ADOPTION OF FREE DESKTOP OPEN SOURCE SOFTWARE IN DEVELOPING COUNTRIES IN AFRICA: A CASE OF KENYAN UNIVERSITY STUDENTS

by

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Declaration

I declare that Adoption of free desktop open source software in developing countries in Africa: A case of Kenyan university students is my own work and that all the sources that I have used or quoted have been indicated and acknowledged by means of complete references. I further declare that I have not previously submitted this work, or part of it, for examination at Unisa for another qualification or at any other higher education institution.

Preface

Some work in this thesis has been previously published in international peer reviewed journals

- Kamau, J. W. & Sanders, I. D., 2013. An Empirical Investigation into the Effect of Usability on Adoption of Desktop Open Source Software by University Students in Kenya. *Computer and Information Science,* 6(3), pp. 108-117.
- Kamau, J. & Namuye, S., 2012. A review of users adoption of open source software in Africa. *Computer and Information Science,* pp. 45-49.

Papers from this thesis that have been accepted for publishing in international peer reviewed journals pending publishing

- Kamau, J. W. & Sanders, I. D., A review of prominent technology acceptance models in the context of predicting software adoption in African developing countries: A case of free desktop Open Source Software (OSS) - Accepted in November 2016. Asian Journal of Information Technology (publisher Medwell journals) - See the acceptance letter in Appendix G

Papers from this thesis that have positive feedback from international peer reviewed journals but are being improved for final acceptance and publishing.

- Kamau, J. W. & Sanders, I. D., An empirical study of Factors contributing to the adoption of Free Desktop Open Source Software in Africa: A case of Kenyan university students – Feedback received in February 2017 – Recommendation -Revise. African Journal of Information Systems.

Papers from this thesis that have been presented in international conferences

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Abstract

Open source products such as software development tools and server applications are gaining popularity among expert users. There is however a notable lag in adoption of desktop open source software among ordinary users especially in Africa. A number of critical factors such as performance expectancy, effort expectancy and facilitating conditions have been suggested as the determinants of Information and Communication Technologies adoption in general. This study deemed it important to establish if the above factors are the determinants of desktop open source software adoption in Africa.

The study aimed to establish the Open Source Software adoption levels among university students in Kenya as well as the factors affecting Open Source Software adoption in this population. The author further aimed to assess the applicability of popular technology acceptance models in the adoption of the software in the population under study. The study employed literature review, quantitative and qualitative approaches. The study also used both descriptive and explanatory research designs in answering the research questions. The Extended Unified Theory of Acceptance and Use of Technology was used as a theoretical framework because it has synthesised all its major predecessors and accommodated all the predecessors constructs. The other reason The Extended Unified Theory of Acceptance and Use of Technology was used is because the model was developed specifically for predicting voluntary technology adoption.

This study established that the adoption of Free Open Source Software products in Kenya is very low and existing literature revealed that this is also the case in other developing countries. The study concluded that the factors affecting adoption of desktop Open Source Software by Kenyan university students are usability, user training, Open Source Software compatibility, social influence, prior experience, social economic status, job market demands, proprietary software piracy culture and patent and copyright laws.

Hence the study suggested that the existing technology adoption models are not appropriate in predicting technology adoption in an Africa setup. The study proposed and validated an appropriate model that fits in this context.

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List of Abbreviations

AI – Artificial Intelligence

ANOVA – Analysis of Variance

BI – Behavioural intention

COTS - Commercial Off-The-Shelf

CRC - Computing Resource Centre

EDC – Economically Developing Country

EUTAUT - Extended Unified Theory of Acceptance and Use of Technology

FSF – Free Software Foundation

GUI – Graphical User Interface

HCI – Human Computer Interface

HTTP - Hypertext Transfer Protocol

ICT – Information Communication Technology

DOI - Diffusion of Innovations

IMF - International Monetary Fund

IS – Information Systems

JMD – Job Market Demands

MIS - Management Information Systems

MIT - Massachusetts Institute of Technology

MM – Motivational Model

MPCU- Model of PC Utilisation

NACOSTI - National Council for Science Technology and Innovation

NGO - Non Governmental Organisations

OSD - Open Source Definition

OSI – Open source Initiative

OSP – Open Source Project

OSS – Open Source Software

OSSA - Open Source Software Adoption

PBC - Perceived Behavioural Control

PC – Personal Computer

PEOU - Perceived Ease-of-Use

PLS - Partial Least Squares

PS - Proprietary Software

PU - Perceived Usefulness

R & D – Research and Development

SCT - Social Cognitive Theory

SI - Social Influence

SME - Small and Medium-sized Enterprises

SN – Subjective Norm

TAM - Technology Acceptance Model

TCO - Total Cost of Ownership

TOE – Technology Organisation and Environment

TPB - Theory of Planned Behaviour

TRA – Theory of reasoned action

UC – University of California

UNISA – University of South Africa

US - United States

UTAUT - Unified Theory of Acceptance and Use of Technology

Glossary of terms

These are generally terms that appear in all the literature or in common usage. In cases where the terms are specific to this thesis and context, citations have been provided.

Affect - the feelings of joy, elation, pleasure, depression, disgust, displeasure, or hate associated by an individual with a particular act (Triandis, 1980).

Affect Towards Use - the feelings of joy, elation, pleasure, depression, disgust, displeasure, or hate associated by an individual with a particular act (Thompson, et al., 1991).

Complexity - the degree to which an innovation is perceived as relatively difficult to understand and use (Thompson, et al., 1991).

Desktop software - an application that runs stand alone on a desktop or laptop computer.

Facilitating Conditions - provision of support for users of PCs may be one type of facilitating condition that can influence system utilization (Thompson, et al., 1991).

Free software - software which users are allowed to run, copy, distribute, study, change and improve without paying for it (Free Software Foundation, 2014).

Graphical User Interface - a visual way of interacting with a computer, using items such as windows, icons, and menus, used by most modern operating systems.

Human Computer Interface – is the means of communication between a human user and a computer system, referring in particular to the use of input/output devices with supporting software.

Information System - is a system composed of people, processes and computers that processes or interprets information.

Job-fit - the extent to which an individual believes that using a technology can enhance the performance of his or her job (Thompson, et al., 1991).

Long-term consequences - outcomes that have a pay-off in the future (Thompson, et al., 1991).

Novice User – a computer user who has very little understanding of how computers work

Open Source Software – computer software where the source code of the program/application is made freely available for anyone to change and distribute provided they abide by the accompanying licence (Open Source Initiative, 1999).

Perceived ease-of-use - the degree to which a person believes that using a particular system would require minimal effort (Davis, 1989).

Perceived enjoyment - the degree to which the action of using the computer is perceived to be enjoyable (Davis, et al., 1992).

Perceived usefulness - the degree to which a person believes that using a particular system would enhance his or her job performance (Davis, 1989).

Proprietary Software - software that has restrictions on any combination of the usage, modification, copying or distributing modified versions of the software.

Relative advantage - the degree to which an innovation is perceived as being better than the idea it supersedes (Rogers, 1995).

Social Factors – an individual's internalization of the reference group's subjective culture, and specific interpersonal agreements that the individual has made with others, in specific social situations (Triandis, 1980).

Chapter 1

Introduction

1.0. Background of the study

There are a number of open source software (OSS) projects that have been considered successful over the years such as the Linux operating system which was begun by Linus Tovalds in 1991 (Feller & Fitzgerald, 2000). There was optimism in the early years of OSS development that the software would overtake proprietary software (PS) in adoption. However, this has not been the case especially in developing countries in Africa (CENATIC Team, 2010). Current market share reports reveal that OSS products such as Linux and Firefox are lagging significantly in adoption (Applications Net, 2012).

Negash et al., (2007), suggest that the cost of licencing PS such as the Microsoft Windows operating system family and the Microsoft Office family is high which is a barrier for Economically Developing Countries (EDC) in adopting such PS. In an EDC the cost of a software product on average, is in most cases, higher than an individual's yearly income (Ghosh, 2003). Bearing in mind the economic status of EDCs, one would expect that individuals in these countries would adopt OSS as a natural choice leading to high adoption levels. Nevertheless, Reijswoud & Mulo (2007), observe that the assimilation of OSS is limited even though international non-governmental organisations (NGOs) and organisations whose goal is to encourage and support economic development have been encouraging the adoption of OSS software in these countries due to the economic benefits. OSS is perceived to have a number of advantages such as cost saving, security, customisability, reliability, quality, customer support from a community, escaping vendor lock-in among others (Kotwani & Kalyani, 2011; Zhu & Zhou, 2012; Krishnamurthy, 2003; Heron, et al., 2013; Keßler & Alpar, 2009; Wheeler, 2001; Dedrick & West, 2004).

Kenya is an emerging and developing economy as classified by the International Monetary Fund (International Monetary Fund, 2010). The population was estimated to stand at 43.0 million in the year 2014 (Kenya Bureau of Statistics, 2015). The country also has a total geographical area of 591,971 Sq. Kilometres (Kenya Bureau of Statistics, 2015). Although there are limited studies on actual computer literacy levels and access to computing devices by citizens and in the country, the ICT sector has been growing at impressive rates (International Data Corporation, 2014). Over the last few years Internet subscription has grown tremendously especially that of terrestrial mobile from 1,562,065 in 2009 to 8,436,578 in 2012 (Kenya Bureau of Statistics, 2015).

International Data Corporation (2014), estimates that ICT spending covering hardware, software, Information Technology (IT) and communication services has grown from 8.9% of Gross Domestic Product (GDP) in 2006 to an estimated 12.1% of GDP in 2013.

Technology acceptance models have been used in the past to explain the uptake of new technologies such as free desktop OSS. Technology Acceptance Model, Model of PC Utilization and Diffusion of Innovations are some of the models that have been developed over the years. These models seek to explain how and why individuals and organizations adopt new information technologies in general (Venkatesh, et al., 2003).

Open source software is a relatively new idea to many computer users in countries with developing economies such as Kenya. It is important to understand the level of adoption and the factors that could affect the adoption of free desktop OSS in Kenya. Possible factors that contribute to technology use behaviour which have been suggested in a recent model are; performance expectancy, effort expectancy, social influence and price value among others (Venkatesh, et al., 2012). Major research gaps exist in the area of OSS adoption as it is clear that its adoption has received little attention. The research gaps exist in the areas of status OSS adoption in Africa, OSS total cost of ownership and factors of OSS adoption (Dedrick & West, 2004; Morgan & Finnegan, 2007; Li, et al., 2011).

Problem statement

The adoption of free desktop open source software applications in developing countries is very low despite the apparent benefits of the software (Mtsweni & Biermann, 2008; Li, et al., 2011). Due to the failure to adopt free OSS, many organisations and individuals end up spending large amounts of money on PS licences. The low adoption of free desktop OSS in developing countries in Africa introduces a need to understand the situation and the factors that contribute to the low adoption levels. A number of models that aim to identify the factors that lead to the acceptance and adoption of technology exist. It is important to assess the suitability of the common technology acceptance models in the African setup. The common models are; the Technology Adoption Model, the Unified Theory of Use and Acceptance of Technology among others.

Due to the limited scope of recent studies on the adoption of free OSS it is very difficult to establish the actual adoption levels of the software. There is a need to conduct empirical studies in order to establish adoption levels in Africa.

Very limited studies have empirically tested the existing technology acceptance models in an African setup in order to establish their applicability and relevance (Mtsweni & Biermann, 2008;

Li, et al., 2011). African countries are different from the US or Europe and other developed countries but they are similar to each other in many respects. The presence of studies involving these models in an African setup would have served to provide useful information regarding technology adoption. Since the studies testing the existing technology models are limited, it is important to conduct studies to assess the applicability of the existing technology models. If the current models are not applicable in the African setup, a new model with a new set of determinants that are applicable to the African setup needs to be developed.

Justification

Although many studies have been conducted in the area of OSS, the studies have concentrated mainly on the motivations of open source programmers and the project management of specific products (Morgan & Finnegan, 2007; Gallego, et al., 2008; Lakka, et al., 2012). According to these authors, although some research has been conducted on OSS adoption these studies have either concentrated on the adoption of specific open source products, have been conducted with companies outside of Europe (excluding Africa) or have concentrated largely on public administrations and companies operating in the primary software sector. Similar observations were made by Cenatic (2010) who noted that, major research gaps existed in the area of OSS adoption. Despite the fact that these studies were general and did not have an African focus, other studies by Johnston et al., (2013) and Bakar et al., (2014), have recommended the need for further research in Africa to establish the reasons for low adoption of OSS and the factors that could lead to its adoption. In addition the factors contributing to OSS adoption by individuals is an area that has received very little attention compared to that of organisational adoption (Li, et al., 2011).

This study focuses on university students because the students fall in the category of the most literate in developing countries. They also generally use computers to a great extent in their studies and research as noted by empirical studies conducted in the past (U.S. Institute of Education Sciences, 2006).

1.1. Research objectives

The aim of this study is to investigate the adoption Free OSS products among university students in Kenya.

The objectives of the study are as follows:

1. To investigate the level of adoption of free desktop open source software by university students in Kenya

2. To investigate the factors affecting adoption of free desktop open source software by university students in Kenya
3. To investigate the applicability of the existing technology acceptance models in measuring adoption of free desktop open source software applications by university students in Kenya
4. To develop an OSS adoption model which is applicable to the situation in Kenya and may be applicable more broadly in Africa
5. To validate the OSS adoption model developed in four (4) above

1.2. Significance of the study

The results of this study will inform free desktop open source software adoption stakeholders on the areas of improvement in order to increase its adoption guided by the independent variables identified by this study. This might play a critical role in increasing the level of free OSS adoption in the country and consequently lowering the software acquisition costs.

The findings of this study will also be useful to OSS developers, training institutions, software developers, the government of Kenya and others interested in promoting free OSS adoption. The study has led to the development of an OSS adoption model and diagnostic tools and a framework that will be useful in predicting OSS adoption in African countries which will inform design changes before users use Desktop OSS products. The findings contained in this thesis could make a major contribution in achieving the country's development goals and provide a basis for conducting further research in the area.

1.3. Research Questions

The research questions for this study are as follows;

1. What is the level of free OSS adoption among Kenyan university students?
2. What factors affect the adoption of free desktop OSS among Kenyan students?
3. To what extent do the current technology acceptance models apply in OSS desktop applications adoption in Kenya and particularly to the Kenyan University students?
4. What constructs and variables would constitute an appropriate model applicable to the situation in Kenya?
5. To what extent is the model developed in four above (4) valid in the Kenyan situation?

1.4. Structure of the thesis

The current chapter presents an introduction to the thesis. The chapter introduces the problem and the background in which it exists. The introduction chapter also contains the problem statement and the justification of the study. The research objectives and questions as well as the significance of the study are also explained.

