OPEN SOURCE APPLICATIONS IN COMMERCIAL BANKS IN KENYA

GEORGE MBURU GITHAIGA

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DECLARATION

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

Name: George M. Githaiga

ID: D61/72885/2009

Signature _____   Date: _____

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

Lecturer: Mr. J. T. Kariuki

Signature _____   Date: _____

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Many thanks to the Almighty God for seeing me through the entire program. I live for you God.

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DEDICATION

To my family and all those who supported me in the completion of this project.

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LIST OF ABBREVIATIONS

ATM	-	Automatic Teller Machine
BSD	-	Berkeley Software Distribution
CBK	-	Central Bank of Kenya
CTS	-	Cheque Truncation System
DB	-	Database
DHCP	-	Dynamic Host Configuration Protocol
DNS	-	Domain Name Server
FLOSS	-	Free/Libre Open Source Software
GNOME	-	GNU Object Model Environment
GNU	-	GNU's Not UNIX
ICT	-	Information and Communication Technology
IMAP	-	Internet Message Access Protocol
IS	-	Information Systems
IT	-	Information Technology
KDE	-	KDesktop Environment
MIT	-	Massachusetts Institute of Technology
OSS	-	Open Source Software
PC	-	Personal Computer
PDC	-	Primary Domain Controller
POP3	-	Post Office Protocol 3
RTGS	-	Real Time Gross Settlement
SMTP	-	Simple Mail Transfer Protocol
SQL	-	Structured Query Language
WINS	-	Windows Internet Name Service

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ABSTRACT

This research explored the opportunities and potential offered by open source software to commercial banks in Kenya, and the extent of adoption of open source software. This study also explored the challenges encountered in the adoption of open source software, as an alternate to the proprietary software, in computing.

The study focused on all the 43 commercial banks in Kenya. The banking sector was selected largely because it has always taken a lead role in implementing strategic management practices and is reported to spend huge amounts on the same. The respondents were IT Managers in the 43 commercial banks.

The questionnaires were used to collect information from the information technology department and other employees concerned with information technology adoption and implementation. The basis of using descriptive measure was to give a basis for determining the weights of the variables under the study. The findings were then presented using tables, pie charts, and bar graphs for easier interpretation. The analysis and data collected the following discussions, conclusions and recommendations were made.

The study revealed that the majority of respondents were males. Majority of these respondents were in their positions for about 5 years, had a degree and were of age 30 years and below which was a clear indication that they were young. On the extent of use of OSS in the commercial banks, the survey findings indicate that majority of the banks were partially using open source on their desktop computers and planned to increase the OSS share by adopting to replace some components. The OSS applications that were mostly being used were Linux and Mozilla.

The survey findings indicate that OSS in commercial banks in Kenya is widely being used and there are various challenges being faced in the adoption. These challenges include a need for an analysis of a return on investment on using OSS, high switching costs when migrating from proprietary software to OSS and uncertainty on the availability of support services.

CHAPTER ONE
INTRODUCTION

1.1 Background of the Study

Use of Information and Communication Technology (ICT) in organizations has revolutionized business operations and products. According to Cohen (2004), ICT intensity and competition in a market are positively correlated. Therefore, ICT investment by organizations is in reaction to the market structure. It is therefore important for organizations to use new technologies so as to attain a competitive advantage. This is in a phenomenon where technology continues to evolve towards an environment that will continue to remove all barriers to entry and geographical barriers (Amant, 2007). It is in this evolution that Open Source Software (OSS) has come of age. Open source is an idea whose time has come, as its products are spreading very fast in many avenues. As it becomes a growing trend, large technology corporations are joining the band wagon in the adoption of Open Source Software.

The Internet, supported by computers and networks, has changed the way people work and interact. According to McHugh, et al (2008); from the internet's infrastructure to operating systems like Linux, the open source movement has some of the greatest accomplishments in computing over the recent years. The evolution of the internet has facilitated global collaboration and distributed development (Richard, 2005). This has been of great significance in the development of OSS. According to Jay (2007) proprietary software is costly, resource demanding, difficult to debug and has the users locked in to the vendor. An example of a proprietary software vendor is Microsoft which offers proprietary software.

An alternative software acquisition mode exists, offering low cost solutions to these problems and this is open source. Open source is not a technology but is a different way of organizing the software development process. It is a philosophy about how software should be developed and distributed (Jay, 2007). Unlike proprietary software which has strict protection of intellectual property, open source development is collaborative and has evolved over the years along with the internet. Open Source application is faced with many challenges such as the monopoly power of the copyright software. It is also difficult to build and sustain the community that surrounds open source software. According to (Feller, 2005), a program is considered "free" software if

users have all the freedoms of not having to request or pay for, permission to use or alter the software. Users as such are free to make modifications and use them privately in their own work; they need not even mention that such modifications exist. According to Roderick (2012), open source is a development method for software that harnesses the power of distributed peer review and transparency of process. The promise of open source is better quality, higher reliability, more flexibility, lower cost and an end to predatory vendor lock-in.

When an organization adopts open source software, the ease of customization becomes a reality, considering that each bank has some special customizations to match with their operational procedures and requirements. These customizations are otherwise difficult to enforce in proprietary software, whose source code is inaccessible and mostly the software is platform dependent (Boldyreff, 2009). With platform independence, open source software is easily integrated with other software and it is generally less resource demanding as its lighter to process as compared to some proprietary software. However, despite these, many challenges are faced by organizations in the application of open source software. This is more so in server computing, where open source software is usually questioned, surrounded by other myths on quality, lack of expert knowledge among others. Open source software is therefore executable software program that is distributed together with the source code and has a license allowing anyone to redistribute or modify the program (Roderick, 2012).

According to Agerfalk (2010), some of the impacts associated with adoption of open source entail total cost of ownership which could initially be high, but eventually they reduce as the running costs are lower. Support services also have a great impact on the adoption and performance of open source. Open source performance is also affected by the ability to integrate and customize. Just as any other Information Technology project, failure to get management support has a detrimental effect on performance.

According to Hanna and Boyson (1993), the banking industry has continued to invest more capital on Information Systems and their management, in the aim of supporting business growth and offering of alternative banking channels in addition to the traditional banking hall services. This has seen a rise in need for high end server computing as banking service channels increase. Commercial Banks rely on diversification of services offered with the aim of being more efficient, available and reliable (Padoan, 2003). Consequently, channels such as Internet

Banking, Mobile banking, Agent Banking, Automatic Teller Machine (ATM) banking and the recent cheque truncation system have all demanded for a further build on the information systems infrastructure (Central Bank of Kenya, 2012).

The banking industry generally applies client-server architecture over a distributed network. In its best application, client server computing moves data-capture and information processing functions directly to the knowledgeable worker (Smith, 1992). Server computing enables sharing of computing technologies amongst the defined users under the management of the underlying operating system. The server hosts applications which are accessed by the users using the client computers. In this setup, there are many opportunities to apply either open source software or proprietary software.

The current trend of increased need for Information Technology solutions to gain on competitive advantage is faced by an increasing need to shrink Information Technology budgets. These solutions are demanded in such areas as web servers, enterprise resource planning, content management systems, network security management systems, electronic mail servers, project management applications, knowledge management systems, operating system, browsers, and office suite applications among others (Bhasker, 2006). With all the challenges facing commercial banks amidst the high competition coupled by need for dynamic technologies, it is of benefit for commercial banks to adopt Open Source Software (OSS). This is because it offers autonomy to banks, which are otherwise manipulated by the proprietary software vendors (Khosrowpour, 2002).

This research explored the opportunities and potential offered by open source software to commercial banks in Kenya, and the extent of adoption of open source software. This study also endeavored to explore the challenges encountered in the adoption of open source software, as an alternate to the proprietary software, in server computing. Discussion is is made on the development of an open source culture and communities in the commercial banks, which will largely benefit the industry and the country which is developing in its information and communication technology skills and resources. Open source software is free for redistribution and users have access to the source code; which they can manipulate as they so wish. This encourages peer production through collaboration with the end product and documentation being available at no cost (Foray, 2009). As such, the economic marginal cost of production is very

low, because other additional users have little or no cost added in production of software. Basically, open source reduces the restrictions imposed by copyright, where copyright places access costs on consumers plus additional administration and enforcement costs. As such, open source adoption would be ideal for developing African countries (Reijswoud, 2008). According to Goldman (2005), application of open source applications has been a cost effective way of facilitating application of the robust requirements for dynamic server computing solutions while maintaining on the quality needs for reliability and performance. Open source is more than just source code in a public place released under the Open Source Software license; communities matter (Scacchi, 2005).

1.1.1 The Banking Industry in Kenya

The banking industry in Kenya is governed by the Central Bank of Kenya which was established in 1966 by a parliamentary act. This was basically as a result of the three East African States move to have independent financial and monetary policies. The act set out the objectives and functions of the Central Bank of Kenya; which falls under the docket of Ministry of Finance, and is responsible for the formulation and implementation of the monetary policy, facilitating liquidity and the proper functioning of the financial system. This is achieved by issuing prudential guidelines to banks.

Another governing arm is the Banking Act, which is an act of Parliament to regulate the business of banking and for matters incidental to the banking industry and matters connected therewith as per Chapter 488 of the Laws of Kenya. The Companies Act that was also enacted by parliament to regulate registration of companies in Kenya as per Chapter 486, Laws of Kenya.

