in advance.

Yours faithfully,

Japheth Dibo
MBA student

APPENDIX 2: QUESTIONNAIRE

SECTION A: PRELIMINARY INFORMATION

(This section requires you to give general information regarding your local authority. Please tick [] or fill in where appropriate).

1. Name _____ (optional)
 2. Name of your local authority _____
 3. Your position within the organisation _____
 4. How many years have you worked for the organisation _____
 5. How many people work in IT department?
Roughly: _____ (number) I don't know []
 6. How many Servers & PCs (including Laptops) do you have in your organisation?
Number of PCs: _____ Number of servers: _____ I don't know []
 7. Roughly speaking, how large is the IT budget of your organisation in 2011?
Roughly _____ KES (number) I don't know []
 8. Roughly speaking, what is the percentage of the share of licence fees for software in your IT budget? Roughly _____ % I don't know []
 9. What do you think: Is this share of license fees too high, too low, or reasonable?
1 [] too high 2 [] too low 3 [] reasonable 4 [] I don't know
 10. Do you use open source software systems in your local authority?
Yes [] No [] I don't know []
- a) **If answer is yes:** In which situation(s) does your organisation use open source software mostly? [**Note:** multiple answers are possible)
- On the desktop we use open source software (almost) exclusively. []
 - On the desktop we use open source software partially. []
 - On the servers we use open source software (almost) exclusively. []
 - On the servers we use open source software partially. []
 - We experiment with open source software in pilot projects. []

11. Which if any of the following software systems do you use in your organisation?

Apache	<input type="checkbox"/>	KDE	<input type="checkbox"/>	Perl	<input type="checkbox"/>
GNOME	<input type="checkbox"/>	Mozilla	<input type="checkbox"/>	Samba	<input type="checkbox"/>
Linux	<input type="checkbox"/>	OpenOffice	<input type="checkbox"/>	FreeBSD/OpenBSD	<input type="checkbox"/>
MySQL	<input type="checkbox"/>	PHP	<input type="checkbox"/>	Others (Specify)	_____
Squid	<input type="checkbox"/>	Zope	<input type="checkbox"/>		

12. Which Operating Systems are the basis of your IT system?

Windows	<input type="checkbox"/>	BEOS	<input type="checkbox"/>	I don't know	<input type="checkbox"/>
BSD	<input type="checkbox"/>	NETWARE	<input type="checkbox"/>	Others (Specify)	_____
MacOS	<input type="checkbox"/>	Linux	<input type="checkbox"/>		
SOLARIS	<input type="checkbox"/>	UNIX	<input type="checkbox"/>		

13. Would you find it useful to increase the share of open source software in your organisation?

Yes No I don't know

a) If answer is YES: On the long run, what would you prefer: to replace some proprietary software components by open source software or to replace all proprietary software components by open source software?

To replace SOME components To replace ALL components
I don't know

14. Would it be a substantial improvement for your IT Department to have access to the source code of the software you use?

Yes No I don't know

15. Who is most important for decisions on software purchases in your organisation, the IT Professional(s) (i.e. yourself), the users, the finance department, other management, or external consultants?

(NOTE: not more than 2 answers, rank them)

IT Professional (yourself)	<input type="checkbox"/>	External consultants	<input type="checkbox"/>
Users	<input type="checkbox"/>	Others	<input type="checkbox"/>
Finance department	<input type="checkbox"/>	I don't know	<input type="checkbox"/>
Other management	<input type="checkbox"/>		

SECTION B: INFORMATION ON OPEN SOURCE SOFTWARE ADOPTION

(This section requires you to give information regarding open source software and your local authority. Please tick).

1. Would you please indicate whether you agree strongly, agree, disagree, or disagree strongly with the following statements? Please let me also know when you have no opinion about a statement.