The next chapter (Chapter 2) reviews the existing OSS literature in terms of the origin of OSS, known OSS benefits and limitations. The chapter also reviews the global status of OSS adoption in both developed and developing countries in other parts of the world and in Africa. The perceived factors contributing to adoption of OSS products are also explained. Finally the chapter briefly gives an overview of the popular technology adoption models.

The third chapter aims to assess the appropriateness of the existing technology acceptance models in predicting free OSS adoption in African developing countries. The chapter also reviews the methodology used to develop these models as well as the criticism of these models by other scholars in terms of their deficiencies and gaps that need to be addressed in the future.

The fourth chapter presents a proposal and a discussion of a new model that the author believes fits in the African scenario. The presented model has a dependent variable, independent variables as well as moderating variables. The chapter also clearly outlines the research hypothesis that guides the study in developing the model.

Chapter five (5) discusses the research methods used to test and validate the hypothesised model. The chapter also explains the target population as well as the sampling methods used in the study. The data collection methods used, which include questionnaires and interviews, are discussed.

In Chapter six (6), the results of the study conducted as explained in Chapter five are presented. The chapter contains descriptive and inferential statistics outcomes which are drawn from the questionnaire and interview analysis. The results presented in this chapter comprise descriptive data analysis for the biographical data such as the year of study, age, and gender of the respondents. Descriptive statistics on usability, social influence, user training, OSS compatibility with other software, patent and copyright laws, social economic status, prior experience, job market demands, piracy culture and OSS adoption are also covered. The model development which was done using regression and correlation analysis of the questionnaire data is also presented. The chapter also presents and discusses the newly developed OSS model validation results.

Chapter seven (7) discusses the results of the study and the implications of the results. The discussion also relates the results of this study with other related studies conducted in information systems and OSS adoption.

Chapter eight (8) concludes this thesis and also discusses the recommendations as well as future work that the author proposes will need to be undertaken on this subject.

1.5. Conclusion

This chapter presents the background of the study in the area of OSS adoption in an economically developing country. This study notes that in Kenya OSS adoption has been very low despite the apparent benefits of the software. The study is justified due to the absence of comprehensive studies in the area of OSS adoption in Kenya and in Africa in general.

The research objectives as well as the research questions are clearly articulated in this chapter. The results of this study could play an important role in increasing the adoption of OSS in economically developing countries. The chapter further presents the structure of the thesis.

Chapter 2

Literature review

2.0. Introduction

This chapter provides a discussion of literature in the area of Open Source Software (OSS). The chapter starts by discussing the origin of OSS, the advantages and disadvantages of OSS as well as how OSS is developed. The chapter also presents the status of OSS adoption including that of African countries. The chapter further discusses the theories and models used in Information Systems and the factors perceived to contribute to software adoption. The chapter concludes by analysing the research gaps in the area of OSS.

2.1. The Open Source Software concept

Open Source Software (OSS) can be defined as a program whose source code is made freely available for anyone to change and distribute provided they abide by the accompanying licence (Open Source Initiative, 1999). The fundamental intention of open source licensing is to deny anybody the right to *exclusively* exploit a software program, in order to allow many people to easily access the program (Laurent, 2004).

In order for software to fit as open source, the program must include source code, and must allow distribution in source code as well as compiled form (Laurent, 2004). The software licence must allow modifications and derived works, and must require them to be distributed under the same terms as the licence of the original software. It must explicitly permit distribution of software built from modified source code although the licence may require derived works to carry a different name or version number from the original software (Laurent, 2004). An Open Source Initiative (OSI) approved licence does not prevent someone from charging for the software as long as the buyer "retains the right to freely copy and distribute the software and to use the source code freely to create derivative works" (Fitzgerald & Bassett, 2003 pg 40). The OSI, is the main movement that advocates for OSS.

Another closely related term to OSS is free software. The free software movement is championed by the free software foundation. Free software is defined as the software which "the users have the freedom to run, copy, distribute, study, change and improve" (Free Software Foundation, 2014). Although the two movements differ in some areas, the Free Software Foundation (2014) acknowledges that the two have a common "enemy", proprietary software. The two terms OSS and free software describe almost the same category of software but they stand for views based on fundamentally different values (Stallman, 2000). OSS is a development methodology while

free software is a social movement. Stallman (2000) argues that free software is an ethical imperative because only free software respects the users' freedom. On the other hand OSS "considers issues in terms of how to make software 'better' in a practical sense only" Stallman (2000 pg. 31).

There has been advocacy for OSS by different movements because of the perceived benefits of the software. The Open Source Initiative (1998) suggests that OSS could offer better products because open source software can be improved faster than conventional commercial software. This is because many programmers read, distribute and modify the source code and hence there is a rapid evolutionary process producing better software than the traditional closed model. This study focusses on OSS that is distributed at no fee and therefore is regarded as free Open Source Software.

2.2. History of OSS

The ground work for what is today called OSS was laid by Richard Stallman when he worked as a programmer at the Artificial Intelligence (AI) Laboratory at Massachusetts Institute of Technology (MIT) in the 1970s and early 1980s (Bretthauer, 2001). Bretthauer (2001) notes that, although Stallman does not identify himself as part of the Open Source Software movement, instead preferring the term "Free Software", he made a major contribution during its inception.

MIT has a rich history of OSS which has been detailed by Bretthauer (2001) and Williams (2002), as summarised in this section. At MIT, Richard Stallman was using a locally developed operating system called ITS, or Incompatible Timesharing System, when he encountered a challenge because he wanted to improve upon the printer driver for a laser printer with a tendency to jam which Xerox had given MIT. Stallman was unable to do this because Xerox would not supply a copy of the source code, therefore Stallman felt that he had become a victim of a non-disclosure agreement.

Previously, companies such as Xerox used to donate machines and software programs to places where good programmers typically congregated (Williams, 2002). Good programmers were considered to be an asset to society as a whole and preferred to use the slangy word "hacker" instead of programmer. If hackers improved on the software of donated equipment, companies could use the improvements by incorporating them into updated versions of the software for the commercial marketplace (Williams, 2002). As a cultural practice, hackers across institutions such as universities used to share information such as source code freely.

Through this simple system of intellectual accumulation, hackers at the AI Lab and other places built up robust creations (Williams, 2002). Williams (2002), further notes that, computer scientists at UC Berkeley working in cooperation with low-level engineers at AT&T developed an entire operating system, dubbed UNIX, using this system. The software was available to any programmer ready to pay for the cost of copying the program onto a new magnetic tape and shipping it.

Later, the computer system at the AI lab was replaced with a proprietary operating system (OS) which led to the collapse of the collaborative programmer community that worked at MIT (Bretthauer, 2001). Bretthauer (2001) further notes that Stallman resigned in 1984 and decided to create an operating system complete with all necessary software tools, which was called GNU that was compatible with UNIX and based on the free software concept. In early 1985, he released the first version of the GNU Emacs editor software that was available through the Internet free of charge (Bretthauer, 2001). Other programmers were interested in using the GNU Emacs editor. Since the Internet was not common at the time, he also made the software available on tape for $150 which catered for his living expenses.

Some users at the time were wondering why the software was being referred to as free and yet Stallman was charging a small fee. He clarified that the word "free" was not referring to the price but the "freedom" as users had the freedom to run, modify and redistribute the software. As the number of programmers using GNU Emacs grew, they also started making significant contributions towards the improvement of the software by sending him source code. Stallman made it a habit to include the source code written by other contributors.

As the GNU work progressed, Stallman thought it wise to protect his work from being taken and used in proprietary software. To allow this protection, Stallman also came up with the broad concept of *copyleft*, meaning that the user had the freedom to modify the software but was obliged to redistribute the modified and extended versions at no fee (GNU, 2014). In October 1985, Stallman founded the Free Software Foundation to support the development of GNU as "a tax-exempt charity that raises funds to promote the freedom to share and change software" (Bretthauer, 2001).

By 1991, Stallman and his programmers had written everything for GNU except the kernel, the part that ties the entire system together (Bretthauer, 2001). In 1990, Stallman visited Polytechnic University in Helsinki, Finland and among the audience members was 21 year old Linus Torvalds, the future developer of the Linux kernel-the free software kernel (Williams, 2002).

This study notes that the revised edition by Williams (2010), records 1991 as the year Stallman visited Polytechnic University in Helsinki. By 1991, Linus Torvalds had released the Linux kernel-the free software kernel destined to fill the GNU Project's most sizable gap (Bretthauer, 2001). Bretthauer (2001), notes that the Linux kernel was combined with the rest of the GNU operating system making a new operating system called Linux although Stallman argues that it should more correctly be called GNU-Linux.

A number of newcomers to the free software movement who were meeting on a regular basis in late 1997 and early 1998 felt that the name "free software" was not appropriate and instead coined the term "Open Source Software" (Bretthauer, 2001). Bretthauer (2001), further reports that the newcomers felt that the term "free software" was holding back the budding industry/movement as "free" meaning "free-as-in-beer", not "free-as-in-speech". The word "free" was being interpreted to mean there is no price to pay for the software. The Open Source Initiative (OSI) was founded in 1998 as a California public benefit corporation, with 501(c)3 tax-exempt status (Open Source Initiative, 1999). As reported on their web site, OSI are the stewards of the Open Source Definition (OSD) and are the community-recognized body for reviewing and approving licences as OSD-conformant.

In order for software to be OSD compliant, it must allow free distribution by not restricting any party from selling or giving away the software as a component of an aggregate software (Open Source Initiative, 1999). OSS must also include source code, allow modification and derived works, it must ensure integrity of the author's source code among other requirements stipulated by the OSI initiative (Open Source Initiative, 1999).

The Linux kernel is licensed under the GPL and it is a good example of software that satisfies both OSS and Free software definitions (Carver, 2005). Although in most cases free software also satisfies the OSS requirements, not all OSS is free software (Open Source Initiative, 2009). Over the years Bretthauer (2001), notes that a number of software packages have been developed as open source projects. Among them are;

- PERL 1.0 scripting/programming language which was released by Larry Wall in 1987
- Python programming language which was released by Guido van Rossum in 1990
- PHP/FI web scripting/programming language which was released by Rasmus Lerdorf in 1994
- Apache web server program released in 1995
- mSQL, MySQL, and PostgreSQL relational databases released in mid-1990's

- Samba which was released by Andrew Tridgell in the mid-1990's

The OSS process

OSS is developed by loosely coordinated software developers who may be located in different locations worldwide (Scacchi, et al., 2006). During the development of OSS, there is no central control or planning of the project (Madey, et al., 2002). Although some large Free/Open Source Software Development (F/OSSD) companies assign and pay software development staff to work on F/OSSD projects as part of their job, it is common for OSS developers to volunteer their time and skill to such an effort (Scacchi, et al., 2006). These developers also provide their own computing resources and software development tools and work at their personal discretion without being scheduled (Scacchi, et al., 2006).

OSS in many instances starts with one developer who wants to solve his or her problem and shares the code for the software solution with other developers for free (Nakakoji, et al., 2002). In most cases, OSS software requirements are not well defined at the start of the software development project (Tiwari, 2011). Developers who have a similar problem to the initial developer improve the initial software solution and end up becoming co-developers of the software (Nakakoji, et al., 2002). The developers and all the participants including the users form a collaborative community (Nakakoji, et al., 2002). The software requirements are gathered as the project progresses mainly based on feedback obtained from early releases of the OSS (Tiwari, 2011).

The participants may create awareness for their project through mailing lists, newsgroups or online news services (Tiwari, 2010). Anyone is allowed to contribute to the development of the software and exchange knowledge until the team achieves a satisfactory result (Tiwari, 2010). During the development of the software, the project work is made publicly available so that many people can be able to access it (Tiwari, 2011). The users also have a role to play and participate by sending error reports, feedback and usability reports to the development community (Scacchi, et al., 2006).

OSS projects in some cases are spearheaded by the initial developer of the OSS who does not have a roadmap of the project at the beginning and does not direct the evolution of the software (Nakakoji, et al., 2002). The project is driven by the entire OSS community collaboratively who serve as both the users and developers of the software (Nakakoji, et al., 2002). Some OSS projects

have large and others small teams of developers who mainly join because they feel they benefit by learning and also sharing what they know (Scacchi, et al., 2006).

Nakakoji, et al., (2002) classifies OSS projects into three categories namely; Exploration-Oriented, Utility-Oriented or Service-Oriented. The aim of Exploration-Oriented projects is to drive the frontline of software development jointly through the sharing of innovations embedded in freely shared OSS systems as is done in scientific research (Nakakoji, et al., 2002). Nakakoji, et al., (2002), explains that Utility-Oriented OSS on the other hand aims at filling a functionality gap. Examples of Utility-Oriented OSS are the device drivers found in operating systems such as Linux (Nakakoji, et al., 2002). Lastly Nakakoji, et al., (2002), describes Service-Oriented as the OSS that provides stable and robust services to both developers and users of OSS such as the Apache server and PostgreSQL system.

There is no single agreed methodology for OSSD, because OSS processes could vary from one project to another (Tiwari, 2011). Tiwari (2011) notes that there are several theoretical approaches which try to explain the OSS phenomenon but so far there is no single agreed development model for OSS. One of the proposed models by Rothfuss (2002), presents a six stage evolution process. The stages are; Planning, Pre-Alpha, Alpha, Beta, Stable and Mature (Rothfuss, 2002). The stages proposed by Rothfuss (2002), are discussed below;

Planning

In the planning stage, the OSS project is just an idea and no code exists. When code is written, the project enters the next stage which is the Pre-Alpha stage.

Pre-Alpha

In the Pre-Alpha stage, the initial code is released although the code is not expected to compile and execute.

Alpha

In this stage, the code starts executing with a few challenges and there may be some initial documentation for the code. The project starts taking shape as the participants work on the features of the software.

Beta

In this stage the software has all the features but it is not completely debugged. During this stage the errors are gradually corrected making the software more reliable.

Stable

The software in this stage has achieved stability for use by the end-user, and the changes that are made to the software are aimed at making it more stable as opposed to adding new features. The changes made to the software are done very carefully and only minor issues could remain as the project enters the next phase.

Mature

In this stage there are very minimal or no changes being made to the software and the few changes being made are done with caution. The software could remain in this stage until it becomes obsolete when it is replaced by more modern software.

Another model proposed by Sharma (2002) suggests that OSS development follows seven common activities. The activities are; problem discovery, finding volunteers, solution identification, code development and testing, code change and review, code commit and documentation and finally release management (Sharma, et al., 2002).

Release management in OSS

OSS development uses an iterative development approach in which development releases are made very frequently (Michlmayr, et al., 2007). In some cases the OSS projects are large and consequently attract many volunteer programmers and result in frequent software releases (Michlmayr & Fitzgerald, 2012). Due to the frequency of releasing software to end users, there is often a challenge in releasing stable software which makes release management of OSS a real issue of concern (Michlmayr, et al., 2007). Recently the issue of release management has drawn some interest in many FOSS projects (Michlmayr & Fitzgerald, 2012).