As of December 2011, there were 43 licensed commercial banks in Kenya (Central Bank of Kenya, 2011). Over the last few years, the Kenya banking sector has continued to grow in terms of assets, deposits, profitability and products offering. These has been facilitated by the wide branch network expansion strategy targeting Kenya and the East Africa Community, as well as the automation of many services based on a move to emphasize on customer service as a pillar to success as opposed to the traditional banking hall products. As a result, the industry players have been faced by heightened competition resulting from new entrants and innovations among existing players in the rush to scoop the large market share.

The core banking systems can support different computing abilities as well as channel products. This implies that the core banking system must then be a very dynamic system with ease of integration to other systems and reliable enough to ensure business continuity (Shroff, 2007). With the modern requirements to offer multiple channels under which customers can access the banking services, many banks have opted to acquire new core banking systems that support these functionalities. This comes with high capital requirements as a project team has to be formed to acquire the new system and then migrate all the data from the old one, with minimal disruption on the business. Upon acquiring the core banking system, they then acquire or upgrade the different channel systems that support different products. These subsystems are integrated with the core banking system, which holds all the customer data that is accessed via a distributed network. According to the Central Bank of Kenya report (2011), there are 43 licensed commercial banks in Kenya with 30beinglocally owned, while the remaining 13 are owned by foreigners. Of the 30 locally owned banks, three are by large owned by state corporations and the government and the remaining 27 are owned by both locals and foreigners.

The banks have different geographical distribution of the branches, and also differ in terms of size and asset base. They also target different markets with some targeting more than one market at a time. The Kenyan market entails the corporate, youth, low income earners, middle income earners and the Diaspora. In the attempt to reach out to all these markets, the banks have developed and diffused different technologies with the appreciation of technology as a competitive advantage. These technologies are in addition to the traditional banking hall approach which applies the core banking system. The new technologies entail Internet banking, mobile banking, Automatic Teller Machine, agent banking, cheque truncation system, Real Time Gross Settlement system, Electronic funds transfer among others. Notably, there are many open source solutions to support these new technologies.

1.2 Problem Statement

While many organizations employ expensive proprietary software, they lose on freedom from vendors as they are locked in to the vendor product(s). They also lack control as they cannot access the source code of the applications and thus lose on the social benefits that come with sharing ideas on source code (Amant & Still, 2007). In the recent past, organizations and individuals have been moving towards open source software adoption. However, this has been at

a slow pace, as they have been worrying about support, reliability and viability of Open Source products. As the open source community releases more advanced, secure and user friendly applications, organizations are also adopting the OSS at a higher rate than before (Grossman, 2009).

While there have been studies on the adoption of open source software in various organizations such as OSS adoption in local governments (Cassell, 2008) and (Dibo, 2011), the area of open source application in commercial banks in Kenya has not been explored and thus there is a research gap in this area. With the limitations of earlier studies on OSS application, it is clear that this is still an emerging research area. The inadequacy of proven theories and general lack of understanding of the application of OSS indicate that there is a gap in theory amassing research on OSS adoption by commercial banks. This gap leads to the question: What is the extent of OSS adoption by Commercial banks in Kenya, impact on performance and the associated challenges?

1.3 Objectives
The objectives of the study were to:

i. Establish the extent to which the commercial banks in Kenya have adopted use of open source software.

ii. Determine the challenges of implementing open source applications in the commercial banks in Kenya.

1.4 Justification
The findings of this study would be of great value and interest to bank management, researchers as well as academicians. This is so, by evaluation of the adoption of open source software as well as the challenges faced in the application of the open source software in the Kenyan banking industry. This will help uncover the relevance of open source software in business computing, while appreciating the challenges facing their application. Generally, it will help demystify the mythical mindset towards open source applications among banks' management, and assist is their appreciation for the benefits realized. This study will be a basis of future reference for researchers and academicians, particularly on open source software and information technology in commercial banks in Kenya. This research will also bring out other areas that can be subject to research by other academicians.

CHAPTER TWO
LITERATURE REVIEW

2.0 Introduction

This chapter reviews the information and communication technology application in server computing and in the management of banks. It also highlights the application of open source software within commercial banks in Kenya, and the challenges faced.

2.1 Open Source

Open Source is any software that is distributed for free together with its source code, and the person is licensed to modify the source code and redistribute the software, as they wish (Das Gupta, 2006). According to Williams (2009), Stallman is the father of "free software" where the word "free" is used to imply freedom and not price. In 1971, Richard worked in Massachusetts Institute of Technology (MIT) in a group using free software exclusively. At this time, even computer companies often distributed free software. To Stallman, free software was morally vital and he was a dedicated crusader for software "freedom". In 1984, Richard Stallman launched the GNU's Not Unix (GNU) Project in attempt to develop the GNU system. This was because by the 1980s software ownership was mostly proprietary. This was to provide a free operating system that was compatible to Unix so that users could easily switch from Unix to GNU. In 1985, the Free Software Foundation was founded to raise funds to help develop the GNU system. By 1990, the major components for GNU system were in place except the Kernel (Chris & Sam, 1999).

According to Glyn (2002), in 1991 a young student collaborated with other developers to develop the kernel called Linux for the GNU system. The combination of GNU and Linux gave rise to a complete operating system called GNU/Linux in 1992. GNU/Linux has risen to become a worldwide phenomenon that runs on many computing platforms such as Personal Digital Assistants (PDA), Personal Computers, mainframes, servers and superdomes. The ultimate goal for GNU/Linux is to provide free software to do the entire jobs computer users want to do and thus make proprietary software a thing of the past.

2.1.1 Structure of Open Source Software Development

The social structure of free and open source software development teams vary widely in their communications centralization, from projects completely centered on one developer to projects

that are highly decentralized and exhibit a distributed pattern of conversation between developers and active users. It is therefore wrong to assume that the projects are distinguished by a particular social structure merely because they are free license open source software (Crowston, 2005). Crowston examined 120 project teams from Source Forge. Source Forge is a web based source code repository, offering a centralized location for open source developers to manage and control their software.

Many strengths of Free/Libre Open Source Software (FLOSS) development are closely linked to the unique communication and social structures of the teams. However, the consistency of these structures is not warranted. As Scacchi (2002) wrote, "little is known about how people in these communities coordinate software development across different settings, or about what software processes, work practices, and organizational contexts are necessary to their success." According to (Crowston, 2005), FLOSS projects differ greatly from the proprietary projects, as they have different licenses, composed mainly of volunteers rather than paid employees and they employ distinctive tools such as SourceForge.

2.1.2 Open Source in Server computing

A server is a program that awaits and fulfills requests from client programs in the same or other computers. A given application in a computer may function as a client with requests for services from other programs and also as a server of requests from other programs (Muffatto, 2006). Open source applications give solutions to the required programs in the client-server architecture as per the following classifications.

Infrastructure services entail the basic network services such as DHCP, DNS, and caching services, as well as the security services such as firewalls, anti-virus and authentication services. Also included are the file transfer and print services such as Samba. According to Gross (2005), the Samba server runs on the Linux/BSD operating systems and can also be a Primary Domain Controller (PDC) and Windows Internet Name Service (WINs), besides being a file server. Notably, Samba has the purpose of integrating Linux/BSD operating systems in a Windows context.

An email server enables users to send and receive mail using a set of protocols named POP3 and SMTP. Mail is sent with the SMTP protocol and accessed with the POP3 or IMAP protocol which is richer and preferable, same as the proprietary software solutions such as Microsoft's Exchange. An example is PostFix, Exim and QMail. PostFix is easy to configure. According to (Kavanagh, 2004), Apache is the ultimate consideration and most successful open source software and is a web server. It constitutes two thirds of the global web server usage and is the reference standard for a web server, offering dynamic customization abilities with great ease to administer and low overheads. Apache is also platform independent and therefore runs on many operating systems. There are three Open source databases that are widely used and they entail Berkeley DB, PostgresSQL and MySQL (Kavanagh, 2004). They are significantly cheaper to adopt as the alternatives such as Microsoft SQL and Oracle have costly expenses besides the deployment costs.

2.1.3 Open Source in desktop computing

A complete open source desktop with application can be sustained using Linux as the operating system. According to Kavanagh (2004), such desktops are attractive, powerful, less expensive and easy to learn from scratch as Windows. He categorized the important desktop applications as follows:

The graphical desktops supported by Linux are the alternative KDesktop Environment (KDE) and the default GNU Object Model Environment (GNOME). They both provide users with menus, icons and various window utilities such as multiple desktops, graphical configuration, and session management (Ramesh, 2007). A web browser is an application used for retrieving, presenting, and surfing information resources on the World Wide Web. Firefox is the most recognized open source browser, which came to be after Netscape created an organization called Mozilla to continue the development of its web browser software (Van, 2008). Office programs or suites entail spreadsheets, word processing and presentation software. According to John (2004) OpenOffice.org is the most comparable office package to Microsoft Office. Professional Applications entail applications that are used in graphics, Database front ends and web design. Desktop publishing tools are fairly scarce in open source. Scribus is an open source publisher that is easy to use and applicable for small publications. The personal applications entail the multi-media players and games. Multimedia programs play both video and audio with open

source examples being Quicktime, Mplayer, Noatun among others. They play most media formats other than the latest Microsoft Windows Media formats.