	Strongly disagree	Disagree	Agree	Strongly agree
Open source software is easier to use than proprietary software				
Open source software is easier to customise than proprietary software.				
Open source software is more reliable than proprietary software.				
Open source software can very easily be combined with proprietary software within the same IT system.				
If open source software would only provide access to the source code, but would not be cheaper than proprietary software, my organisation would not use it!				
It is too hard for my organisation to find companies that provide technical support for open source software.				
Migrating to open source software makes sense only if other organisations like mine do it first.				
Training people in my organisation to use open source software will be too expensive or take too much time.				
I prefer open source software because it is less susceptible to security attacks such malware and viruses.				
Software warranties are very important to our organisation.				
The IT policy in place in our organisation makes it difficult to migrate to open source software platform.				

		Strongly disagree	Disagree	Agree	Strongly
l	IT vendors are too powerful I wish I could get more control over my software.				
ll	Open source software can significantly reduce the expenditure for software in our organisation.				
n	My organisation can significantly reduce the risk of prosecution for using pirated software by using Open source software.				
o	I prefer open source software because it gives me more freedom with the software.				
p	Government IT policy plays a major role in influencing migration to open source software in our organisation.				
q	Migrating to open source software is most likely to be successful in our organisation if championed by senior officers or top IS professionals.				
r	Open source software is complex to use.				
s	Migrating to open source software makes more sense if the software functions have been tried and tested				
t	Our organisation's approach toward IT/IS innovation is not conducive for taking up open source software at the moment				
u	Software's strategic importance to our organisation is key.				
v	Presence of staff with previous open source software experience in the organisation is important when considering migration to open source software.				
w	If there is lack of human and financial resources our organisation would not adopt open source software.				
x	Open source software is more scalable than proprietary software.				
y	Open source software has poor documentation than proprietary software.				
z	Open source software users require above average technical skills.				

THANK YOU!!

APPENDIX 3: LIST OF LOCAL GOVERNMENTS

List of local authorities in Kenya

Nairobi Province

- **Nairobi District**
 - Nairobi city

- Maragua town council
- Maragua county council
- Kandara town council
- Makuyu town council

Central Province

- **Kiambu District**
 - Kiambu municipality
 - Kiambu county council
 - Limuru municipality
 - Kikuyu town council
 - Karuri town council
- **Kirinyaga District**
 - Kerugoya/Kutus municipality
 - Kirinyaga county council
 - Sagana town council
- **Muranga District**
 - Murang'a municipality
 - Murang'a county council
 - Kangema town council
- **Nyandarua District**
 - OlKalou town council
 - Nyandarua county council
- **Nyeri District**
 - Nyeri municipality
 - Nyeri county council
 - Karatina municipality
 - Othaya town council
- **Thika District**
 - Thika municipality
 - Thika county council
 - Ruiru municipality
- **Maragua District**

Coast Province

- **Kilifi District**
 - Kilifi town council
 - Kilifi county council
 - Mariakani town council
- **Kwale District**
 - Kwale town council
 - Kwale county council
- **Lamu District**
 - Lamu county council
- **Malindi District**
 - Malindi municipality
 - Malindi county council
- **Mombasa District**
 - Mombasa municipality
- **Taita-Taveta District**
 - Taita-Taveta county council
 - Taveta town council
 - Voi municipality
- **Tana River District**
 - Tana river county council

Eastern Province (Kenya)|Eastern Province

- **Embu District**
 - Embu municipality
 - Embu county council
 - Runyenjes municipality

- **Isiolo District**
 - Isiolo county council
- **Kitui District**
 - Kitui municipality
 - Kitui county council
- **Makueni District**
 - Wote town council
 - Makueni county council
 - MtitoAndei town council
- **Machakos District**
 - Machakos municipality
 - Masaku county council
 - Mavoko municipality (Athi River town)
 - Kangundo town council
 - Matuu town council
- **Marsabit District**
 - Marsabit county council
- **Mbeere District**
 - Mbeere county council
- **Meru Central District**
 - Meru municipality
 - Meru county council
- **Meru North District** (Nyambene District)
 - Maua municipality
 - Myambene county council
- **Meru South District** (Nithi District)
 - Chuka municipality
 - Chogoria town council
 - Meru south county council
- **Moyale District**
 - Moyale county council