There are three different types of OSS release processes namely; design release, development release and testing release (Kumar & Mangalam, 2012). *Design release* targets software developers who are involved in working on the OSS project while a development release is made when some new significant features and functionality have been included (Kumar & Raghuraman, 2014). Kumar and Raghuraman (2014), defines a testing release as a release that is made to the user community after the OSS has been well tested and only requires minor correction of bugs after getting feedback from the users.

A comparison of OSS versus Traditional closed source software release management can be summarised in the Table 2.2-1.

Table 2.2-1 OSS versus traditional closed source software

Traditional closed source	FOSS
Often follows a waterfall model	Typically follows iterative development practices
Delivery of a monolithic release after long time in development	Small releases published in an incremental fashion
Uses dedicated planning tools such as Gantt charts	Few dedicated planning tools but good integration of infrastructure (e.g. bug tracking) with release planning
Development releases are private	Development is open, and releases and repositories accessible
Few releases made for the purpose of user testing	Development releases published according to motto "release early, release often"

Source: Michlmayr & Fitzgerald (2012).

How use of OSS is regulated

OSS uses several licences that comply with the OSD including the GNU General Public Licence (Open Source Initiative, 2009). The GNU General Public Licence (GPL) is a free copyleft licence for software that is intended to ensure that the user has the freedom to share and modify software (GNU, 2007). The Open Source Initiative (2009), has a list of all the approved licences as well as the common ones such as; Apache licence 2.0, MIT, and BSD, General Public Licence, Eclipse public licence among others. The MIT and BSD were two of the earliest OSS licences (Laurent, 2004). Before a licence is declared open source compliant, it must be taken through the OSI licence review process (Open Source Initiative, 1999).

The GNU general public licence is enforced by the copyright holders of the software (GNU, 2016). The enforcement of the GNU general public licence is mainly done through mediation (Fitzgerald & Bassett, 2003). The GNU (2016) encourages the public to report violations of a GPL licence to the developers of the GPL-covered software involved. The GPL licence can also be enforced through a legal process and so far there have been cases in court involving the licence

both in Germany and in the United states which have proved that the licence is enforceable (Wacha, 2004).

2.3. Advantages of Open Source Software

OSS is perceived to have a number of advantages, as discussed by several advocates of OSS and authors around the world. This section discusses the advantages of OSS.

Cost saving

One of the principle justifications for the existence of FOSS is the provision of the software and the code at no fee in order to allow companies and individuals to benefit from the software (Bretthauer, 2001, Williams, 2002). It has been reported that, as a result of using OSS many organisations have been able to achieve significant cost savings in technology expenditure to the tune of millions of dollars (Nagy, Yasssin, & Bhattacherjee, 2010; Dedrick & West, 2004). Dedrick & West (2004), noted that an OSS platform frees companies from sizable annual fees for OS usage and upgrades. A study conducted Derrick & West (2004), noted that many companies opt to use OSS such as Linux as it results in both a software and a hardware cost advantage apart from the fact that the software can be downloaded for free. This is because Linux is platform independent and can run on any server allowing organisations to choose cheaper hardware.

Although there has been optimism regarding cost savings, the software licence is free but the software is not free to use because an organisation must have people to "maintain it and develop it and foster it" and all these things cost money (Dedrick & West, 2004).

Even though the initial cost of OSS is considerably lower than is the case for PS, organizations should also consider the Total Cost of Ownership (TCO) as an OSS solution might need to be customized to suit the needs of an organization (James & Belle, 2008). James & Belle (2008) argue that, the TCO for OSS is normally significantly lower than for PS although this is different for every case study. The TCO is determined by calculating all financial costs relating to the software that the organisation incurs during the life span of the project.

Security

Computer security goals include confidentiality, integrity and availability (Wheeler, 2001). Due to the fact that OSS is developed by a group of collaborating programmers who can quickly detect and fix bugs, it is believed to be more secure (Mtsweni & Biermann, 2008). According to

them, OSS operating systems have been found to be more secure and less vulnerable to viruses when compared to their proprietary counterparts such as Microsoft Windows OS.

Not everyone believes that OSS provides better security because open source code exposes the source code to examination by everyone, both the attackers and defenders. This might give the attackers an upper hand (Wheeler, 2001). In his book Wheeler (2001), reports that there is a school of thought that argues that a system without publicly released source code is more secure because, since there is little information accessible for an attacker, it would be more difficult for an attacker to discover the vulnerabilities. An opposing argument is that attackers in general don't require source code, and if they want to use source code they can use disassemblers to re-create the source code of the product.

Customisation

There are occasions where the software requirements of an organisation cannot be adequately satisfied by an OSS product even though the software has options for configuration and parameterisation (Keßler & Alpar, 2009). The source code for OSS is made freely available giving organizations and individuals an opportunity to modify and customise the software to suit their own needs (Dedrick & West, 2004). The process of customisation needs to be well managed and planned in order to avoid configuration management challenges (Keßler & Alpar, 2009).

Reliability

Since the inception of OSS, the movement has attracted much “free” labour to the foundation to build open, transparent software systems (Heron, et al., 2013). This development approach is unique and it has resulted in numerous substantial open source projects becoming reliable, scalable technologies that have been used at all levels of the digital economy (Heron, et al., 2013). OSS is used for everything from individual servers to the hardware that runs mission critical systems for multinational organisations (Heron, et al., 2013). It is also expected that since the software has many users, there are high chances of fault minimization, with the many small, but constant changes of the code by the OSS development community as many users can discover bugs (Đurković, et al., 2008). By providing the users with source code, they are empowered to improve the product (Krishnamurthy, 2003).

Quality

The OSS method of software development allows a potentially endless number of developers and testers to work on the program (Krishnamurthy, 2003). OSS is thoroughly tested because even a company willing to devote resources to product testing may not be able to accurately

simulate all conditions under which it will be used (Krishnamurthy, 2003). OSS developers have been able to develop some high quality products, such as the Apache HTTP server, that have almost eliminated their proprietary counterparts because of the developers' high talents and skills (Ågerfalk, et al., 2005).

Customer support from a community

According to Krishnamurthy (2003), users of OSS are likely to get support faster because there is an engaged community willing to respond to the user's questions. He notes that PS companies on the other hand in most cases have a small customer service department as a cost cutting measure that is unable to respond to customer questions rapidly.

Escaping vendor lock-in

Competition is a paramount aspect in PS whereby vendor lock-in is one of the strategies that vendors use to reduce the bargaining power of customers and increase that of vendors in the post adoption period (Zhu & Zhou, 2012). Vendor lock-in is something that PS vendors achieve by frequently releasing software upgrades which they force customers to take thus making them increasingly dependent on vendor support (Zhu & Zhou, 2012). If customers do not take these software upgrades, they risk getting stranded with outdated systems. In the case of OSS, there is no forced upgrade, and the software is supported by an open community which is more than willing to support even legacy software (Zhu & Zhou, 2012). In African countries, companies like Microsoft have been able to achieve customer lock-in in both the public and in the private sector and liberation from this can most effectively be provided by OSS (Kamau & Namuye, 2012).

An empirical study conducted by Zhu & Zhou (2012), revealed that the lock-in strategy is too costly for the proprietary software provider when it competes with OSS as switching costs hurts rather than benefits the proprietary software provider. The reason for this is because OSS can credibly precommit its future price forcing the PS provider to change its pricing behaviour (Zhu & Zhou, 2012). In their view the presence of a competing OSS solution therefore neutralizes the intended lock-in strategy because the intended victims have an alternative and in most cases they switch to the OSS solution.

Encouraging innovations

The OSS development model is known to encourage and increase innovations (Kotwani & Kalyani, 2011). This opinion is shared by Agerfalk et al., (2005) who also observed that

innovation was in the forefront in a vision of OSS as an enabler of increased research and development (R&D) in SMEs.

Increasing collaboration

A study conducted by Agerfalk et al., (2005), established that OSS allows for extensive collaboration not only between individual organisations, but also between industry and government. The study further noted that OSS, as a development model, enables the sharing of costs and benefits from a collective pool of knowledge.

2.4. Disadvantages of OSS

Although OSS has many advantages, it also has some disadvantages as discussed in this section.

Complexity

Due to the complexity of OSS in terms of usability, the software tends to be preferred by the high end technical user explaining why products such as Linux have done well on the server side (Krishnamurthy, 2003). Similarly, technical products such as Apache tend to be used by skilled technical workers rather than the lay employee (Krishnamurthy, 2003). The standard and novice users want performance and features over reliability, prefer one easy-to-use suite and most likely do not care about access to the source code. Usability has been identified as one of the limitations that make OSS unattractive to ordinary users making it a hindrance to its adoption because it looks complex to the users (Kamau & Sanders, 2013).

Lack of product awareness

Unlike commercial software, where the vendor advertises their products through the traditional media, OSS awareness is mainly achieved through the word-of-mouth (Krishnamurthy, 2003). Due to the aggressiveness in marketing of PS products by giant companies such as Microsoft, the public are not generally aware of the alternatives because the OSS community generally adheres to a non-commercial business model (Ellis & Belle, 2009). Heili and Assar (2009), noted that PS is on many occasions preinstalled by computer manufacturers as they sell the computers.

Lack of user support agreements

While users of proprietary software believe that they can turn to the vendor for technical support because of an existing agreement, there is no vendor of OSS but only a loose community of developers who are not necessarily on call when a system crashes or a user needs assistance (Dedrick & West, 2004).

Proliferation of versions

Krishnamurthy (2003) in his study noted that there is a tendency in open source software to have a proliferation of versions. The study revealed that there were 65 versions of the Linux software running on user machines at the time of the study. He further noted that in some cases, there was a phenomenon called “forking the code,” which aggravates the version proliferation problem by creating two different evolution paths for the product.

2.5. Summary of advantages and disadvantages of OSS.

A study conducted by Morgan & Finnegan (2007) identified advantages and disadvantages of OSS as the technical and business drawbacks of OSS as summarized in the Table 2.5-1. The study also established that, the business drawbacks posed a bigger challenge for companies than the technical benefits, with lack of support, lack of ownership and insufficient marketing ranking as the most significant drawbacks to adoption.

Table 2.5-1: Summary of advantages and disadvantages of OSS

TECHNICAL BENEFITS	
Reliability	High availability and dependability of applications
Security	High security due to the availability of source code, the reduced threat of viruses and extra awareness of security in design phase of products
Quality	Enhanced quality from peer reviews and the quality of developers / testers
Performance	High performance in terms of capacity and speed
Flexibility of Use	Beneficial because it facilitates changes, customisation, experimentations and allows freedom of choice
Large Developer/Tester Base	Very beneficial as it ensures that OSS is quality software and is up-to-date
Harmonisation	Improved harmonisation in interoperability and practices/operations
BUSINESS BENEFITS	
Low Cost	In terms of reduced licensing fees, upgrades, virus protection and the cost of the whole package, i.e. service and software
Flexibility allowed by licences	Has a significant impact on reducing capital expenditure in company
Escapes vendor lock-in	Highly beneficial as it facilitates freedom of choice, gives sense of control and provides independence from private vendors
Increases collaboration	Greater collaboration from OSS community facilitates product development, cooperation and exchange of knowledge, provides new ways of collaboration and permits sharing of expenses with other companies
Encourages innovation	Access to the source code produces ideas and encourages technical innovation while also creating more opportunities for innovation.
Extra business functionality	The small OSS development teams are able to develop software with many features which are needed by organisations
TECHNICAL DRAWBACKS	
Compatibility Issues	Not significantly disadvantageous, but some compatibility problems with current technology, skills and tasks
Lack of Expertise	Employees lack OSS expertise - may be more about lack of awareness
Proliferation of Interfaces	Results in confusion in deciding which one to choose
Less Functionality	Level of integration not as good as Microsoft since there is no one single vision, plan or strategy, and hence limited control.
BUSINESS DRAWBACKS	
Lack of support	No safety net as there is no support and no company to back it up
Lack of ownership	Inability to hold someone responsible or accountable for problems
Access to the source code	Once organisations have changed the code to meet their requirements, some are uncomfortable with releasing source code.
Insufficient marketing	No one organisation owns it all; OSS has no marketing budget which results in it being driven primarily by word of mouth

Source: Morgan & Finnegan (2007)

2.6. Global status of OSS adoption

This section reviews the status of OSS adoption around the world as reported by studies conducted by different researchers. The section discusses the adoption status for developed countries (advanced economies), developing countries (emerging economies) and African countries. According to the International Monetary Fund (IMF) (2010), a country can be an advanced economy or an emerging and developing economy. According to them countries like China, United Kingdom, United States, Australia, Canada, France, Germany, Japan among others are advanced or developed economies. The emerging and developing economies are India, Kenya, Brazil, China, Jamaica, Chile, China, Malaysia, Turkey, South Africa, and Libya among

many others. It is important to note that despite the fact that China is an advanced economy, the country is making some remarkable progress in growth making it fall under both categories. All the African countries are in the emerging and developing economies category.

2.6.1. Adoption of OSS in developed countries

Very few OSS adoption studies have been conducted in developed countries such as Europe as noted by Morgan & Finnegan (2007), who observed that major research gaps existed in the area of OSS adoption. However, a comprehensive international study conducted by CENATIC (2010), reveals that the strongest economies (in North America, Western Europe and Australia) have widely adopted OSS. Their study established that the United States (US), Australia and the Western European countries lead the development and adoption of open source software. The high adoption levels according to them were expected in the US as it is the home to the world's most prominent OSS distribution companies such as Sun Microsystems, Red Hat, Novell, etc. They also noted that the American universities had made an indisputable contribution to the creation and development of OSS which further explains the high adoption levels.

In France it was observed that the majority of the users use proprietary software which comes preinstalled by the computer manufacturers although it was noted that following several recent events users are more and more interested in OSS (Heili & Assar, 2009).