2.2 OSS Adoption Frameworks

As is evident with other types of change, adoption of OSS by an organization can be difficult while the benefits can be great. The system migration can also be met by resistance from employees, affect staff morale or result in complete failure. There are several frameworks that have been established in regard to technology adoption. The theory of Diffusion of Innovation seeks to explain the manner in which new ideas and technology are spread through cultures. According to Rogers (2003), diffusion is the process through which an innovation is communicated through various channels over time among members of a social system. Rogers synthesized research from over 508 studies and came up with the theory on adoption of innovation among individuals and organizations. He proposed four elements that influence the spread of a new idea or technology. They entail Innovation, which is an idea or technology that is perceived as new by an individual or group. Communication channels, which are the modes through which information gets from one person to another. Time, which is the duration required to pass through the innovation decision process. Lastly, a Social System, which is a collection of interrelated units which are involved in joint problem solving so as to accomplish a common goal.

Rogers (2003) defines the innovation-decision process as the process through which an individual passes from first knowledge of an innovation to forming an attitude toward the innovation, to a decision to adopt or reject, to implementation and use of the new idea, and to confirmation of this decision. The diffusion of innovation process can be tracked on a micro level as is the case of an individual who is a targeted member of an audience, or traced at the macro level when considering economic development or technological advances. The rate of adoption is defined by Rogers as the relative speed with which the members of a social system adopt an innovation. The adoption of an innovation takes an S shaped curve when plotted over a length of time. Rogers came up with five categories that classify the adopters on the basis of innovativeness. These categories are: innovators, early adopters, early majority, late majority, and laggards.

The Technology Acceptance Model (TAM) was developed to address system usage by helping one to understand the reasons and factors that affect the use and adoption of new or existing systems (Moller, 2012). The model facilitates the understanding of the conduct and motivational factors that influence adoption and use of Information Systems and Technologies. The model allows for a contrast in behaviour on the part of the user and is based on four fundamental variables or constructs which are: Perceived Usefulness (PU), Perceived Ease of Use (PEU), Intention to Use (IU), and Usage Behaviour (UB). The four constructs predict the actual behavior (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 (Sobh, 2010). Generally, TAM describes the factors leading to higher levels of acceptance and usage of technology.

The Technology Organization Environment Framework (Tomatzky and Fleischer, 1990) is a comprehensive framework, to study adoption of technological innovation at an organizational level. It is used to identify technological, organizational, and environmental factors that affect Information and Technology diffusion in organizations. Technological context refers to technologies that are relevant to firms; Organizational context generally refers to organizational characteristics such as size, scope and resources available within a firm. Environmental context involves the macro-circumstances in which a firm conducts its business, including industry, competitors, and government relations among others. The framework is suitable to identify factors shaping innovation adoption (McMaster, 2007).

2.3 Determinants of Successful Implementation of ICT

Information and communication technologies are used to support operations, management and decision making in an organization. In essence, Information Systems are used to increase organizational efficiency and therefore their success rate and function are very important in the day to day of organizations (Goel, 2010). For the successful implementation of Information and Communication Technologies, various key success factors have been observed over time and can therefore be used to determine the success of an implementation. According to Hunter (2009), these critical success factors are either technological or organizational. Ownership and support of the process by the management is paramount for the successful implementation and diffusion of

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technology. The management helps give direction of the project and provide confidence and status checks on the progress of implementation.

User involvement is also critical to the successful implementation of a project, as the technology is based on user requirements which must be defined by the end users. As such, their involvement is mandatory for success because they otherwise resist the technology and the change it comes with. Financing is also very important as the technology should be well budgeted and funded to ensure its success, else it collapses. This is even more so for proprietary software, whose license fees are huge coupled with the implementation and maintenance costs.

Planning is also important especially in the initial stages, so that the organization gets to understand that which is needed, why it's needed and the most efficient way of achieving the goal. Otherwise, without proper planning, the system would not deliver the necessary information. Implementation skills require project management skills and support, which are necessary in implementation which is more difficult than the development process. This will enable monitoring the large number of tasks involved in implementation and ongoing communication. Change management is also critical with the help of a steering committee, project management and championing. This enables a smooth transition from the old system to adoption of the new.

2.4 Potential Risks of OSS Adoption

According to Agerfalk (2010), there are five potential risk areas in OSS as described hereafter. The Total Cost of Ownership (TCO) resulting from OSS adoption is generally low, but could pose a potential risk as it could further involve user training, configuration, legacy costs and support. In the short run, the total cost of ownership is often higher thus little difference with adoption of proprietary software. However, in the long run, lower licensing costs become more significant and the organization finds OSS adoption to be efficient and productive (Fitzgerald et al, 2011). The Lack of products with specific functionality to meet an organization's needs could hinder OSS adoption. This is in comparison to the proprietary software which has products with specific functionality. Support services could also be a challenge, especially for product specific solutions. There could be little or no software documentation and thus hindering the relationship between the customer and the OSS project as compared to proprietary software which has proper documentation, support and expertise.

Licensing and integration issues could arise from the need to integrate OSS with proprietary software, as the code modification could contravene the proprietary license. Customization implies the need to fit something into contextual use and therefore requires expertise and support to maintain present and future compatibility issues. This is a risk as the expertise and support may be unavailable. According to(Fitzgerald et al, 2011), the more successful cases of OSS adoption were promoted by the adaptability of the code to local needs, because the source code was available, accessible, and the license allowed modifications to be done.

Management Support is paramount for OSS adoption, as managers should plan and avail the required resources for OSS adoption. This would go a long way in boosting employee confidence on the OSS adoption, as the OSS ideology will be clear to the staff and thus they are aware and have a positive employee attitude. As a result, resistance to adoption of OSS would have been alleviated. Also, access to professional support services is important so as to boost confidence in software customizations and maintenance. Proprietary software lock-in can hinder adoption of OSS, as the cost of changing over from proprietary software to OSS could be too high in terms of finances, efforts, risk of loss and customization. Security in OSS is more visible with transparency from greater accessibility to the source code owing to the licensing, and thus creation of more secure systems. The theory behind this is that visibility makes it possible for many parties to become aware of the problem. The pool of talented developers is therefore faced with a greater ability to sort out the problem (Fitzgerald, 2000).

2.5 Challenges in Adoption of Open Source

Organizations face many challenges when adopting open source software in their server computing applications. This is mainly because they have been locked in by the proprietary software, interfacing is a challenge and they do not maintain an open source community which would sustain the open source software. Firms have to observe a high level of security and therefore cannot take chances deploying software that has no assurance of success, in their server computing. As such, the management is always more comfortable to use software solutions that have been tried and tested by other organizations (Bridgwater, 2012). This myth has denied organizations an opportunity to apply some high secure open source applications that have been actively tested by the community and are available freely at a very low cost as compared to proprietary software. New data from Forrester Research has shown that 58% of IT Executives

and technology decision makers in large companies are concerned about the security of open source software (Bwired, 2009).

Proprietary software generally employs expert usability testing, and the software is tailored; aimed at a more targeted audience and as such usability is generally ranked quite high. In addition, detailed user manuals and guides are provided. This enables faster training and provides an immediate reference, allowing users to move along the learning curve more quickly. Supporting services include seminars, targeted training courses and extensive support to help maximize use of the software. In contrast, open source documentation and design has been wanting, as it inhibits the uptake of OSS programs, as per (Nichols, 2003). Traditionally the users of OSS have been experts, early adopters, and nearly synonymous with the development pool. As OSS enters the commercial mainstream, a new emphasis is being placed on usability and interface design, with Caldera and Corel explicitly targeting the general desktop with their Linux distributions. Non-expert users are unlikely to be attracted by the available source code and more likely to choose OSS products on the basis of cost, quality, brand and support (Fitzgerald, 2000).

Many organizations associate open source with upcoming developers that are trying to establish a niche for self as they sharpen their programming skills. As such, they have their reservations towards supporting and applying the open source products in their computing environments, owing to the social influence. Majority of the open source software projects have failed, with few making it through to successful application. Notably, there is little publication or emphasis on the rate of failure, and thus the trend worries the watchful eye of bank managers who are even more afraid of being involved of a failed open source project. This trend is on the rise as more open source communities form while others break over the internet. Maintaining a community is very difficult, more so where there is no monetary gain and with high reliance on self-motivation for the success of a project.

Service is one of the key issues regarding open source software. Open source software relies on its online community network to deliver support via forums and blogs. While there are massive, loyal and engaged online communities that users can turn to, time-poor consumers of today are familiar with the immediate service and support that enables issues to be resolved in a timely

manner, and these communities cannot guarantee the high level of responsive service and support proprietary software can offer.

2.6 Conceptual Framework

The framework below allows us to examine, together, the factors and therefore better understand their interrelationships in the adoption of OSS in Commercial Banks in Kenya.

Factors Influencing Open Source Software Adoption	
Technological Context	Cost saving
	Innovativeness
	Quality characteristics
	IT Infrastructure
Organizational Context	Return on Investment
	Staff Capacity
	Management Support
	Ownership Structure
Environmental Context	Support
	Government Policies
	Developer Collaboration

Table 2.6a: *Factors Influencing OSS Adoption* (Tomatzky and Fleischer, 1990).

2.7 Summary and conclusion of the literature review

Based on the above, the conclusion is that that there is a lot of potential in open source computing despite the numerous challenges facing it. This is more so, for server computing where the proprietary software are expensive and do not offer the expected high quality and reliance. Notably, organizations in developing countries can adopt use of open source to cut on significant costs used in proprietary software while developing local skills and thereby empowering selves. Linux and open source software have forever altered the computing landscape. There has been no study known to the researcher, focusing on the adoption of OSS, the benefits and challenges to the commercial banks in Kenya and the effects on performance. This presents a gap in the current knowledge and appreciation for OSS, and this study seeks to fill this gap.