- **Mwingi District**
 - Mwingi town council
 - Mwingi county council
- **Tharaka District**
 - Tharaka county council

North Eastern Province (Kenya)|North Eastern Province

- **Garissa District**
 - Garissa municipality
 - Garissa county council
- **Mandera District**
 - Mandera town council
 - Mandera county council
- **Wajir District**
 - Wajir county council
- **Ijara District**
 - Ijara county council

Nyanza Province

- **Gucha District**
 - Ogembo town council
 - Gucha county council
 - Nyamarambe town council
 - Nyamache town council
 - Tabaka town council
- **Homa Bay District**
 - Homa Bay municipality
 - Homa Bay county council
- **Kisii Central District**
 - Kisii municipality
 - Gusii county council
 - Keroka town council
 - Suneka town council
 - Masimba town council
- **Kisumu District**

- Kisumu municipality
- Kisumu county council
- **Kuria District**
 - Kehancha municipality
- **Migori District**
 - Migori municipality
 - Migori county council
 - Rongo town council
 - Awendo town council
- **Nyamira District (North Kisii District)**
 - Nyamira town council
 - Nyamira county council
 - Nyansiongo town council
- **Rachuonyo District**
 - Oyugis town council
 - Kendu Bay town council
 - Rachuonyo county council
- **Siaya District**
 - Siaya municipality
 - Siaya county council
 - Yala town council
 - Ugunja town council
 - Ukwala town council
- **Suba District**
 - Mbita Point town council
 - Suba county council
- **Bondo District**
 - Bondo town council
 - Bondo county council
- **Nyando District**
 - Nyando county council
 - Muhoroni town council
 - Ahero town council

Rift Valley Province, Kenya | Rift Valley Province

- **Baringo District**
 - Kabarnet municipality
 - Baringo county council
- **Bomet District**
 - Bomet municipality
 - Bomet county council
- **Buret District**
 - Litein town council
 - Buret county council
 - Sotik town council
- **Keiyo District**
 - Iten/Tambach town council
 - Keiyo county council
- **Kajiado District**
 - Kajiado town council
 - Olkejuado county council
- **Kericho District**
 - Kericho municipality
 - Kipsigis county council
 - Londiani town council
 - Kipkelion town council
- **Koibatek District**
 - Eldama Ravine town council
 - Koibatek county council
- **Laikipia District**
 - Nanyuki municipality
 - Laikipia county council
 - Nyahururu municipality
 - Rumuruti town council
- **Marakwet District**
 - Marakwet county council
 -

- **Nakuru District**
 - Nakuru municipality
 - Nakuru County Council
 - Naivasha municipality
 - Molo town council
- **Nandi District**
 - Kapsabet municipality
 - Nandi county council
 - Nandi Hills town council
- **Narok District**
 - Narok town council
 - Narok county council
- **Samburu District**
 - Maralal town council
 - Samburu county council
- **Trans Mara District**
 - Trans Mara county council (Kilgoris)
- **Trans-Nzoia District**
 - Kitale municipality
 - Nzoia county council
- **Turkana District**
 - Lodwar municipality
 - Turkana county council
- **UasinGishu District**
 - Eldoret municipality
 - Wareng county council
 - Burnt Forest town council
- **West Pokot District**
 - Kapenguria municipality
 - Pokot county council
 - Chepareria town council
- **Bungoma District**
 - Bungoma municipality
 - Bungoma county council
 - Kimilili municipality
 - Sirisia town council
 - Malakisi town council
 - Webuye municipality
- **Busia District**
 - Busia municipality
 - Busia county council
 - Funyula town council
 - Nambale town council
 - Port Victoria town council
- **Butere/Mumias District**
 - Butere-Mumias county council
 - Mumias municipality
- **Mount Elgon District**
 - Mount Elgon county council
- **Kakamega District**
 - Kakamega municipality
 - Kakamega county council
 - Malava town council
- **Lugari District**
 - Lugari county council
- **Teso District**
 - Malaba town council
 - Teso county council
- **Vihiga District**
 - Vihiga municipality
 - Vihiga county council
 - Luanda town council