In Europe, the countries surveyed use OSS to some degree (Ghosh & Glott, 2005). While some countries such as Germany, Spain and Italy, are significant users, others such as Greece and the United Kingdom showed a lower degree of adoption although their study did not establish the reason for the low adoption (Ghosh & Glott, 2005). Their study revealed that European countries show substantial interest in OSS for different technologies, from operating systems to application software. The summary results of their study are shown in Figure 2.6-1;

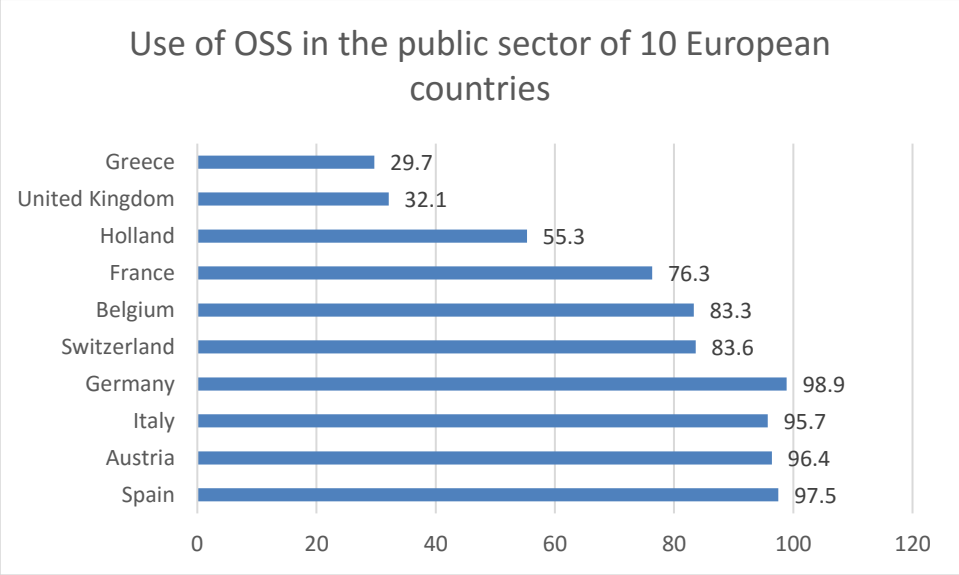

Figure 2.6-1: Use of OSS in the public sector of 10 European countries

Source: Ghosh & Glott (2005)

Notably, in Europe the governments and the European Commission have been encouraging the use of OSS and have gone ahead to develop policy documents to that effect (CENATIC Team, 2010).

The 2005 study conducted by Ghosh & Glott (2005), also revealed that, although there was OSS usage in European local governments, OSS had not become a standard within these governments. Their study also revealed that the Windows Operating system was still in the lead as shown in Figure 2.6-2;

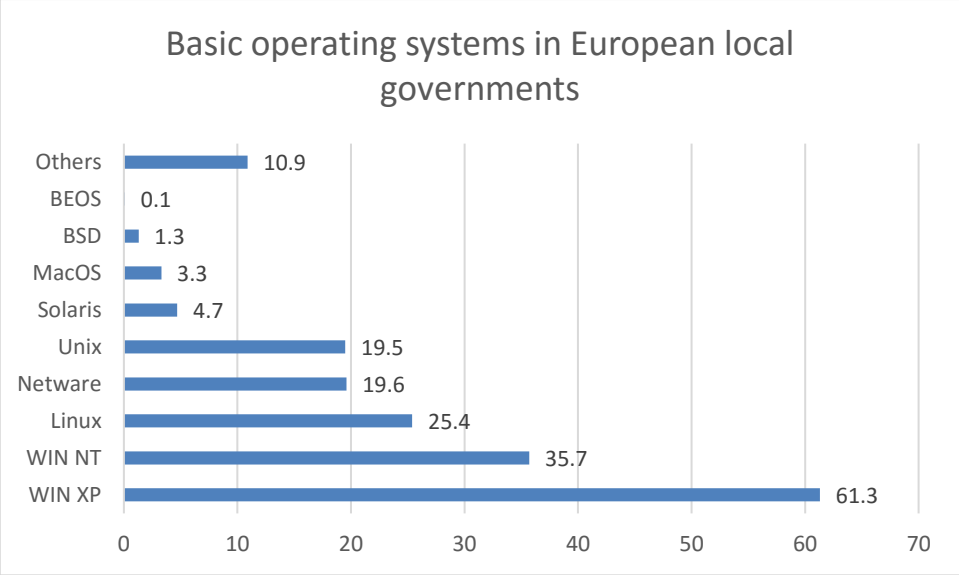

Figure 2.6-2: Basic operating systems in European local governments

Source: Ghosh & Glott (2005)

According to Ghosh & Glott (2005), it is clear that OSS has already been quite successful in advancing from the operating systems and Internet applications level to the desktop level in the European countries, but they believe that this process has just begun. Although Figure 2.6-1 and Figure 2.6-2 are not recent, this study could not find newer studies showing the current status of OSS adoption in European local governments and in the public sector.

The Japanese and South Korean governments have clear policies promoting OSS (CENATIC Team, 2010). These same authors note that in South Korea, the aim is to promote the national ICT sector and thereby boost the economy while in Japan, the motive is reducing dependence on multinational software companies. They further observed that penetration of OSS in the private sector is still not very high in either of these countries, but OSS has already achieved an important position in South Korea, and to a lesser degree in Japan. According to CENATIC (2010), OSS penetration is already quite significant in the banking and hospitality sectors in Korea, although in Japan the lack of support has slowed down OSS penetration in the Japanese private sector. They noted that some companies that provide technical support for OSS are consolidating their positions in the country, which will help to make its use more widespread.

In China, Linux adoption has been on the increase since the year 2000 with a steady growth of over 40% per year (Dudley-Sponaugle, et al., 2007). The CENATIC team (2010) reports that in China OSS not only gets crucial support from and promotion by the government, but its development is also planned and orchestrated at a governmental level. According to them its development and implementation is not dictated by the market, but by the government. They

further note that there is a regulation by the Chinese Government which requires all new computers to be sold with preinstalled OSS and encourages the purchase of software made in China to reduce dependence on intellectual property from foreign countries. The Chinese Government has a stake as the second largest shareholder in the main Linux supplier in China called Red Flag Linux, a company that was founded in 1999 (CENATIC Team, 2010). According to them, China continues to encourage the adoption of OSS technologies given that it is a developing country, where the main drivers are lower ownership costs, the availability of the necessary applications and open standards and development processes.

2.6.2. OSS adoption in non-African economically developing countries

The adoption of OSS in Non-African Economically developing countries (ECDs) is as summarised by Kamau & Namuye (2012). Several Non-African ECDs have extensively adopted OSS with Brazil taking the lead (Reijswoud & Mulo, 2007). In their view, Brazil was the first country in the world to pass a law regarding the use of OSS and this paid off with good levels of adoption notably in the states of Rio Grande do Sul and Pernambuco. The Brazilian Government promotes development and use of OSS through numerous regulations (CENATIC Team, 2010). According to them, the government has also created a series of bodies that have taken leadership roles in the area of OSS and have spearheaded generating and coordinating actions aimed at discussing and disseminating it, especially within the government and state companies, such as SERPRO and EMBRAPA. Large financial institutions in Brazil have not been left behind; because the bank of Brazil, the largest financial institution in Latin America, carried out pilot tests with OSS technologies. The migration was carried out in stages (CENATIC Team, 2010). The CENATIC team (2010), noted that the bank had migrated to Open Office, Linux, Free Mind, G3270, DIA, PDFCreator, Mozilla Firefox, Apache/Tomcat, Moodle, DotProject, CVS/SVN/Trac, PostgreSQL, Eclipse, etc.

The CENATIC team (2010) noted that in Argentina the central government has policies that do not favour either OSS or proprietary software. There has been advocacy by OSS activists for the use of OSS in Argentina. In addition, universities have been carrying out projects that contribute to the adoption of OSS which has led to 42% Linux use in companies with many of them planning to implement OSS in new applications (CENATIC Team, 2010).

In Mexico, the CENATIC team (2010) observed that there was a significant OSS penetration in the public administration, both at a state and local level. They noted that 74% of civil servants were aware of OSS and 66% used it. Another report by IDC (n.d.) cited by the CENATIC team

indicated that 60% of the companies in Mexico and Latin America are at the stage of evaluating, implementing or adding to the Linux operating system for servers, which represents 40% in terms of workstations. In 2006, Linux use grew by 7.6% in Mexico, making it the second largest Latin American market after Brazil (CENATIC Team, 2010).

India, China and a few other developing countries in Asia have experienced significant advancement in ICT over the last few years, increasing their consumption of certain ICT-related goods and services in the most important urban areas (CENATIC Team, 2010). According to them there have been joint efforts between China, Japan and Korea and additional efforts by OSS communities to adapt the software to local languages in order to promote its adoption and development in the region. CENATIC notes that the English language barrier in this region, except in India, has been seen as a factor that limits the contribution made by these countries to the global OSS community.

India is an emerging and developing economy (International Monetary Fund, 2010). According to Dudley-Sponaugle *et al.,* (2007) OSS in India is supported by the government and businesses. They observed that OSS groups in India are distributing free copies of desktop productivity software. According to them India and China have benefited through OSS by reducing cases of piracy, cost savings, flexibility and other benefits. The Indian government also encourages the use of OSS through diverse programmes, such as the National Resource Centre for FOSS (NRCFoss), whose activities concentrate on training, repository creation and maintenance, local adaptation, policy formulation and the promotion of OSS-related business initiatives (CENATIC Team, 2010). According to them, the government has also launched initiatives such as the Linux India Initiative. This initiative was launched with the primary objectives being to develop OSS resource centres and pilot projects, support OSS local adaptation and carry out research studies. The CENATIC team (2010) report further noted that of late in India, large international projects from multinational software companies increasingly often include open source technologies, and this is generating a demand for skilled employees. Indian universities have responded by offering training and participating in OSS projects.

The report by CENATIC (2010) observed that OSS adoption and development in India, China and Brazil was higher than expected, considering their level of IS advancement, with Brazil in the lead with OSS adoption.

2.6.3. OSS adoption in African economically developing countries

Africa trails the world in the development of OSS; lacks even the least means required for developing OSS, has few public promotion policies and also has a high rate of illegitimate software use (CENATIC Team, 2010). According to them in Africa, only South Africa is anywhere near the worldwide average for the OSS index.

Reports from different sources as summarised by Kamau and Namuye (2012), confirm that there is a problem with OSS adoption in Africa. Among the African states, South Africa has been on the frontline in the official implementation of OSS as a strategy within the public sector (Laszlo, 2007). The South African government acknowledges that OSS is a viable alternative to proprietary software and this is evident by the approval of the OSS policy by the cabinet (Mtsweni & Biermann, 2008). Nevertheless in South Africa, expenditure by all citizens and businesses for proprietary software licences amounted to ZAR6 billion annually which is channelled to foreign companies such as Microsoft (Gopalakrishnan, 2006). By the year 2007 several years after the government policy was passed by the SA cabinet in 2003, not much had been achieved in terms of adoption (Archibald, 2007).

Mutula & Kalaote (2010) found that in Botswana, which is one of the leading economies in Africa, OSS is not widely used. A study conducted by Mutula and Kalaote (2010), in the government ministries indicated that the use of OSS is limited with only a few IT managers who had made individual efforts to spearhead its use. They further noted that Botswana did not have an OSS policy and that the government had made a long-term agreement with Microsoft for use of its products.

Ghana is a country that has widely embraced technology, but OSS adoption is lagging behind PS with Microsoft windows operating system taking the lead at 84.7% and Linux at 11.9% (Amega-Selorm & Awotwi, 2010). According to them some of the reasons given for this are: Microsoft Windows comes pre-installed on computers, ease of use, availability of applications and availability of technical support. They cited the absence of an OSS adoption and procurement policy as a major challenge.

Few studies on OSS Adoption in developing countries have been conducted. A very limited body of knowledge exists in this domain (Mengesha, 2010). The existing studies such as the study of Mengesha (2010), tend to deal with other areas of OSS such as its development. There is no recent official empirical data or report on the levels of OSS adoption in the public and private

sector in Kenya but an old report suggests that there is very limited use of OSS in most African countries such as Kenya both in the government and in the private sector (Bridges.org, 2005).

The next section discussed the different theories that are used in predicting technology adoption in information systems.

2.7. Theories and models used in information systems

A theory is defined as a statement of the hypothetical relationship between and among a number of variables (Gelso, 2006). A theory can also be defined as a set of logically organised laws that explain a phenomenon (Heinen, 1985). Theory is different from hypothesis as theory articulates why something occurs while hypothesis states what is likely to occur (Sutton & Staw, 1995). Theory assists in understanding and explaining a phenomenon in the world and can also be used in predicting (Gregor, 2002). From the above definitions Sutton & Staw (1995), clarify that theory is not data, a list of variables or constructs or even diagrams.

One of the main concepts of theory is the relation between cause and event which is referred to as causality (Gregor, 2002). There are different types of theory as classified by Gregor (2002); "theory for analysing and describing, theory for understanding, theory for predicting, theory for explaining and predicting, and theory for design and action" (pg. 2).

Although the terms "model" and "theory" have been used interchangeably, the two terms are totally different (Klein & Romero, 2007). A model is basically used in research for the purpose of illustrating relationships within a theory and to help in visualising the inter-relatedness of variables displaying their causal direction (Gay & Weaver, 2011). Models are useful in representing theories and do not contain the complete theory to which they refer (Leijonhufvud, 1997).

Over the years several technology acceptance theories have been developed with each set having its own set of acceptance determinants (Venkatesh, et al., 2003). According to them there are eight prominent models and their extensions used in information systems. Although some of the eight prominent theories use the term "model", there is a general consensus that they are theories in the IS field (Moody, et al., 2010). Some of the theories used in IS are imported or "borrowed" from other fields (Straub, 2012). The theories "borrowed" from other fields and used in IS are referred to as imported theories, while those that have been specifically developed to explain or predict an IS phenomena are called native or indigenous theories (Moody, et al., 2010). Moody et al., classifies the Technology Adoption Model, and the Unified Theory of Acceptance and Use of Technology as native IS theories while Theory of Reasoned Action, Theory of Planned

Behaviour and Diffusion of Innovations are imported theories. This section contains a discussion on the common imported and native models and theories used in information systems. The imported theories are discussed in order to trace the origin of some constructs that are in use in contemporary theories such as EUTAUT.

2.7.1. Imported theories used in information systems

This section discusses the theories which are "borrowed" from other fields and used in information systems.

2.7.1.1. Theory of Reasoned Action (TRA)

According to Venkatesh et al., (2003), the theory of reasoned action was derived from social psychology and is one of the most influential theories of human behaviour. Hence it is not specific to technology adoption and use although it has been used to examine those issues. The components of TRA are three general constructs: behavioural intention (*BI*), attitude (*A*), and subjective norm (*SN*) (Fishbein & Ajzen, 1975). TRA suggests that an individual's behavioural intention is dependent on the individual's attitude about the behaviour and subjective norms ($BI = A + SN$). If an individual intends to behave in a certain way it is possible that the individual will carry out the associated actions (Fishbein & Ajzen, 1975).

Behavioural intention measures an individual's relative strength of intention to perform a behaviour (Fishbein & Ajzen, 1975). Attitude consists of beliefs about the consequences of performing the behaviour multiplied by his or her assessment of these consequences (Fishbein & Ajzen, 1975). Subjective norm is seen as a combination of perceived expectations from relevant persons or groups along with intentions to comply with these expectations. In other words, the individual's perception that most persons who are important to him think he should or should not perform the behaviour in question (Fishbein & Ajzen, 1975).