CHAPTER THREE
RESEARCH METHODOLOGY

3.1 Research design

In this study, descriptive survey research was used to gather responses on the adoption of OSS, effects on performance and challenges faced in OSS adoption. This entailed investigation of factors influencing adoption of Open Source Software by commercial banks, effects of adoption on performance and the extent of adoption in server computing. The study also surveyed the challenges faced in the adoption of OSS by the commercial banks.

3.2 The population

The study focused on all the 43 commercial banks (Central Bank of Kenya, 2011). The banking sector was selected largely because it has always taken a lead role in implementing information technologies and is reported to spend huge amounts on the same. All the 43 commercial banks in Kenya were considered, with the respondents being one Senior Manager or equivalent post selected from the Information Technology department.

3.3 Data collection

The study made use of questionnaires that had both open and close ended questions. The questionnaire had three sections. Section A: demographic data, Section B: information on open source adoption and Section C: Challenges in adoption of open source. The demographic data was be used for the determination of the impact of open source application on performance while information on open source adoption was used to establish the extent of OSS adoption in commercial banks in Kenya. The last section was used to determine the challenges faced in the adoption of OSS in commercial banks in Kenya. The structured questionnaire was used to collect data from the targeted respondent and a "drop and pick" method of administering the questionnaires was used.

3.4 Data Analysis

The data collected was cleaned, edited, coded then summarized using descriptive statistics, percentages and mean scores, so as to describe important characteristics of Commercial Banks in Kenya, in regard to OSS adoption and challenges faced in adoption. Charts were generated with

frequency distribution and percentages which are a vital part of making sense of the data. Cross tabulation was then applied on the data, to establish any interdependent relationships between two variables.

CHAPTER FOUR
MAIN FINDINGS

4.1 Introduction

This chapter presents in summary; the statistically analyzed primary data that was collected in the study. A total of 39 questionnaires were completed. Summaries of the collected data in each aspect are presented in percentage and mean scores. 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. The broad objective of the proposed study was an assessment of the extent of OSS adoption by Commercial banks in Kenya and the associated challenges.

4.2 Responses to the questionnaire

Thirty nine questionnaires were edited and coded after they were filled in. Four questionnaires were not filled so they were rejected, resulting in a ninety one percent (91%) response rate.

Table 4.2a: Response rate

	Targeted	**Actual**	**% Response**
Respondents	Respondents	Respondents	Total
IT Managers	43	39	91%

Source: Survey data

4.3 Sample Demographics

a. Distribution of respondents by age

The majority of respondents were between the ages of twenty five and thirty (25-30) years old, being twenty eight percent (28%) of the total respondents, while twenty six percent (26%) were between 31-35 years and 41-45 years respectively. Eighteen percent (18%) were between 36-40 years while only three percent (3%) were above 45 years. Results obtained from the study shows that most respondents surveyed were below 30 years, as represented in the table below.

Table 4.3a: Distribution of respondents by age

Age	Frequency	Percent
25-30 yrs.	11	28%
31-35 yrs.	10	26%
36-40 yrs.	7	18%
41-45 yrs.	10	26%
Above 45 yrs.	1	3%
Total	39	100

Source: Survey data

b. Distribution of respondents by academic qualification

Sixty seven percent (67%) of the respondents had a degree while thirty three percent (33%) were post graduates implying that most respondents are skilled in their different careers.

Table 4.3b: Distribution of respondents by academic qualification

	Frequency	Percent
Degree	26	67%
Post graduate	13	33%
Total	39	100

Source: Survey data

This information was very important to the researcher to help determine how well the respondents were versed with open source software and its use in their organization.

c. Distribution of respondents by Gender

Majority of the respondents were male at sixty nine percent (69%), while thirty one percent (31%) were females.

Table 4.3c: Distribution of respondents by gender

	Frequency	Percent
Male	27	69%
Female	12	31%
Total	39	100%

Source: Survey data

This implies that the Information Technology sector has been dominated by the males.

d. Distribution of respondents by length of service

Sixty two percent (62%) of the respondents have been in employment for less than 5 years, while 26% have been in service between 6-10 years and the rest 13% have had working experience of more than 11 years, as depicted in the table below:

Table 4.3d: Distribution of respondents by length of service

	Frequency	Percent
Less than 5 years	24	62%
6-10 years	10	26%
11-15 years	3	8%
16-20 years	1	3%
Above 20 years	1	3%
Total	39	100%

Source: Survey data

Majority of the respondents are youthful and more likely to initiate change, be innovative and risk taking. This could make them more likely to adopt Open Source Software amidst the myths that have developed around the phenomenon.

e. Number of years the organization has been in operation

Asked to state the number of years the company they were working for had been in operation, majority (44%) of the respondents did not indicate. Eighteen percent (18%) indicated they had been operating for the last 30 years and above while 15% mentioned between 20-30 years. A further 24% indicated less than 20 years. This implies that the organizations are generally of age and have stable management structures in place.

Table 4.3e: Number of years the organization has been in operation

	Frequency	Percent
Didn't indicate	17	44%
5 or less	3	8%
6-10 years	3	8%
11-20 years	3	8%
20-30 years	6	15%
Above 30 years	7	18%
Total	39	100

Source: Survey data

f. Ownership structure of the organization

Fifty four percent (54%) of the organizations were locally owned while 28% were foreign owned. Only 18% were publicly owned. This implies that the industry is attractive and thus the diverse ownership structures, with the locals owning majority if the banks.

Table 4.3f: Ownership structure of the organization

	Frequency	Percent
Locally owned	21	54%
Foreign owned	11	28%
Public owned	7	18%
Total	39	100%

Source: Survey data

g. Number of employees in the bank's IT Department

Fifty four percent (54%) of the commercial banks surveyed had less than 10 employees in their Information Technology department. Forty one percent (41%) of the commercial banks had between 11-50 employees while the remaining five percent (5%) had between 51-100 employees. This implies that majority of the banks have relatively lean structures in the Information Technology departments.

Table 4.3g: Number of employees in the bank

	Frequency	Percent
10 or less	21	54%
11-50	16	41%
51-100	2	5%
Total	39	100%

Source: Survey data

h. Distribution of respondents by job title

From the findings, a majority of forty six percent (46%) of the respondents were system administrators, twenty one percent (21%) were Director/Manager IT support services and Director Manager Information systems respectively as shown from the table below.

Table 4.3h: Table Distribution of respondents by job title

Source: Survey data

	Frequency	Percent
Systems Administrator	18	46%
Director/Manager IT Support Services	8	21%
Director/Manager Information Systems	8	21%
Chief Information Systems Officer	3	8%
Director/Manager Network Systems	1	3%
Developer/Programmer	1	3%
Total	39	100%

i. Number of servers and personal computers in the organization

Findings from the study shows that forty one percent (41%) and forty four percent (44%) of the organizations have between 11-50 computers and servers respectively. Thirty eight percent (38%) of the organizations and thirty six percent (36%) have less than 10 computers and servers respectively. Only ten percent (10%) of the organizations have more than 100 computers and servers respectively as shown from the figure below.

Table 4.3i: Number of servers and personal computers in the organization

Source: Survey data

23
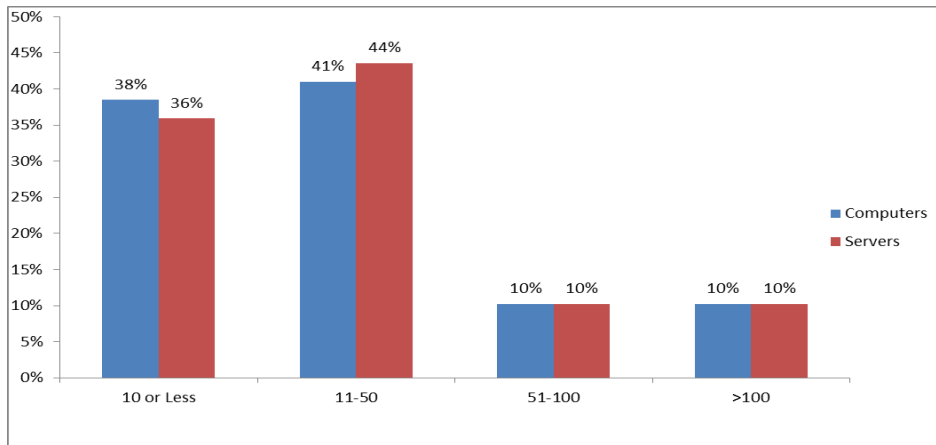
The implication is that majority of the banks have between 11 and 50 computers and servers as well, which is a good indicator that the banks have the capacity to harness the full benefits of large scale deployment of OSS.

j. Percentage of operating budget

From the survey, most organizations' IT operating budget over the total organizations budget over the last three years was more than 10% as shown by thirty eight percent (38%) of the respondents below. A further twenty eight percent (28%) of the respondents IT budget was between 7-10% while it was between 2-6% to eighteen percent (18%) of the respondents as shown from the table below.