Western Province (Kenya)|Western Province

- **Bungoma District**

APPENDIX 4: TABLES

Table 17: Communalities

Communalities

	Initial	Extraction
Open source software is easier to use than proprietary software	1.000	.886
Open source software is easier to customize than proprietary software	1.000	.799
Open source software is more reliable than proprietary software	1.000	.783
Open source software can very easily be combined with proprietary software within the same IT system	1.000	.898
If open source software would only provide access to the source code, but would not be cheaper than proprietary software, my organisation would not use it	1.000	.791
It is too hard for my organisation to find companies that provide technical support for open source software	1.000	.796
Migrating to open source software makes sense only if other organisations like mine do it first	1.000	.850
Training people in my organisation to use open source software will be too expensive or take too much time	1.000	.703
I prefer open source software because it is less susceptible to security attacks such malware and viruses	1.000	.830
Software warranties are very important to our organisation	1.000	.760
The IT policy in place in our organisation makes it difficult to migrate to open source software platform	1.000	.750
IT vendors are too powerful I wish I could get more control over my software	1.000	.848
Open source software can significantly reduce the expenditure for software in our organisation	1.000	.720
My organisation can significantly reduce the risk of prosecution for using pirated software by using Open source software	1.000	.819
I prefer open source software because it gives me more freedom with the software	1.000	.801
Government IT policy plays a major role in influencing migration to open source software in our organisation	1.000	.840

Migrating to open source software is most likely to be successful in our organisation if championed by senior officers or top IS professionals	1.000	.847
Open source software is complex to use	1.000	.771
Migrating to open source software makes more sense if the software functions have been tried and tested	1.000	.766
Our organization's approach toward IT/IS innovation is not conducive for taking up open source software at the moment	1.000	.744
A software's strategic importance to our organisation is key	1.000	.837
Presence of staff with previous open source software experience in the organisation is important when considering migration to open source software	1.000	.822
If there is lack of human and financial resources our organisation would not adopt open source software	1.000	.860
Open source software is more scalable than proprietary software	1.000	.893
Open source software has poor documentation than proprietary software	1.000	.841
Open source software users require above average technical skills	1.000	.855

Extraction Method: Principal Component Analysis.

Table 18: Total Variance Explained

Total Variance Explained

Component	Initial Eigenvalues			Extraction Sums of Squared Loadings			Rotation Sums of Squared Loadings		
	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %
1	11.212	43.124	43.124	11.212	43.124	43.124	7.821	30.079	30.079
2	6.314	24.285	67.409	6.314	24.285	67.409	5.949	22.880	52.960
3	1.930	7.423	74.832	1.930	7.423	74.832	4.160	16.000	68.960
4	1.652	6.353	81.185	1.652	6.353	81.185	3.178	12.225	81.185
5	.878	3.378	84.563						

6	.714	2.746	87.309				
7	.575	2.211	89.519				
8	.451	1.736	91.255				
9	.406	1.562	92.817				
10	.298	1.147	93.964				
11	.266	1.023	94.987				
12	.240	.922	95.909				
13	.184	.707	96.616				
14	.168	.646	97.262				
15	.128	.494	97.755				
16	.122	.468	98.223				
17	.110	.425	98.648				
18	.082	.314	98.962				
19	.075	.287	99.249				
20	.053	.202	99.452				
21	.043	.166	99.617				
22	.033	.127	99.745				
23	.024	.093	99.838				
24	.019	.074	99.912				
25	.013	.052	99.963				
26	.010	.037	100.000				

Extraction Method: Principal Component Analysis