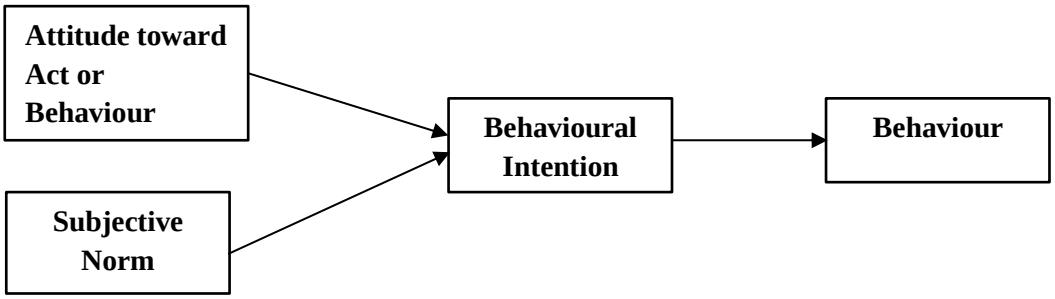

Figure 2.7-1: Theory of Reasoned Action

Source: Fishbein & Ajzen, (1975)

2.7.1.2. Motivational Model

Davis et al., (1992) introduced perceived enjoyment in the Motivational Model as an intrinsic motivation and defined perceived usefulness as an extrinsic motivation. They applied motivational theory to comprehend new technology adoption and use. Perceived enjoyment was defined as the degree to which the action of using the computer is perceived to be enjoyable, apart from any performance consequences that may be expected (Davis, et al., 1992). Therefore, perceived enjoyment is a form of intrinsic motivation and emphasizes on the pleasure and inherent fulfilment derived from the activity in question. They found that the perceived usefulness had a large significant effect on the intention to adopt a technology and its influence was complemented by the perceived enjoyment.

2.7.1.3. Theory of Planned Behaviour

The theory of planned behaviour predicts the occurrence of a particular behaviour, provided that behaviour is intentional because behaviour can be deliberative and planned (Ajzen, 1991). The TPB asserts that behaviour (B) is a direct function of behavioural intention (BI) and perceived behavioural control (PBC) and that behavioural intention is formed by one's attitude (A) which reflects feelings of favourableness or unfavourableness towards performing the behaviour (Ajzen, 1991). Ajzen (1991) defines perceived behavioural control as people's perception of the ease or difficulty of performing the behaviour of interest. The supporting theory of behavioural control was provided by the research work carried out by Bandura and others which established that people's behaviour is highly influenced by their confidence in their ability to perform that behaviour (Bandura, et al., 1977); (Bandura, et al., 1980). Subjective norm (SN) reflects perceptions of an individual to perform or not to perform a behaviour which is influenced by the judgement of others, and PBC, which reflects perceptions of internal and external constraints on behaviour (Ajzen, 1991). The theory of planned behaviour (TPB) is an extension of the TRA which included the construct of perceived behavioural control (Venkatesh, et al., 2003). The theory which was developed by Ajzen proposes a model which can measure how human actions are guided (Venkatesh, et al., 2003).

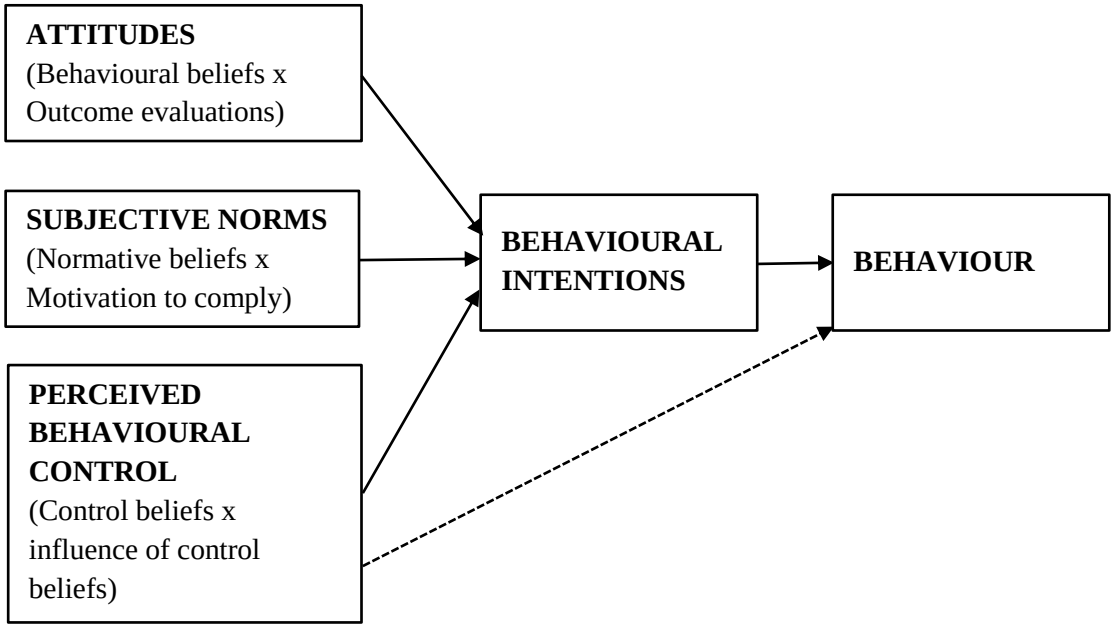

Figure 2.7-2: Theory of Planned Behaviour

Source: Ajzen (1991)

2.7.1.4. Social Cognitive Theory (SCT)

The theory holds that portions of an individual's knowledge acquisition can be directly related to observing others within the context of social interactions, experiences, and outside media influences (Bandura, 1986). People do not learn new behaviours exclusively by trying them and either succeeding or failing, but rather, the survival of humanity depends upon the replication of the actions of others (Bandura, 1986). Depending on whether people are rewarded or punished for their behaviour and the outcome of the behaviour, that behaviour may be modelled. Once an individual has acquired the learned behaviours they are likely to become central to one's personality (Bandura, 1986).

Bandura (1986) identified five core concepts in the SCT framework. These core concepts are observational learning/modelling, outcome expectations, self-efficacy, goal setting and self-regulation.

The theory was developed by Bandura (1986) and is founded on a causal model of triadic reciprocal causation. In this model, personal factors in the form of cognitive, affective and biological events, behavioural patterns, and environmental events wholly function as interacting determinants that influence one another bidirectionally (Bandura, 1999). According to Bandura (1986), human behaviour is commonly explained in terms of unidirectional causation in which

behaviour is represented as either being formed and governed by environmental influence or driven by internal dispositions.

The social cognitive theory was developed from studies conducted in the area of psychology by Bandura and others. In a study that aimed to demonstrate that people learn from watching others, a series of experiments involving 72 children participants were conducted using a Bobo doll (Bandura, et al., 1961). The study consisted of three experiments which aimed at demonstrating how children imitate aggressive behaviours from adults. In the experiments, the children were exposed to aggression, non-aggression and mild aggression environments. The results of these experiments revealed that children in the aggressive conditions exhibited more aggressive behaviour than those in the non-aggressive conditions with boys performing more aggressive behaviour than girls in the same conditions (Bandura, et al., 1961).

2.7.1.5. Diffusion of Innovations (DoI)

The Diffusion of Innovations by Rogers (1995) has been used to study a variety of innovations. According to him, rate of adoption is the relative speed with which an innovation is adopted by members of a social system which is generally measured as the number of individuals who adopt a new idea in a specified period, such as each year. The perceived attributes of an innovation are one important explanation of the rate of adoption of an innovation. The theory identifies five attributes of an innovation that influence the adoption and acceptance behaviour: relative advantage, complexity, compatibility, trialability, and observability (Rogers, 1995). Below are the attributes of an innovation as discussed by Rogers which are also the constructs of the DoI model (1995).

Relative advantage

Relative advantage is defined by Rogers (1995) as the degree to which an innovation is perceived as being better than the idea it supersedes. The degree of relative advantage is frequently stated as social prestige, economic profitability, or other benefits. The nature of the innovation is the determinant of the specific type of relative advantage. According to him, the relative advantage could be economic, social, and the like. Rogers (1995) argues that most people who try an innovation adopt it if it has a good level of relative advantage. Innovations without acceptable levels of relative advantage are likely to be rejected by individuals (Rogers, 1995).

Compatibility

Compatibility can be defined as the degree of consistency with past experiences, existing values and needs of existing adopters (Rogers, 1983). An innovation such as a software application can be compatible or incompatible with earlier introduced ideas, clients' needs for innovations or social cultural values and beliefs (Rogers, 1983).

Complexity

Complexity is defined by Rogers (1995) and Thompson et al., (1991), as the degree to which an innovation is perceived as relatively difficult to understand and use. Any new idea may be classified on the complexity-simplicity band. Some innovations are clear in their meaning to potential adopters whereas others are not. His study suggests that the complexity of an innovation, as perceived by members of a social system, is negatively related to its rate of adoption.

Trialability

Trialability is defined by Rogers (1995) as the degree to which an innovation may be experimented with on a limited basis. He argues that new ideas that can be tried on the instalment plan are generally adopted more rapidly than innovations that are not divisible. According to him, some innovations are more difficult to divide for trial than are others. The personal trying-out of an innovation is useful in giving meaning to an innovation, to establish how it works under one's own conditions. This trial is a means to dispel any uncertainty about the new idea. His theory suggests that trialability of an innovation, as perceived by members of a social system, is positively related to its rate of adoption.

Observability

Observability is defined by Rogers (1995) as the degree to which the results of an innovation are visible to others. According to him, the results of some ideas are easily observed and communicated to others, whereas some innovations are difficult to observe or to describe to others. His theory suggests that the observability of an innovation, as perceived by members of a social system, is positively related to its rate of adoption.

Technology innovation diffusion process over time

The decision by individual to adopt an innovation is a process that consists of a series of actions that occur over time (Rogers, 1995). Rogers (1995), explains that the innovation decision process by individuals consists of five stages namely;

1. Knowledge - this is the stage where an individual becomes aware of the existence of an innovation and gets to know how the innovation functions.
2. Persuasion – this stage occurs when an individual forms an attitude towards the innovation. The attitude towards the innovation can be either positive or negative.
3. Decision – this is the stage where an individual undertakes activities that lead to a choice to adopt or reject the innovation.
4. Implementation – this stage occurs when an individual starts using an innovation
5. Confirmation- this stage occurs when an individual seeks support for an innovation decision already made. During this stage an individual may abandon the innovation if there are conflicting messages about the innovation.

2.7.2. Native Information Systems theories

This section presents the common native theories used in information systems.

2.7.2.1. Technology Acceptance Model

The technology acceptance model (TAM) is a widely cited model that seeks to explain the reasons why people accept or reject technology (Davis, 1989). TAM is an adaptation of the Theory of Reasoned Action (TRA) which specifies two subjective assessments of the technology; perceived usefulness and perceived ease of use as determinants of attitude towards Information Technology and intentions usage. In this theory the author suggests that when users are offered a new technology, two factors influence their choice about how and when they will use it, notably: Perceived usefulness (PU) – is "the degree to which a person believes that using a particular system would enhance his or her job performance" and Perceived ease-of-use (PEOU) is defined as "the degree to which a person believes that using a particular system would be free from effort".

The model is shown in Figure 2.7-3;

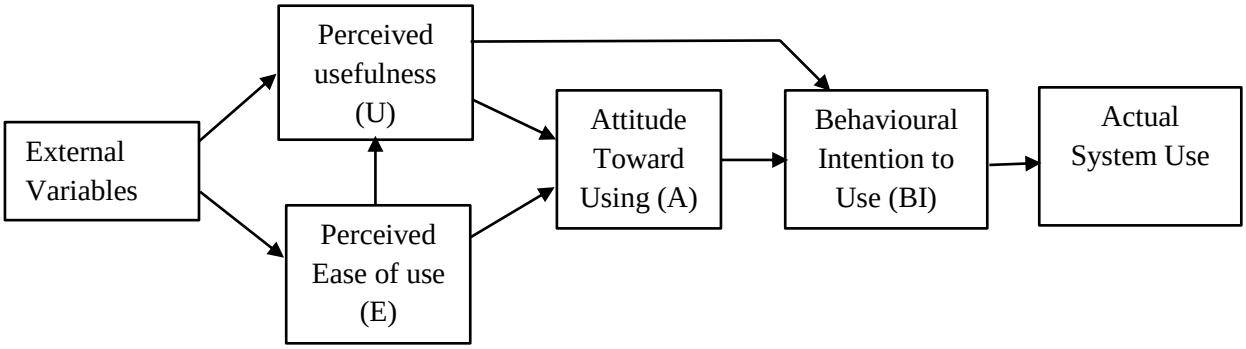

Figure 2.7-3: Technology Acceptance Model

Source: Davis (1989)

2.7.2.2. Combined TAM and TBP

A hybrid model combining the predictors of Technology Adoption Model (TAM) and Theory of Planned Behaviour (TPB) was developed by Taylor and Todd (1995) with the constructs of perceived usefulness and ease of use from TAM (Taylor & Todd, 1995). According to them, including PBC in TAM was a significant step toward a richer theoretical understanding since in the technology adoption context the availability of technology or technical capabilities of the individual can have considerable effect on behaviour. The model is as shown in Figure 2.7-4;