Table 4.3j: Percentage of operating budget

	Frequency	Percent
2% or less	6	15%
2-6%	7	18%
7-10%	11	28%
More than 10%	15	38%
Total	39	100%

Source: Survey data

Implacably, the operating budget as a component of the total budget is substantial because a significant portion of it is appropriated to license fees which can be alleviated by adoption of OSS.

4.4 Impact on Performance and the Associated Challenges of Adoption of OSS by Commercial Banks in Kenya

A number of factors were assessed in a bid to establish the impact on performance and the associated challenges of adopting OSS by commercial banks in Kenya.

Adoption of Open Source Software by Commercial Banks in Kenya

a. Extent of adoption of OSS

Respondents were asked whether their organization had (OSS) application, product or system. From the findings, ninety seven percent (97%) of the respondents said their organization had adopted the open source software while three percent (3%) were not aware.

Figure 4.4a: Extent of adoption of OSS
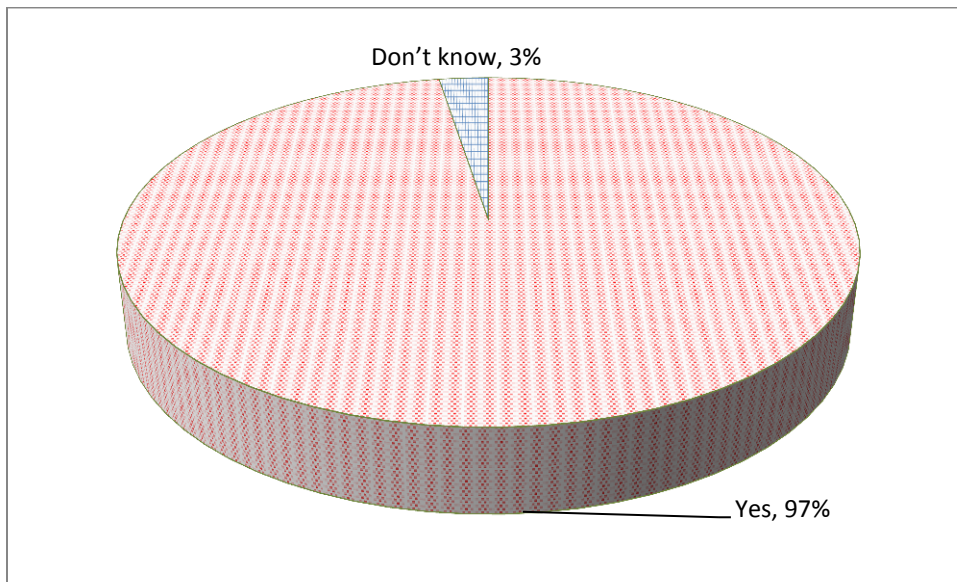
Source: Survey data

This implies that OSS is used in the various organizations in one way or another.

b. Application of Open Source software in the organization

Ninety seven percent (97%) of the organizations partially use open Source Software on their desktop, while sixty three percent (63%) of the respondents claimed that the software is also partially used on their servers. However, it's used almost exclusively by eight percent (8%) of

the organizations and further eight percent (8%) of the organizations use open source software on the desktop almost exclusively.

Figure 4.4b: Application of open source software
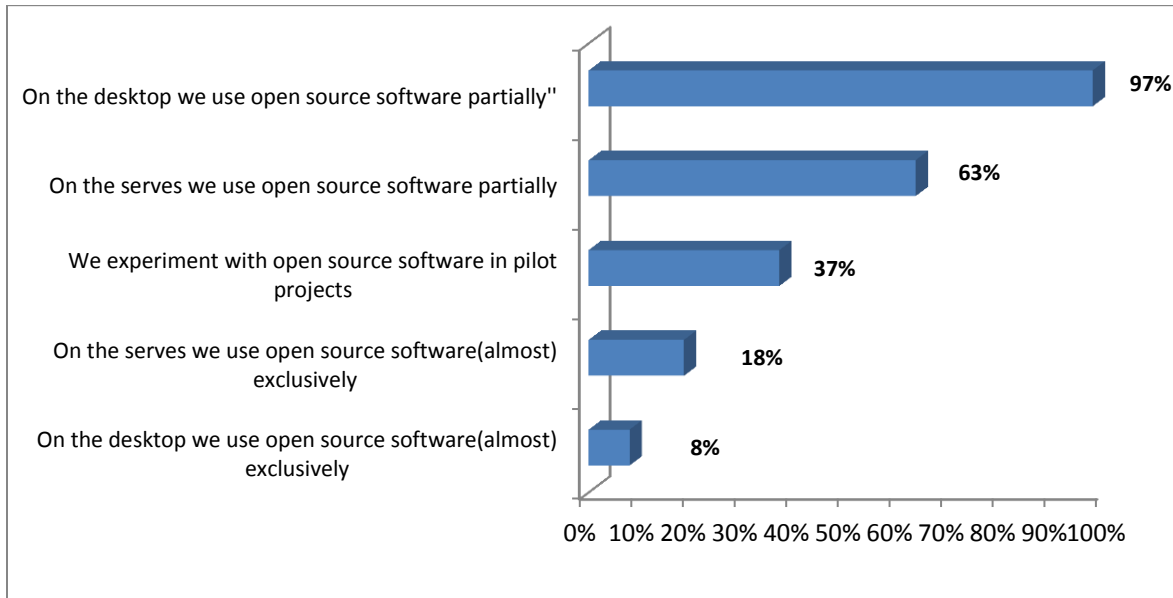
This implies that as much as OSS is used by the banks, its full potential has not been harnessed. By adopting OSS on a large scale, the organizations would be in a position to harness the full benefits of OSS.

c. Main influencers in the decision making process on technology adoption

Findings from the research shows that sixty seven percent (67%) of the main influencers in decision process regarding new technology adoption are other management while IT professional constitute of fifty nine percent (59%). Thirty eight percent (38%) of the organizations' finance departments are influencers regarding adoption of new technology. However, only five percent (5%) of the organizations rely on users

Table 4.4c: Main influencers in the decision making process on technology adoption

	Frequency	Percent
Other management	26	67%
IT Professionals	23	59%
Finance department	15	38%
External consultants	11	28%
Users	2	5%

Source: Survey data

26

This implies that the management and Information Technology professionals are the most influential in the decision making process on technology adoption.

d. Open Source Software used in commercial banks in Kenya

When asked which Open Source software are used in their organization, Linux and Mozilla was mentioned by ninety seven percent (97%) of the respondents respectively. Ninety two percent (92%) of the respondents use MySQL while Apache was mentioned by eighty two percent (82%). A few, three percent (3%), use Zope as open source software; as depicted in the tabulation below:

Table 4.4d: Open Source software used in the bank

	Frequency	Percent
Linux	37	97%
Mozilla	37	97%
MySQL	35	92%
Apache	31	82%
PHP	22	58%
OpenOffice	21	55%
FreeBSD/OpenBSD	19	50%
Gnome	7	18%
Samba	6	16%
Squid	4	11%
KDE	2	5%
Perl	2	5%
Zope	1	3%
Others	5	13%

Source: Survey data

This implies that the OSS products indicated are all used to some extent by the commercial banks in Kenya, with Linux, Mozilla, MySQL and Apache being the most widely OSS used.

e. Increased share of open source software

From the findings, sixty four percent (64%) of organizations were planning to increase the share of open source software within the next 24 months, while twenty six percent (26%) were not for the idea. However, ten percent (10%) were not sure; as depicted in the chart below:

Figure 4.4e: Intention to increase the OSS share in future

I dont know, 10%

No, 26%

Yes, 64%
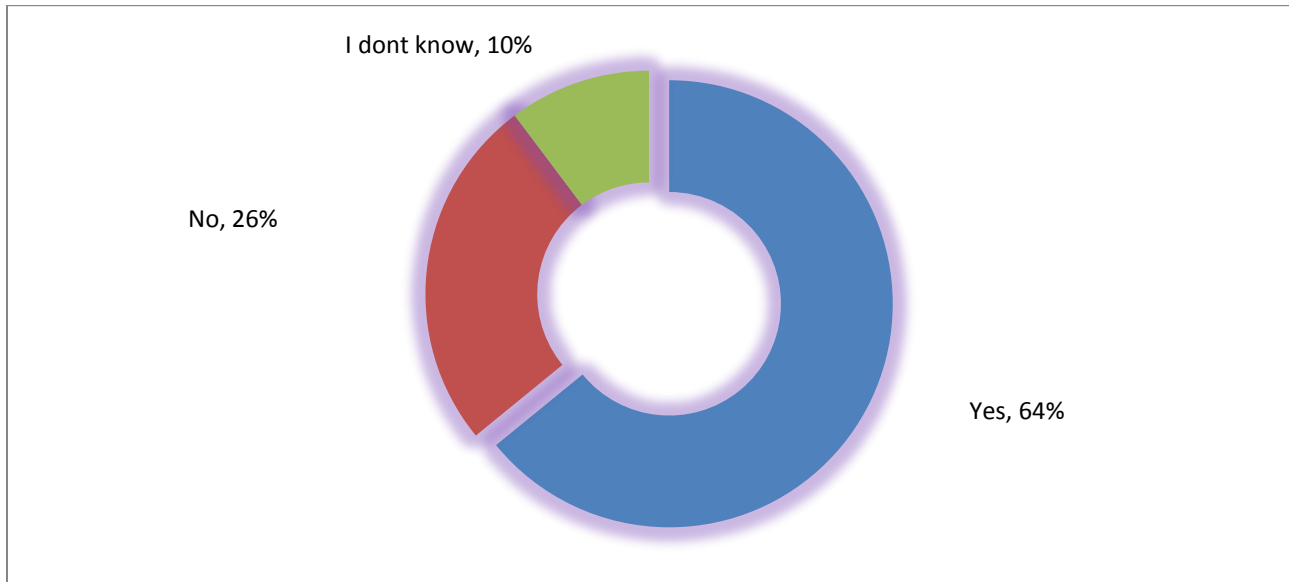
Source: Survey data

This shows that the management and professionals want and are willing to have more OSS products in their organization.

f. Preferred components for Open Source share increase, over the next two years

From the findings, sixty four percent (64%) of the Organizations planning to increase the share of open source software indicated that they will replace some components while thirty two percent (32%) said will replace all components. However, four percent (4%) of the organizations indicated that they were not sure.