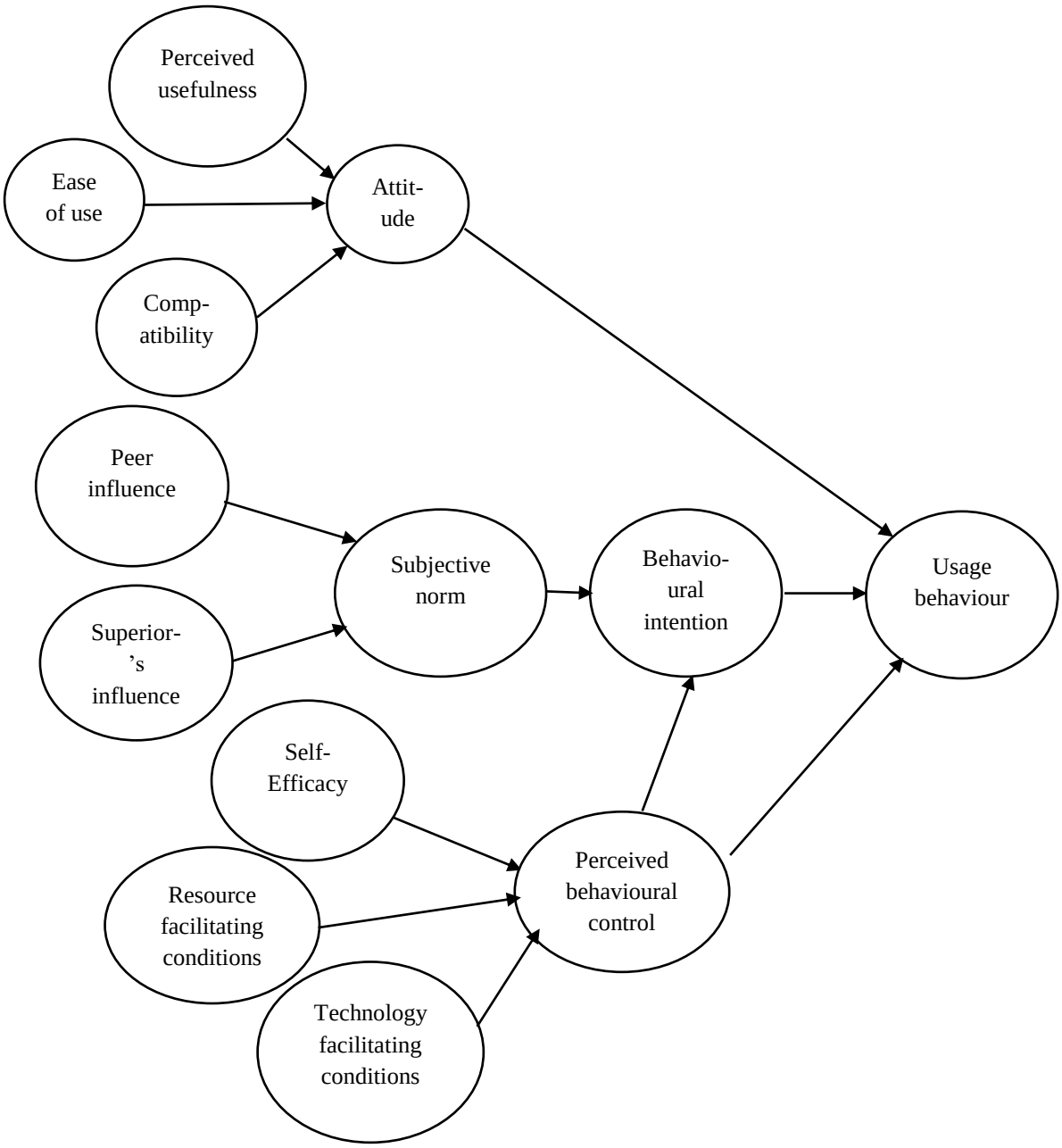

Figure 2.7-4: Combined TAM and TBP

Source: Taylor and Todd (1995)

2.7.2.3. Model of PC Utilisation (MPCU)

This model presents a competing perspective to that proposed by TRA and TPB whose nature is suited to predict individual acceptance and use of a range of information technologies (Venkatesh, et al., 2003). The theories previously developed by sociological and psychological researchers were found to be unsuitable for the adoption of computing technologies making it necessary to develop a model that suits information technology use (Thompson, et al., 1991).

Their model has the following constructs and their definitions:

- Job-fit: “the extent to which an individual believes that using a technology can enhance the performance of his or her job” (p. 129).
- Complexity: “the degree to which an innovation is perceived as relatively difficult to understand and use” (p. 128).
- Long-term consequences: “Outcomes that have a pay-off in the future” (p. 129).
- Affect Towards Use: “feelings of joy, elation, or pleasure, or depression, disgust, displeasure, or hate associated by an individual with a particular act” (p. 127).
- Social Factors: “individual’s internalization of the reference group’s subjective culture, and specific interpersonal agreements that the individual has made with others, in specific social situations” (p. 126).
- Facilitating Conditions: “provision of support for users of PCs may be one type of facilitating condition that can influence system utilization” (p. 129).

The model as developed by Thompson, Higgins, & Howel, (1991) is shown in Figure 2.7-5;

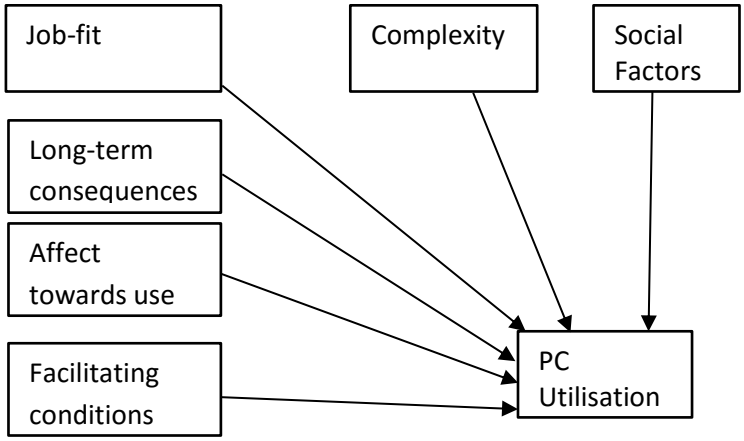

Figure 2.7-5: The model of PC utilisation

Source: Thompson et al., (1991)

2.7.2.4. Unified Theory of Acceptance and Use of Technology (UTAUT)

A number of models exist that suggest different sets of technology acceptance determinants as discussed above. The unified theory of acceptance and use of technology (UTAUT) is one of the most frequently cited theories of technology acceptance. Recent studies in the area of information systems that have been conducted have treated it as a successor to TAM (Gonzalez, et al., 2012).

The theory suggests a model that integrates elements across eight models which are; Theory of Reasoned Action, Technology Acceptance Model, Motivation Model, Theory of Planned Behaviour, Combined TAM and TBC, Model of PC Utilisation, Diffusion of Innovations and Social Cognitive theory (Venkatesh, et al., 2012). The model suggests three direct determinants of intention to use which are; performance expectancy, effort expectancy and social influence. It also suggests two determinants of usage behaviour which are intention and facilitating conditions. The moderating factors are experience, voluntariness, gender and age. The model is as shown in Figure 2.7-6;

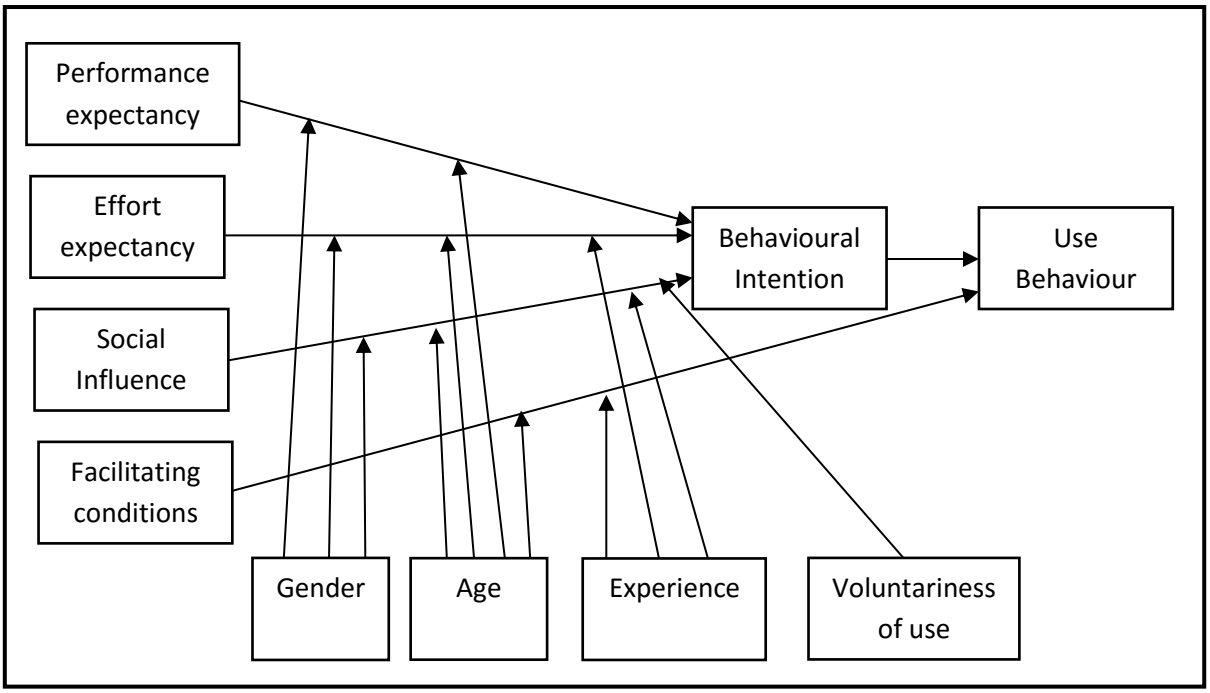

Figure 2.7-6: Unified Theory of Acceptance and Use of Technology

Source: (Venkatesh, et al., 2012)

2.7.2.5. Extended Unified Theory of Acceptance and Use of Technology (EUTAUT)

The Extended Unified Theory of Acceptance and Use of Technology is a recent adjustment of the UTAUT that incorporates three additional factors, hedonic motivation such as enjoyment, price value of the technology and habit (Venkatesh, et al., 2012). EUTAUT was developed because UTAUT was not suitable for predicting voluntary technology adoption by individuals (Venkatesh, et al., 2012). The cost aspect is one of the most important factors that determine the adoption of a technology in a voluntary setting which is not taken care of in UTAUT (Venkatesh, et al., 2012).

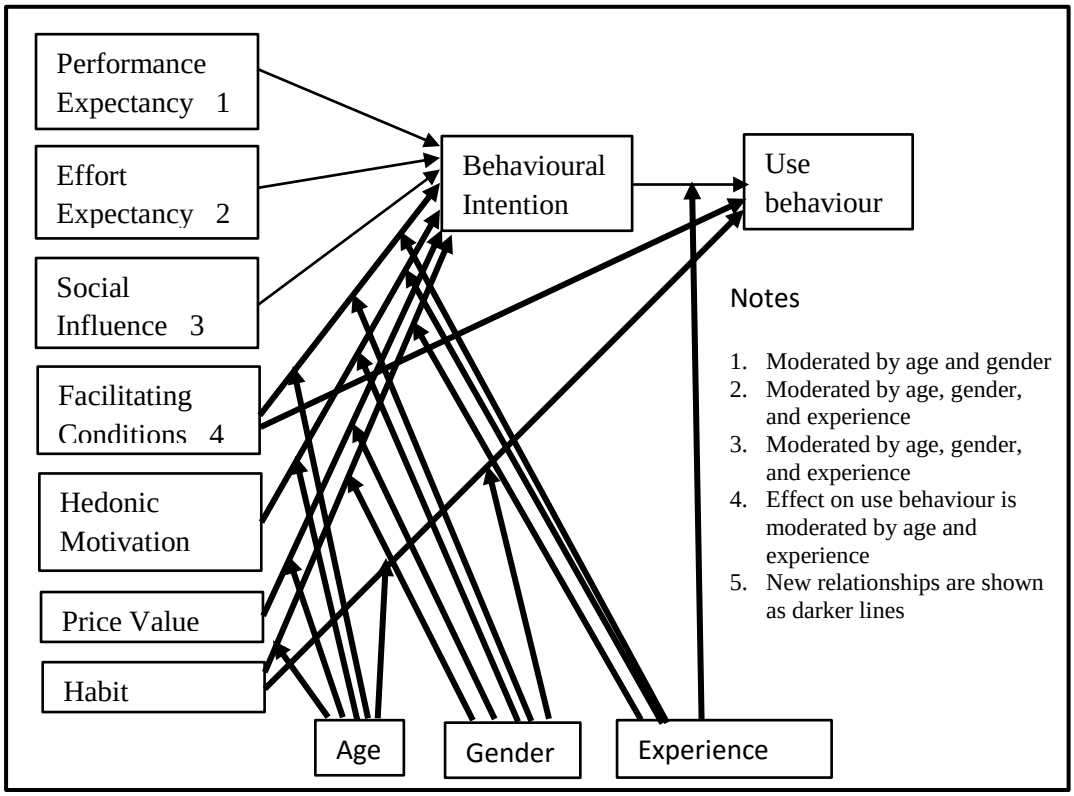

Figure 2.7-7: Extended Unified Theory of Acceptance and Use of Technology

Source: (Venkatesh, et al., 2012)

2.7.3. Models/theories used in OSS adoption

The theories discussed in sections 2.7.1 and 2.7.2 above are general in nature because they were designed to be able to predict a variety of technologies in different contexts. This section reviews theories and models that have been developed in various parts of the world specifically for predicting OSS adoption. The review of OSS specific models will be useful in informing this study on specific constructs and factors that could be significant in free Desktop OSS adoption.

A Model/Theory of OSS adoption

Many researchers have conducted studies in an attempt to explain individual innovation and technology adoption in general and as a result a number of models have been developed (Li, et al., 2011). This study found very limited studies on theories specifically developed to predict OSS adoption. The discussion below reviews one study that developed and employed a model to predict OSS adoption.

The study was conducted by Gallego et al., (2008) in an attempt to explain the factors that influence the acceptance of technologies based on OSS by users largely borrowed from TAM. Galego et al. concluded the discussion of their study by admitting that they had not included all the OSS constructs in their study and therefore their proposed model does not explain 100% of the behaviour towards OSS use on behalf of the users in their study environment. Their study resulted in the model shown in Figure 2.7-8;

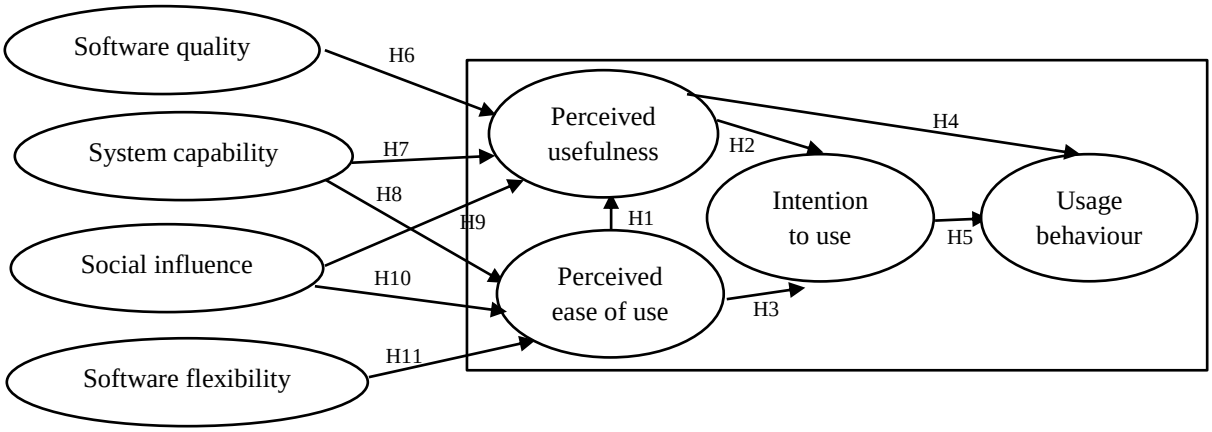

Figure 2.7-8: Factors influencing the acceptance of technologies based on OSS

Source: Gallego et al., (2008)

According Li et al., (2008), one of the most widely used models although currently outdated, is the TAM which has been criticised by many including its own author and therefore not suitable for the OSS adoption scenario. In an attempt to understand adoption of OSS they developed a model based on motivational factors, i.e., intrinsic motivation, extrinsic motivation and amotivation borrowing widely from the theory of Deci & Ryan, (1985).