Table 4.4f: Preferred share increase of OSS in future

OSS share increase in the next 2 years	Frequency	Percent
Yes, to replace SOME components	16	64%
Yes, to replace ALL components	8	32%
I don't know	1	4%

Source: Survey data

This gives an implication that they are inclined to having more OSS in their Information Technology applications, most likely due to the benefits to be derived from large scale OSS adoption. However, since majority does not plan to replace all proprietary software components, it implies that there are challenges being encountered on OSS adoption.

g. IT operating budget over the total organizations budget

From the survey, most organizations' IT operating budget over the total organizations budget over the last three years was more than 10% as shown by thirty eight percent (38%) of the respondents below. A further twenty eight percent (28%) of the respondents IT budget was between 7-10% while it was between 2-6% to eighteen percent (18%) of the respondents as shown from the table below.

Table 4.4g: IT operating budget over the total organization's budget

IT operating budget over the total organizations budget	TOTAL		Ownership					
			Locally owned		Foreign owned		Public owned	
	Freq	%	Freq	%	Freq	%	Freq	%
2% or less	6	15%	4	19%	0	0%	2	29%
2-6%	7	18%	6	29%	1	9%	0	0%
7-10%	11	28%	6	29%	2	18%	3	43%
More than 10%	15	38%	5	24%	8	73%	2	29%

Source: Survey data

h. Significance of access to software source code

When asked whether it would be a substantial improvement for the IT departments to have access to the source code of the software being used, fifty nine percent (59%) of the respondents were positive while thirty one (31%) were negative. However, ten percent (10%) were not sure.

Figure 4.4h: Significance of access to software source code
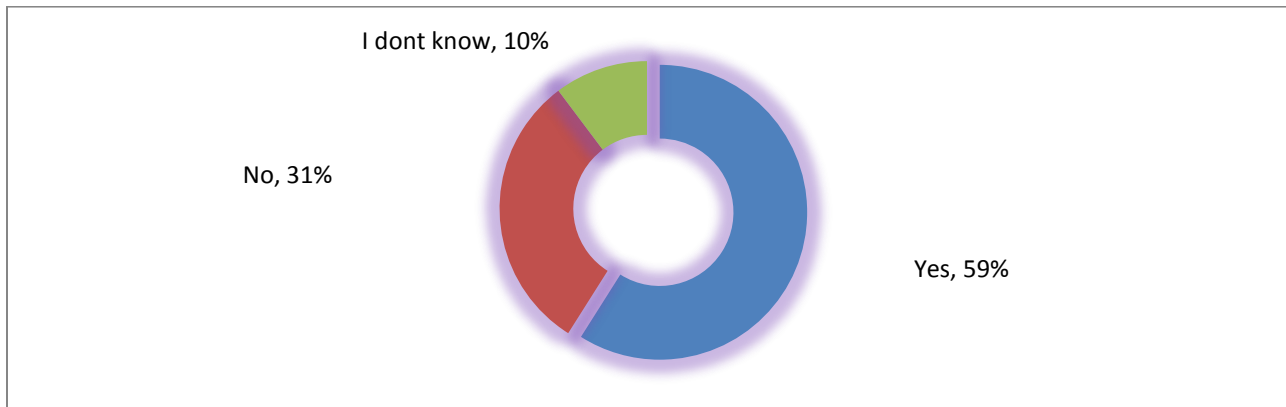
Source: Survey data

This implies that most of the banks have software development capabilities and thus would benefit from the customizations of open source software whose source code is accessible and can be modified and redistributed accordingly.

4.5 Challenges in Adoption of Open Source

The challenges encountered on the adoption or use of OSS is rated on a 5 point likert scale. A mean above 4.5 was used to indicate that the particular issue was considered to a very large extent. A mean of 3.5 but less than 4.5 indicated that the issue was considered to a great extent. A mean of 2.5 but less than 3.5 indicated the issue was considered to a moderate extent. A mean score of 1.5 but less than 2.5 indicated that the particular issue was considered to a small extent. Finally, a mean of 1 but less than 1.5 indicated that the issue was not considered at all.

Findings from the research indicate that forty one percent (41%) agreed while thirty three percent (33%) strongly agreed that their organization needed a return on investment analysis when using OSS applications. Although eighteen percent (18%) were not sure, five percent (5%) disagreed while three percent (3%) disagreed strongly. This implies that lack of a return on investment analysis was significantly affecting the adoption of OSS, as the management needed to see the projections of the financial impacts in OSS adoption. This would in turn inform their decision making process as they would have a clear understanding of the benefits to expect from OSS adoption, vis-à-vis the challenges.

The switching costs from proprietary software to OSS were found to be too high by twenty three percent (23%) and thirty three percent (33%) who agreed and agreed strongly. However, eighteen percent (18%) of the respondents were not sure while five percent (5%) disagreed. A further twenty one percent (21%) disagreed strongly. This gives an implication that majority of the respondents identified switching costs to be significantly high, owing to the lock-in strategies applied by the proprietary software vendors.

Majority of the respondents fifty nine percent (59%) disagreed strongly that they lacked knowledge on how to access open source software solution. A further twenty one percent (21%) disagreed while fifteen percent (15%) were not sure. Only a small sample of five percent (5%)

agreed implying that most organizations were aware on how to access open source software solution.

Most of the organizations' banking systems were not designed for use in a proprietary Operating System. This is shown by thirteen percent (13%) of the respondents who disagreed and a further fifty nine percent (59%) disagreed strongly. This implies that the organizations can more easily incorporate open source software into their desktop and server computing, without affecting the operations of the banking systems, since they are platform independent and can therefore run on OSS.

Table 4.5a: Challenges in adoption of open source

	Strongly Disagree		2		3		4		Strongly Agree		Mean Score
	Freq	%	Freq	%	Freq	%	Freq	%	Freq	%	
We lack a Return-On-Investment analysis on using OSS applications	1	3%	2	5%	7	18%	16	41%	13	33%	3.97
The switching costs from proprietary software to OSS are too high	8	21%	2	5%	7	18%	9	23%	13	33%	3.44
We are not certain on the availability of Support Services when using OSS	2	5%	8	21%	9	23%	13	33%	7	18%	3.38
We do not have feature comparisons between OSS and proprietary solutions.	4	11%	9	24%	10	26%	10	26%	5	13%	3.08
We do not have experience in OSS development or maintenance	11	28%	6	15%	5	13%	8	21%	9	23%	2.95
Open Source Software is not very secure for our business	7	18%	4	10%	16	41%	9	23%	3	8%	2.92
The decision on technology adoption is not within our control	16	41%	5	13%	14	36%	4	10%	0	0%	2.15
OSS is too expensive to acquire	19	49%	9	23%	4	10%	1	3%	6	15%	2.13
We do not understand the legal requirements of Open Source	17	44%	12	31%	6	15%	2	5%	2	5%	1.97
Our banking system is designed for use in a proprietary Operating System	23	59%	5	13%	5	13%	4	10%	2	5%	1.90
We do not know how to access open source software solutions.	23	59%	8	21%	6	15%	2	5%	0	0%	1.67

Source: Survey data

4.6 Cross tabulation

a. Ownership structure and the OSS software used

The researcher wanted to find out if there was any relationship between the type of ownership structure of the organization and the OSS used. A cross tabulation was carried out to gauge out the relationship as shown below.

Table 4.6a: Ownership structure and the OSS software used

| | TOTAL | | Ownership | | | | | |
| | | | Locally owned | | Foreign owned | | Public owned | |
	Freq	%	Freq	%	Freq	%	Freq	%
Total	38	100%	21	100%	10	100%	7	100%
Linux	37	97%	20	95%	10	100%	7	100%
Mozilla	37	97%	21	100%	10	100%	6	86%
MySQL	35	92%	20	95%	10	100%	5	71%
Apache	31	82%	17	81%	10	100%	4	57%
PHP	22	58%	12	57%	8	80%	2	29%
OpenOffice	21	55%	9	43%	7	70%	5	71%
FreeBSD/OpenBSD	19	50%	7	33%	8	80%	4	57%
Gnome	7	18%	2	10%	2	20%	3	43%
Samba	6	16%	3	14%	3	30%	0	0%
Squid	4	11%	1	5%	3	30%	0	0%
KDE	2	5%	0	0%	2	20%	0	0%
Perl	2	5%	2	10%	0	0%	0	0%
Zope	1	3%	1	5%	0	0%	0	0%
Others	5	13%	1	5%	4	40%	0	0%

Source: Survey data

From the findings, Linux software and Mozilla are preferred by ninety seven percent (97%) of the organizations across the board. However Mozilla is mostly used by local and foreign based organizations than the publicly owned as shown from the table above. Foreign owned banks were observed to have a 100% adoption of Linux, Mozilla, MySQL and Apache OSS with locally owned being next on positive responsiveness on OSS adoption. This implies that foreign owned banks are influenced positively by their management to adopt OSS owing to better exposure on benefits of adopting OSS in the developed foreign countries.

b. Number of Computers and OSS software used

Table 4.6b: Number of Computers and OSS software used

	TOTAL		10 or Less		11-50		51-100		>100	
	Freq	%	Freq	%	Freq	%	Freq	%	Freq	%
Linux	37	97%	14	93%	16	100%	4	100%	3	100%
Mozilla	37	97%	15	100%	16	100%	4	100%	2	67%
MySQL	35	92%	13	87%	16	100%	4	100%	2	67%
Apache	31	82%	11	73%	15	94%	4	100%	1	33%
PHP	22	58%	5	33%	12	75%	4	100%	1	33%
OpenOffice	21	55%	8	53%	8	50%	4	100%	1	33%
FreeBSD/OpenBSD	19	50%	7	47%	8	50%	4	100%	0	0%
Gnome	7	18%	0	0%	3	19%	4	100%	0	0%
Samba	6	16%	0	0%	4	25%	2	50%	0	0%
Squid	4	11%	2	13%	2	13%	0	0%	0	0%
KDE	2	5%	0	0%	1	6%	1	25%	0	0%
Zope	1	3%	0	0%	1	6%	0	0%	0	0%
Others	5	13%	1	7%	2	13%	1	25%	1	33%
Total	38	100%	15	100%	16	100%	4	100%	3	100%

Source: Survey data

c. Whether plan to increase the share of open source software

Eighty two percent (82%) of foreign owned companies plan to increase their OSS in the next 24 months compared to fifty seven percent (57%) of local and public owned organizations respectively. This implies that the foreign owned banks have a prospect to increase their OSS adoption in the next two years, as a result of the external influence from their foreign affiliations.

Table 4.6c: Plan to increase the share of OSS and ownership structure

	TOTAL		Ownership					
			Locally owned		Foreign owned		Public owned	
	Freq	%	Freq	%	Freq	%	Freq	%
Yes	25	64%	12	57%	9	82%	4	57%
No	10	26%	6	29%	2	18%	2	29%
I dont know	4	10%	3	14%	0	0%	1	14%
Total	39	100%	21	100%	11	100%	7	100%

Source: Survey data

d. Profit before tax against ownership structure

A cross tabulation of the mean was carried out to determine the highest gross profit before tax attained by the various banks surveyed. From the table below, Public owned banks generate the highest profit after tax (3563) followed by foreign owned and locally owned commercial banks.

Table 4.6d: Bank ownership and profits

Ownership	Gross profit
Locally owned	1746.00
Foreign owned	2852.91
Public owned	3563.00
Total	2418.84

Source: Survey data

e. Average Percentage of annual budget allotted to Information technology in respect to the ownership structure.

Table 4.6e: Ownership Structure and percentage of IT operating budget over annual budget

IT operating budget over annual budget	TOTAL		Ownership					
			Locally owned		Foreign owned		Public owned	
	Count	%	Count	%	Count	%	Count	%
2% or less	6	15%	4	19%	0	0%	2	29%
2-6%	7	18%	6	29%	1	9%	0	0%
7-10%	11	28%	6	29%	2	18%	3	43%
More than 10%	15	38%	5	24%	8	73%	2	29%

Source: Survey data

A cross tabulation between the number of computers and the three year average of IT operating budget over annual budgets the commercial banks in Kenya reported that most banks had over ten percent (10%) of their budgets being allotted to information Technology operations. This is so as 38% of banks had more than 10% of operating budget on IT. The findings also indicate that most locally owned banks allot between 2 percent and10 percent of their total budget to IT operations while most foreign owned banks allot more than ten percent and most public owned banks allot between 7 percent and 10 percent of their total annual budget, to the IT operating budget.

4.7 Hypothesis Testing

In this section the study presents the results of the tested hypotheses in which the chi-square was used to test the relationships between the decision to outsource and the variables. In the first hypothesis to study sought to establish the relationship between the organizational structure and the decision on technology adoption. The results are presented in the Table below.

Table 4.7a: Chi-Square Tests on organizational structure and decision on technology adoption

H_1o: Organizational structure affects the decision on technology adoption

H_1A: Organizational structure doesn't affect the decision on technology adoption

Significance level: α=0.05

	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	10.605[a]	6	.101
Likelihood Ratio	13.362	6	.038
Linear-by-Linear Association	.975	1	.324
N of Valid Cases	39		

a. 10 cells (83.3%) have expected count less than 5. The minimum expected count is .72.

The results indicate that there is no statistical significant relationship between organizations structure and decision on technology adoption (chi-square with 6 degree of freedom = 10.605, p = 0.101). We therefore reject the null hypothesis that states that *Organizational structures affect the decision on technology adoption.*

Table 4.7b: Chi-Square Tests on academic qualification and understanding of OSS legal requirements.

H_1o: Academic qualifications affect the understanding of OSS legal requirements.

H_1A: Academic qualifications do not affect the understanding of open office legal requirements.

Significance level: α=0.05

	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	2.404[a]	4	.662
Likelihood Ratio	3.094	4	.542

Linear-by-Linear Association	.249	1	.618
N of Valid Cases	39		

. 7 cells (70.0%) have expected count less than 5. The minimum expected count is .67.

Source: Survey data

The results indicate that there is no statistical significant relationship between Academic qualifications and understanding of open office legal requirements. (Chi-square with 4 degree of freedom = 2.404[a], p = 0.662). We therefore reject the null hypothesis that states that *Academic qualifications affect the understanding of open office legal requirements.*

CHAPTER FIVE

CONCLUSIONS AND RECOMMENDATIONS

5.0 Introduction

This chapter states the conclusions drawn from the analysis of the data as well as the recommendations and limitations of the study. The objective of this study was to assess the extent of OSS adoption by Commercial banks in Kenya and the associated challenges.

5.1 Summary of the findings

OSS adoption in the banking industry is widespread for some applications and not for others, despite the inherent benefits. All of the factors found to be relevant in literature were also found to be relevant in the Kenyan context. Some of the challenges entail lack of return on investment analysis, switching costs as a result of lock-in strategies applied, uncertainty on availability of support services, lack of feature comparisons between OSS and proprietary software, and inexperience in OSS development,

The OSS development model results in software that inherently adheres to principles that help organizations 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 market with other OSS vendors and proprietary software vendors.

OSS provides organizations with the freedom to choose if they want to use a software vendor or become the software vendor. Organizations 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.

5.2 Conclusions

The use of OSS has not been fully embraced by organizations with most of them using the open source software's only partially on their desktops and servers. Most sixty four percent (64%) of

organizations however have a plan to increase usage of OSS in the next 24 months. The main decision makers in regard to the open source software's used are the management, IT people and the finance people.

The open source software's used most often by banks in Kenya are Linux, Mozilla, MySQL, Apache and PHP. Fifty nine percent (59%) of the respondents would also like to have access to the source code of the software being used. This implies that they would not only want to use OSS as it is, but also want to modify the program so they can customize it for their use.

The greatest concern that organizations have with regard to OOS adoption is the lack of a Return-On-Investment analysis on using OSS applications. This would help them make more informed decisions on software adoption, as there would be a financial basis to assist in the analysis.

There are concerns within the organizations that the switching costs from proprietary software to OSS are too high, uncertainty on the availability of Support Services when using OSS, lack of feature comparisons between OSS and proprietary solutions, lack of experience in OSS development or maintenance and concerns that Open Source Software is not very secure for their businesses.

5.3 Recommendations

There is need for banks to embrace use of open source software's fully in order to reap the benefits that come with it. Some of the benefits that come with OOS adoption are increased cost savings since open source software's do not have license fees, they apply highly tested security features, and are of high quality, given that OSS is developed by hundreds of developers. They are also easy to customize because the source code is availed and modifications are allowed.

There is need to educate software users on its benefits. This is important because as seen from the findings many people are not aware of the advantage of having access to the source code of the software being used yet this would enable them to modify it to add the functionality they want which is an advantage that is not available with other software's. There is need to address

the issue of switching costs from the proprietary software's to open source as cost was cited as the greatest concerns that businesses have. Support Services should also be made readily availed to organizations that use OSS. Education on the features available should be offered to enable organizations do comparisons between OSS and proprietary solutions.

5.4 Limitations of the Study

The study only covered commercial banks and not all the financial institutions in Kenya were covered. Conclusions could probably have been different if the whole population of financial institutions was studied. The study only assessed the extent of OSS adoption by Commercial banks in Kenya and the associated challenges. As it is, this is an aspect among the many factors and challenges affecting commercial banks in Kenya.

5.5 Suggestions for further research

This study serves to improve OSS knowledge in the banking industry in Kenya. However, OSS can be researched further, as it is becoming an increasingly important aspect of ICT adoption and growth in the developing nations. Further research on OSS adoption in developing countries could include the following: a quantitative study of OSS adoption in Kenyan organizations; a study into the availability and perception of OSS vendors in Kenya; case studies investigating OSS adoption successes and failures in Kenya.

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APPENDIX 1: Questionnaire

SECTION A: DEMOGRAPHIC & GENERAL INFORMATION

(This section requires you to give general information regarding your Bank. Please tick inside the braces [ ] or fill in where appropriate).