A number of technology adoption models exist from which researchers choose or they choose some constructs from a number of models (Venkatesh, et al., 2003). In an attempt to better explain technology adoption Venkatesh et al., (2003) developed the unified model of use and acceptance of technology which they later modified in 2012. There are a limited number of studies that have tested these models in an African setup in order to determine their application and suitability in understanding adoption of OSS in this scenario.

2.8. General factors perceived to contribute to software adoption

A number of factors have been identified as affecting the adoption of technology such as Information Communication Technology. In this section, the author discusses the different factors generally agreed to contribute to technology and software adoption.

Usability

Usability is an important attribute in software and has been defined as 'the extent to which a product can be used by specified users to achieve specified goals with effectiveness, efficiency and satisfaction in a specified context of use' (ISO-9241-11, 1998).

Open source software has been in existence for some years now but issues of usability seem not to have received sufficient attention. Although user centred designs are gaining popularity within OSS, usability is not being considered as one of their primary goals (Raza & Capretz, 2012). A comparison between PS and OSS reveals that one of the main competitive advantages of PS over OSS is usability and if OSS has to compete with PS, the OSS developers need to benchmark with PS software (Sen, 2007a).

Some researchers suggest that one way of solving the usability issue is by inclusion of usability testing methods in the context of OSS, by involving either users, or usability experts, or both in their projects (Sen, 2007b). In the recent past, research has been conducted on user involvement in the development process of OSS using the User Centered Design approach (Sen, 2007b). User centred design is defined as the approach to 'interactive system development that focuses specifically on making systems usable' (ISO-13407, 1999). Worldwide, computer users have increased in number and it is therefore important to address usability issues in order to take care of diverse sets of users (Shneiderman, 2000).

Software usability is defined in terms of understandability, learnability, operability and attractiveness (ISO/IEC-9126-1, 2001). Empirical results suggest that, improving the usability aspects such as understandability, learnability, operability, and attractiveness has a positive impact on the overall usability of OSS products (Raza, Capretz, & Ahmed, 2011).

User training

Several researchers have generally established that training is an important component in the adoption of computer applications and technology (Bedard, et al., 2003; Igbaria, 1993; Venkatesh, 2000; Compeau & Higgins, 1995; Nelson & Cheney, 1987; Hung, et al., 2012). A study conducted by Nelson et al., (1987) concluded that user training facilitates individuals to use Information Systems and also established a relationship between end user ability to use an information system and the adoption of the same as shown in the Figure 2.8-1.

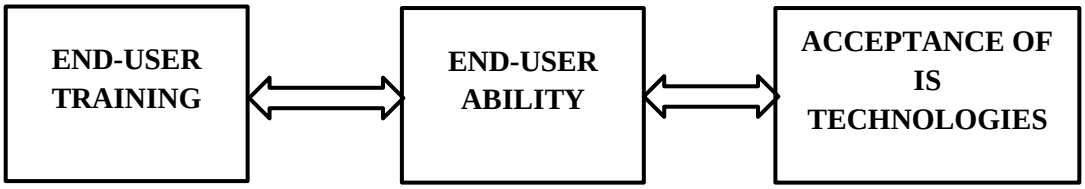

Figure 2.8-1: A relationship of end-user training, end-user ability and acceptance of I.S. technologies

Source (Nelson & Cheney, 1987)

A study conducted by Hung et al., (2012) that sought to identify influential factors that contribute to the National Healthcare Services Systems success in Taiwan, established that user training is a major factor that contributes to system use and in turn user satisfaction. This finding supports the earlier finding by Nelson & Cheney (1987), which advanced the same theory. User training is the most important stage in the implementation of new software (Hasibuan & Dantes, 2012).

An empirical study conducted by Igbaria, et al., (1997), that aimed to establish the factors affecting personal computing adoption established that, training was an important component in the adoption of a technology. Another study by Alenezi et al (Alenez, et al., 2011) on E-learning adoption confirmed that training and technical support are instrumental factors contributing to the adoption of E-learning technology.

The uptake of OSS products in African countries has been very slow compared with both non-African developing countries and developed countries (Ghosh, 2003). The Free and Open Source Software (FOSS) movement considers training to be a key factor in increasing the levels of adoption and have been developing formal training programs in order to improve the adoption levels (Wade, 2008).

Cost

Cost is one of the main factors that companies and individuals consider when making software acquisition decisions (Ven & Verelst, 2006). The cost advantage of OSS consists of hardware and software cost (Dedrick & West, 2004). In their study, they established that OSS such as Linux has no hardware cost advantage over Microsoft Windows servers, because they both run on the same Intel hardware. They further established that companies that installed Linux saved software costs because Linux can be downloaded for free making it cheaper than either Windows or the proprietary versions of Unix. Upgrades are also free, so there is no on-going cost to stay with the latest version of Linux, as opposed to Unix or Windows.

The total cost of ownership (TCO) of OSS is still unclear because of the many hidden costs and therefore many organisations are not sure whether the software is cheaper (Ven & Verelst, 2006). Their study established that the cost factor alone is not a sufficient condition for adoption but in most cases, the low costs combined with the high reliability of OSS motivates adoption by organisations.

A study conducted in the schools environment revealed that the relative advantage of reduced cost linked to software licences, upgrades and hardware costs is the most prominent factor positively influencing OSS adoption (Johnston, et al., 2013).

Social influence

In the recent past technology adoption studies have been focusing on social influence as a factor contributing to technology adoption (Vannoy & Palvia, 2010). Social computing has been playing an important role in promoting use of technology. Social computing has been defined as "intra-group social and business actions practiced through group consensus, group cooperation, and group authority, where such actions are made possible through the mediation of information technologies, and where group interaction causes members to conform and influences others to join the group" (Vannoy & Palvia, 2010 pg. 149). They argue that group fellowship makes some actions look appropriate and the individual is guided by the group's rules and practice leading to technology adoption.

There is a wide body of literature indicating that social influence is a significant factor that influences behaviour in a number of domains (Venkatesh & Morris, 2000). A study conducted in the area of OSS adoption indicated that social influence has a significant role in adoption of OSS technologies (Gwebu & Wang, 2011).

Prior experience

Users with prior experience of a technology are more likely to use it because experience makes knowledge more accessible in memory (Fazio & Zanna, 1978). Knowledge gained from past behaviour helps to shape intention to use a technology implying that IT usage may be more effectively modelled for experienced users (Ajzen, 1991).

The section has discussed usability, user training, cost, social influence, prior experience as general factors that contribute to OSS adoption.

2.9. Other factors that are perceived to be specific to OSS adoption

Skills compatibility

Compatibility with current skills is another factor that contributes to the adoption of OSS because in some cases the users and IT support staff have to be given time to adapt to incompatibilities between OSS and other proprietary products (Dedrick & West, 2004). According to them, implementation of OSS products has implications regarding staffing needs where in some cases it is difficult to find system or network administrators with the necessary skill to handle the new OSS environment. Another study conducted by Johnston et al., (2013), contradicted the above findings because the respondents did not see skills as an important or an influencing factor at all because they believe that they can learn from their colleagues or from the experts. Users who have skills that are incompatible with a new software product might need some training to enable them use the new product.

Trialability.

Triability is defined by Rogers (1983) as the ability to try out a new innovation on a limited basis before making a decision on whether to adopt the innovation or not. Getting a new idea adopted, even when it has obvious advantages, is often very difficult (Rogers, 1983). According to him, many innovations require a long period, often some years, from the time when they become available to the time when they are widely adopted. A study conducted by Dedrick & West (2004) established that the ability to try out OSS at a very low cost is a factor that contributes to OSS adoption. According to Ven & Verelst (2006), OSS is more convenient to try out than commercial software. This is because the software could be run on existing commodity hardware and could be downloaded for free from numerous websites (Dedrick & West, 2004).

Availability of Support

Availability of support is an important factor that contributes to the adoption of OSS (Gurusamy & Campbell, 2012). Having better support is one of the reasons for OSS adoption which can be realized through commercial and/or in-house support (Gurusamy & Campbell, 2012). In some cases commercial support for OSS applications is perceived to be better than for proprietary products (Gurusamy & Campbell, 2012). Support for users during and after technology change is very important because the users can be supported when they get stuck (Johnston, et al., 2013).

Fit to task

One of the main reasons most organisations adopt OSS is because of the extent to which organisational business needs can be satisfied by these products (Gurusamy & Campbell, 2012). Their study established that, the selection of software tends to be based on how well the software meets organisational requirements irrespective of whether it is a Commercial Off-The-Shelf

(COTS) product or an Open Source product. Johnston et, al. (2013), found that OSS products can adequately work in a school environment.

Security

Security issues are important in the decision to adopt OSS products (Gurusamy & Campbell, 2012). In their study, they established that experience of security issues when using commercial software was one of the reasons given for OSS adoption.

Existence of OSS Community

The OSS community's contribution to OSS products and the opportunity to contact the main code contributors is also an important factor of OSS adoption (Gurusamy & Campbell, 2012). According to them, organisations are interested in improvements, enhancements and various versions published for OSS products. Active community involvement helps to further develop and improve OSS products.

Access to Source Code

As stated by Ven & Verelst (2006), having access to the source code of OSS and therefore the opportunity for modification or customization of the software is one of the main advantages claimed by open source advocates. They however doubt given the technical nature of applications such as Linux and Apache, whether many users will actually study and/or change the source code. In their study, they established that the majority of the respondents had not made use of the source code to improve or customize the OSS they use because they deemed it stable.

Boundary Spanners

Boundary spanners are individuals within an organization who connect their organization with external information and can bring the organization in contact with new innovations (Tushman & Scanlan, 1981)**.** The introduction of open source software is primarily a bottom-up initiative where a number of employees have some knowledge of OSS and introduce it in the organization when appropriate (Ven & Verelst, 2006). Therefore the boundary spanners play an important role in promoting adoption of OSS in organisations.

Product awareness

Awareness of the existing OSS products is an influencing adoption factor (Johnston & Seymour, 2005). The majority of users are not aware of OSS products but are familiar with Microsoft software products which might be attributed to marketing strategies employed by Microsoft (Johnston, et al., 2013).

OSS Compatibility with other software

According to Dedrick & West (2004), the decision to implement OSS platforms is greatly influenced by the compatibility of the new technology with current technologies, skills and tasks. In their view, compatibility with current applications is a major concern in the adoption decision. In their study they established that the lack of Linux support for applications such as PeopleSoft and See Beyond was a barrier to adoption in organisations. Another study conducted by Johnston et, al. (2013) revealed that product compatibility is the most problematic technological factor because in many organisations Microsoft is the common standard. The study further revealed that compatibility can be an issue, with regard to the file formats of the different products.

Software Piracy

Software piracy is a common phenomenon that makes PS available to personal computer (PC) users, either at a small cost or none at all. A recent study conducted by the Business Software Alliance (2010) shows that PS piracy is rampant and is on the increase in emerging economies such as Kenya. The study also noted that there are indications that piracy is proportional to the number of new PC acquisitions in these economies. The study revealed that piracy in the year 2010 was the second highest the organization has ever found, at a global rate of 42%. Software licence reuse (installing software using the same product key) was found to be the most common form of piracy, although many perpetrators were not aware that it was illegal. The availability of pirated PS makes OSS look inferior to their PS counterparts (Knight, 2005). In his view there is a ‘removal of social conscience in regards to copying’, and users are not making a choice based on the traditional parameters of budget, suitability and effectiveness (Knight 2005, pp. 47). He continues to argue that piracy removes the cost factor, leaving the biggest and best as the only viable choice.

2.10. Classification of technology adoption factors

The different factors that contribute to the adoption of Management Information Systems (MIS) technologies in an organisation can be classified into three, based on a robust framework called the TOE framework (Depietro, et al., 1990). Their model consists of three elements; Technology,

Organisation and Environment. Based on the above model Dedrick & West (2004) have classified the factors of OSS adoption under the above three categories as follows;

Technology: The technology factors are relative advantage, cost, reliability, compatibility, skills, fit to task and trialability

Organisation: The organization factors are IT innovativeness, strategic importance of IT, and availability of both financial and human resources.

Environment: The environmental factors are available technology skills and services and legitimacy.

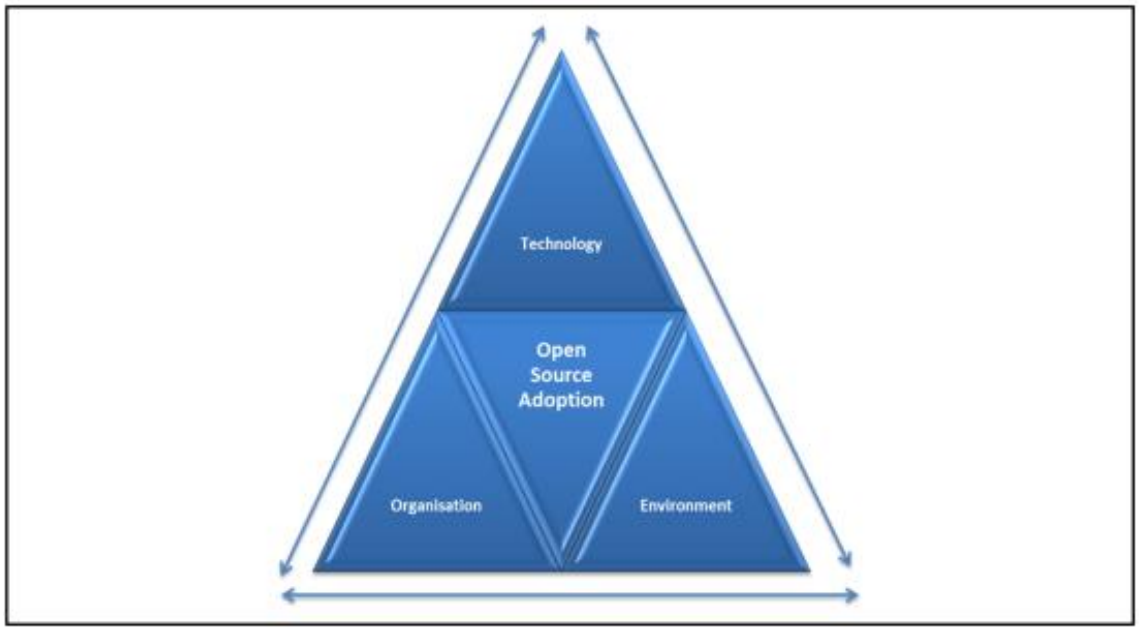

Figure 2.10-1: The TOE model

Source: Johnston et al., (2013)

2.11. A comparison of common theories relating to adoption of technology

This section discusses the theories that are used in the adoption of technology. The parameter of comparison is the constructs that these theories/models use in order to identify related or similar constructs across the models. Constructs are mental ideas which can be measured using variables although in some cases a construct may only be represented using one variable (Creswell, 2009). Creswell (2009) notes that in some cases the name of a construct and that of a variable can be the same. This study has established that the constructs used across TAM, MM, MPCU, DoI, SCT, EUTAUT and UTAUT theories are; performance expectancy, effort expectancy, cost/price value, social influence, and facilitating conditions, hedonic motivation, behavioural intention and habit. The constructs are discussed below;

Performance expectancy

Performance expectancy can be defined as the extent to which a person believes that using a system will help him or her achieve better results in job performance (Venkatesh, et al., 2003). Performance expectancy is similar or closely related to perceived usefulness in TAM, Extrinsic motivation in MM, job fit in MPCU, relative advantage in DoI, and outcome expectations in SCT (Almatari, et al., 2012). Venkatesh, et al., (2003) closely relates performance expectancy with perceived usefulness, extrinsic motivation and job fit. Performance expectancy is also a major construct in EUTAUT. Studies that have investigated technology adoption in organisations have established that performance expectancy is the main driver of technology adoption (Venkatesh, et al., 2012). Venkatesh et al., (2012) note that in the case of consumers' technology adoption other factors such as hedonic motivation and price value are more significant. In UTAUT, performance expectancy is moderated by age and gender because men (especially younger men) are more task oriented than women (Venkatesh, et al., 2003).