1.1 Name of your Organization _____

1.2 What is the ownership structure of your organization?

    [ ] locally owned

    [ ] foreign owned

    [ ] public owned

1.3 How many years has your Organization been in operation? _____

1.4 How many years have you worked in your Organization? _____

1.5 What is your organization's last posted annual gross profit in Kenya Shillings?

    _____

1.6 Which of the following, best describes your title?

    *Please choose **one** of the following*

    [ ] Chief Information Systems Officer

    [ ] Director/Manager Information Systems

    [ ] Director/Manager Network Systems

    [ ] Director/Manager IT Support Services

    [ ] Systems Administrator

    [ ] Developer/Programmer

1.7 What is your age in years _____

1.8 What is your highest academic qualification?

    [ ] Certificate   [ ] Diploma

    [ ] Degree   [ ] Post Graduate

1.9 What is your sex?

    [ ] Male

    [ ] Female

1.10 How many employees does your IT Department have (in Kenya)?

*Please choose **one** of the following*

[ ] 10 or Less   [ ] 11 – 50

[ ] 51 – 100   [ ]> 100

1.11 How many Servers and Personal Computers (PCs) including Laptops do you have in your organization?

a) Number of PCs   [ ] 100 or Less [ ] 101 - 500 [ ] 501 – 1000   [ ]> 1001

b) Number of servers: [ ] 10 or Less   [ ] 11 - 50   [ ] 51 – 100   [ ]> 100

1.12 What is the average percentage of the total annual IT operating budget over the total organization's budget over the last three years (*Please choose **only one** of the following*)

[ ] 2% or less

[ ] 2– 6%

[ ] 7 – 10%

[ ] More than 10%

[ ] I don't know

SECTION B: INFORMATION ON OPEN SOURCE ADOPTION

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

2.0 Has your organization adopted any Open Source Software (OSS) application, product, or system?

*Please choose **one** of the following*

Yes   [ ]   No [ ]   I don't know   [ ]

If answer is yes: How is open source applied in your organization[**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. [ ]

2.1 Which if any of the following Open Source Software do you use in your organization?

Apache [ ]   KDE [ ]   Perl [ ]

GNOME [ ]   Mozilla [ ]   Samba [ ]

Linux [ ]   OpenOffice [ ]   FreeBSD/OpenBSD [ ]

MySQL [ ]   PHP [ ]   Squid [ ]

Zope [ ]

Others (Specify) _____

_____

2.2 Do you plan to increase the share of open source software in your organization, within the next 24 months?

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?

Yes, to replace ALL components [ ]

Yes, to replace SOME components [ ]

I don't know [ ]

2.3 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 [ ]

2.4 In your organization, who are the most important influencers in the decision making process in regard to new technology adoption?

(*Please do not check on more than **two** options*)

IT Professional (yourself)   [ ]

External consultants   [ ]

Users   [ ]

Other management   [ ]

Finance department   [ ]

I don't know   [ ]

Others (Please specify) _____

SECTION C: CHALLENGES IN ADOPTION OF OPEN SOURCE

3.1 What are the challenges faced by your organization on the decision to adopt OSS?

*Please choose the appropriate response for **each** item:*

	Strongly Disagree				Strongly Agree
	1	2	3	4	5
We are not certain on the availability of Support Services when using OSS	[ ]	[ ]	[ ]	[ ]	[ ]
We need a Return-On-Investment analysis on using OSS applications	[ ]	[ ]	[ ]	[ ]	[ ]
OSS is too expensive to acquire	[ ]	[ ]	[ ]	[ ]	[ ]
We do not have feature comparisons between OSS and proprietary solutions.	[ ]	[ ]	[ ]	[ ]	[ ]
We do not understand the legal requirements of Open Source	[ ]	[ ]	[ ]	[ ]	[ ]
The switching costs from proprietary software to OSS are too high	[ ]	[ ]	[ ]	[ ]	[ ]
Open Source Software is not very secure for our business	[ ]	[ ]	[ ]	[ ]	[ ]
We do not know how to access open source software solutions.	[ ]	[ ]	[ ]	[ ]	[ ]

Our banking system is designed for use in a proprietary Operating System	[ ]	[ ]	[ ]	[ ]	[ ]
We do not have experience in OSS development or maintenance	[ ]	[ ]	[ ]	[ ]	[ ]
The decision on technology adoption is not within our control	[ ]	[ ]	[ ]	[ ]	[ ]

Thank you for taking your time to fill in this questionnaire.

APPENDIX 2: Commercial Banks in Kenya

1) African Banking Corporation Ltd.

2) Bank of Africa Kenya Ltd.

3) Bank of Baroda (K) Ltd.

4) Bank of India

5) Barclays Bank of Kenya Ltd.

6) CFC Stanbic Bank Ltd.

7) Charterhouse Bank Ltd

8) Chase Bank (K) Ltd.

9) Citibank N.A Kenya

10) Commercial Bank of Africa Ltd.

11) Consolidated Bank of Kenya Ltd.

12) Co-operative Bank of Kenya Ltd.

13) Credit Bank Ltd.

14) Development Bank of Kenya Ltd.

15) Diamond Trust Bank Kenya Ltd.

16) Dubai Bank Kenya Ltd.

17) Ecobank Kenya Ltd

18) Equatorial Commercial Bank Ltd.

19) Equity Bank Ltd.

20) Family Bank Limited

21) Fidelity Commercial Bank Ltd

22) Fina Bank Ltd

23) First community Bank Limited

24) Giro Commercial Bank Ltd.

25) Guardian Bank Ltd

26) Gulf African Bank Limited

27) Habib Bank A.G Zurich

28) Habib Bank Ltd.

29) Imperial Bank Ltd

30) I & M Bank Ltd

31) Jamii Bora Bank Limited.

32) Kenya Commercial Bank Ltd

33) K-Rep Bank Ltd

34) Middle East Bank (K) Ltd

35) National Bank of Kenya Ltd

36) NIC Bank Ltd

37) Oriental Commercial Bank Ltd

38) Paramount Universal Bank Ltd

39) Prime Bank Ltd

40) Standard Chartered Bank Kenya Ltd

41) Trans-National Bank Ltd

42) UBA Kenya Bank Limited

43) Victoria Commercial Bank Ltd

APPENDIX 3: Ownership of Commercial Banks in Kenya

```
                    ┌──────────────────────────────┐
                    │  Commercial Banks in Kenya    │
                    └──────────────────────────────┘
                              │
              ┌───────────────┴───────────────┐
    ┌─────────────────┐              ┌─────────────────┐
    │ Private         │              │ Public Commercial│
    │ Commercial Banks│              │ Banks            │
    └─────────────────┘              └─────────────────┘
         │                                    │
    ┌────┴────┐                    ┌──────────────────────┐
┌─────────┐ ┌──────────┐           │ - Consolidated Bank  │
│ Locally │ │ Foreign  │           │   of Kenya (77.8%)   │
│ Owned   │ │ Owned    │           │                      │
└─────────┘ └──────────┘           │ - Development Bank   │
    │           │                   │   of Kenya (100%)    │
┌─────────┐ ┌──────────┐           │                      │
│ 27      │ │ 13       │           │ - National Bank of   │
│Commercial││Commercial│           │   Kenya (70.6%)      │
│ Banks   │ │ Banks    │           └──────────────────────┘
└─────────┘ └──────────┘
```
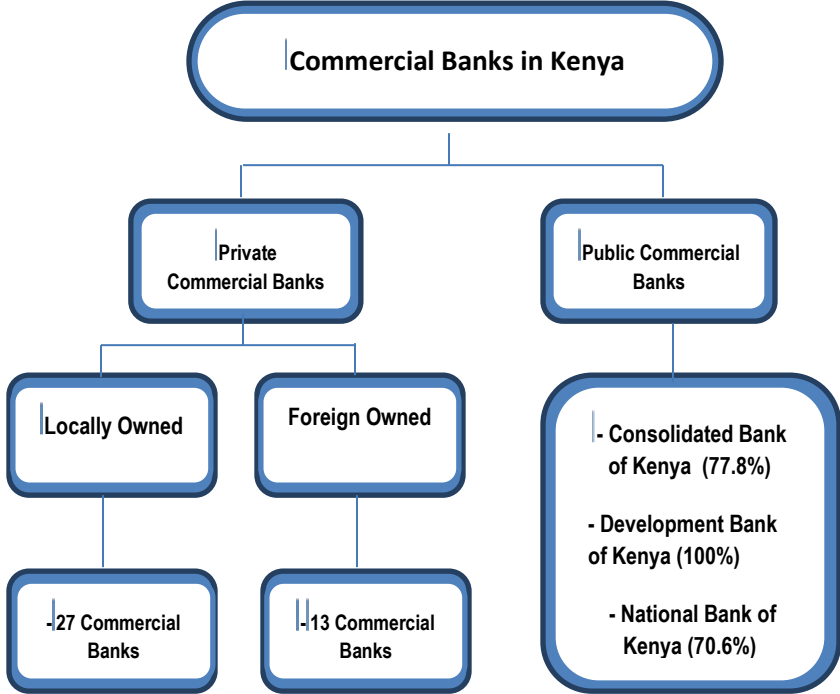
Figure APP3. Ownership of Commercial Banks in Kenya, (Central Bank of Kenya, 2011)*.*