Effort expectancy

Effort expectancy can be defined as the level of ease associated with the use of a system (Venkatesh, et al., 2003). Effort expectancy is similar to perceived ease of use, complexity and ease of use (Almatari, et al., 2012). Perceived ease of use is one of the main constructs in TAM, complexity in MPCU and ease of use in IDT respectively (Venkatesh, et al., 2012). Effort expectancy is one of the main constructs in both UTAUT and EUTAUT (Venkatesh, et al., 2012). A study conducted in Ghana that sought to establish the factors that contribute to the adoption of ICT for learning by students in tertiary institutions established that effort expectancy plays a very significant role in the adoption of ICT (Attuquayefio & Addo, 2014). There is a general agreement that effort expectancy is a major driver towards adoption of a technology in studies that have been conducted (Thomas, et al., 2013). The moderators of effort expectancy in UTAUT, are age and gender whose effects as moderators are more significant in women especially the old ones (Venkatesh, et al., 2003).

Cost/price value

The price of a software product is perceived to be an important factor for individual consumers because they normally have to bear the cost of the product (Venkatesh, et al., 2012). Studies that have been conducted indicate that price is a significant factor that has an influence on consumer behaviour (Cho & Sagynov, 2015). The UTAUT model had not captured this important construct

and therefore in the EUTAUT, it was included in order to customise the model to the context of consumer technology use (Venkatesh, et al., 2012). While developing EUTAUT, Venkatesh et al., (2012) introduced gender and age as moderators of price value where they established that effect of price value is more significant to older women.

Social influence

Social influence is the level to which a consumer perceives that others who are important to the consumer believe he should use a product (Venkatesh, et al., 2003). Social influence as a construct is equivalent to social norms in TRA, social factors in MPCU and image in DoI (Almatari, et al., 2012). Although the construct has different names in the models (TRA, MPCU, UTAUT) it bears the same meaning as the constructs contain the implicit or explicit belief that the behaviour of a consumer is influenced by the way they believe others will view them as a result of using a technology (Venkatesh, et al., 2003). The social influence construct is absent in TAM making it inadequate in predicting voluntary adoption of a technology by individual consumers (Malhotra & Galletta, 1999). In the EUTAUT model, social influence was retained as it was proved to contribute to individual consumer's adoption of a technology (Venkatesh, et al., 2012). Although the social influence construct has been controversial with some studies indicating that it is insignificant, in UTAUT the effect of social influence was found to be significant especially to older female workers during early stages of adoption (Venkatesh, et al., 2003). In UTAUT, Venkatesh et al., (2012) introduced gender, age, voluntariness and experience as moderators, which they proved they had a moderating effect on social influence.

Facilitating conditions

Facilitating conditions means the extent to which a person believes that organisational and technical infrastructure exists to support the use of the system (Venkatesh, et al., 2003). The term facilitating conditions is also used in MPCU although in DoI it is referred to as compatibility (Almatari, et al., 2012). In DoI compatibility is defined as the extent to which an innovation is thought to be consistent with the current values, previous experiences and requirements of potential adopters (Rogers, 1995). Studies have revealed that facilitating conditions play a significant role in the adoption of a technology especially for older workers in an organisation setup and that was the reason for including it in UTAUT (Venkatesh, et al., 2003). In EUTAUT, the facilitating conditions construct is present and has a significant effect on behavioural intention especially for older women (Venkatesh, et al., 2012). In EUTAUT, the facilitating conditions construct is moderated by age, gender and experience (Venkatesh, et al., 2012).

Hedonic motivation

Hedonic motivation is the perceived fun or pleasure that results from using a technology (Venkatesh, et al., 2012). Subjective norm bears the same meaning with hedonic motivation which is a major construct in TPB (Venkatesh & Brown, 2001). Subjective norm is the perceived social pleasure to perform the behaviour in question (Ajzen, 1991). Hedonic motivation is perceived to be significant in a household PC usage setup and not in a workplace setting because the aspect of fun is not relevant in a workplace setting (Brown & Venkatesh, 2005). In a household PC usage setup, as opposed to a workplace, the entertainment potential of PCs plays an important role in the adoption decision (Venkatesh & Brown, 2001). In a consumer environment hedonic motivation contributes to adoption especially in the use of hedonic features such as mobile games and entertainment in mobile Internet technology (Venkatesh, et al., 2012). Hedonic motivation is a construct in the Model of Adoption Technology in Households (MATH), which was initially proposed by Ajzen (1991) and modified by Brown & Venkatesh (2005) who retained the construct in the modified model.

In MATH the hedonic motivation construct is present with the name hedonic outcomes and in EUTAUT the name hedonic motivation is used to refer to the same construct. The moderator of hedonic motivation in MATH is age because younger people are more likely to use technology for the sake of enjoyment (Brown & Venkatesh, 2005). In EUTAUT the moderators of hedonic motivation are age, gender and experience where it was established that hedonic motivation is more significant for younger men (Venkatesh, et al., 2012).

Behavioural intention

Behavioural intention is a construct that represents an individual's deliberate plan to apply effort to carry out a behaviour (Malhotra & McCort, 2001). In UTAUT, behavioural intention predicts usage behaviour and is (behavioural intention) determined by performance expectancy, effort expectancy and social influence (Venkatesh, et al., 2003). Behavioural intention is also present in TRA as a determinant of behaviour (Ajzen, 1991). EUTAUT also has the behavioural intention construct as a determinant of use behaviour (Venkatesh, et al., 2012). Empirical studies for some time now have established that individuals often fail to act according to their stated intentions (Ajzen, et al., 2004). Some recent studies have also challenged the role of behavioural intention as a key predictor of technology use (Kim & Malhotra, 2005).

Habit

Habit is defined as a repeated behavioural pattern that an individual performs automatically without being conscious (Triandis, 1977). Once a behaviour has been repeated routinely, a mental linkage is established that activates a routinized behaviour (Kim & Malhotra, 2005). Habit is a related term to experience although different because experience is necessary but not sufficient when an individual is forming a habit (Venkatesh, et al., 2012). Venkatesh et al., (2012) note that in the context of technology use, habit is a perceptual construct that reflects the results of previous experiences. Habit is a one of the new constructs that were introduced in EUTAUT (Venkatesh, et al., 2012). The habit construct has also been incorporated into the expectation confirmation theory (ECT) because it provides extra explanatory power in explaining IS adoption (Limayem, et al., 2007). Limayem et al., (2007) suggest that prior use predicts habit because once an individual has used a technology previously, the individual is likely to continue using the technology and it eventually becomes a behaviour.

In EUTAUT habit is moderated by gender, age and experience where it was established that habit is more significant in older men who have more experience with a technology (Venkatesh, et al., 2012).

Table 2.11-1 A comparison of the constructs in the common technology adoption models

Construct	Constructs with a similar meaning	Models/theories using	moderators
Performance expectancy	perceived usefulness, Extrinsic motivation, job fit, relative advantage	TAM, MPCU, DoI, SCT, EUTAUT, UTAUT	Age, Gender
Effort expectancy	Perceived ease of use, complexity, ease of use	TAM, MPCU, DoI, UTAUT, EUTAUT	Age and gender
Cost	price value	E-UTAUT	Age and gender
Social influence	social norms, social factors, Image	TRA, MPCU, DoI, UTAUT, EUTAUT	Gender, Age, Voluntariness
Facilitating conditions	Compatibility	DoI, UTAUT, EUTAUT	Age, gender and experience
Hedonic motivation	Subjective norm	TPB, EUTAUT	Age, gender and experience
Behavioural intention		TRA, UTAUT, EUTAUT	
Habit		EUTAUT	Age, gender and experience

Source: Researcher

The Table 2.11-1 reveals that EUTAUT has all the eight constructs identified from the different common technology adoption models. The eight constructs of EUTAUT are performance

expectancy, effort expectancy, cost/price value, social influence, and facilitating conditions, hedonic motivation, behavioural intention and habit. EUTAUT was developed with the aim of predicting voluntary technology adoption and was tested in the mobile Internet consumer context (Venkatesh, et al., 2012). EUTAUT synthesised all its major predecessors and accommodated all the constructs although some have different names as demonstrated by the above table (Göğüş, et al., 2012).

2.12. Scholarly validation of EUTAUT as a voluntary technology adoption model by individuals

EUTAUT was developed with the aim of predicting voluntary technology adoption by individuals and has constructs that are relevant in that context (Venkatesh, et al., 2012). Many studies have been conducted after the development of the model with the aim of predicting voluntary technology adoption in a variety of contexts. Selected studies that are relevant to this study are discussed in this section.

A study conducted by Raman and Don (2014) that aimed at establishing the relationships between the constructs that influence preservice teachers' adoption of Moodle (a FOSS) in their learning process was conducted in Malaysia. The study used EUTAUT model to examine the factors that contribute to the adoption of Moodle. The findings of the Raman and Don (2014) Moodle study were consistent with those of Venkatesh et al., (2012) study. However in the Moodle adoption study, the habit construct was not significant because in this context the respondents were using Moodle for academic purposes only (Raman & Don, 2013). Raman and Don (2014) concluded that the model was less suitable in educational settings and recommended more variables such as security and time of access to be included in order to make the model more appropriate for the context.

EUTAUT has been tested in Turkey in the context of educational technology adoption. The study recommended the incorporation of cultural dimensions as a construct in order to make it more predictive across different cultures (Göğüş, et al., 2012). The study further noted that including computer literacy as a variable of the EUTAUT model is likely to become the strongest independent variable. Göğüş et al., (2012) note that although EUTAUT has included facilitating conditions which encompass computer anxiety, EUTAUT can be more explicative if computer anxiety can be included as a construct on its own.

Another study that aimed at validating EUTAUT was conducted in Spain that aimed at establishing the determinants of consumer purchase of website airline tickets (Escobar-

Rodríguez & Carvajal-Trujillo, 2013). The study established that the main determinants of online purchase intention are, in order of significance, habit, price saving, performance expectancy, and facilitating conditions (Escobar-Rodríguez & Carvajal-Trujillo, 2013). The study further noted that there was no "significant impact of effort expectancy on the online purchase intention, social influence from referents; and hedonic motivation to use the website" (Escobar-Rodríguez & Carvajal-Trujillo, 2013 pp 58).

EUTAUT has also been tested in a study that was conducted in a Spanish public university which aimed at identifying the factors that contribute to the adoption of social media technologies in learning (Escobar-Rodríguez, et al., 2014). The study established that, facilitating conditions, hedonic motivation, effort expectancy, social influence, performance expectancy and habit were found to be useful in predicting students' intention to adopt social media technologies in learning.

In the context of mobile money payment adoption in the UK, EUTAUT was found to be lacking perceived risk and trust constructs that were considered important in this context (Slade, et al., 2013). The addition of the two constructs in the study resulted in EUTAUT becoming more appropriate in this scenario. A similar study conducted in Saudi Arabia had consistent findings with the UK study because the two constructs (trust and risk) were incorporated into EUTAUT in order to make it more predictive in the mobile technologies consumer adoption scenario (Baabdullah, et al., 2014).

A study conducted in Tanzania that employed EUTAUT revealed that apart from performance expectancy all other constructs in EUTAUT were significant in determining the adoption of multimedia enhanced content in secondary schools (Mtebe, et al., 2016). Their study noted that EUTAUT needed to be improved by adding constructs such as information quality, attitude and awareness in order to make the model more predictive in this situation.

Examples of EUTAUT in FOSS research

The researcher found very few studies relating to the adoption of FOSS which employed EUTAUT probably because EUTAUT is relatively new and secondly because there are not many FOSS studies especially in Africa. Nevertheless, EUTAUT has been applied in a few FOSS research studies because it is considered to include more constructs than its predecessors (Venkatesh, et al., 2012). A study conducted in Malaysia that sought to establish the factors that contribute to the adoption of Moodle, which is a FOSS, applied EUTAUT (Raman & Don, 2013). Raman & Don (2013) recommended the inclusion of security and time of access as constructs in order to make the model more predictive in an education context.

2.13. Adoption of computing technologies by students in tertiary institutions

Computing technologies are known to be adopted faster by students in tertiary institutions than other populations with older users (Grundmeyer, 2014). The technologies are used to enhance the learning by both the learners and the teachers. Some technology adoption studies have been conducted in tertiary institutions including TAM by Davis (1989) where some postgraduate participants were drawn from Boston University. The Table 2.13-1 shows a summary of popular technology adoption models and theories that were conducted in a tertiary institution setup.

Table 2.13-1 Summary of popular technology adoption models and theories

Model/theory	**Context developed**
TAM	Boston university MBA students were among the respondents involved
Combined TAM	Resource centre for, business students were the respondents
MM	MBA students were the respondents

Source: Researcher

2.14. OSS research gaps

This section provides a discussion of the various research gaps identified in the literature in the area of OSS. The section provides insights into the potential areas of research in the area.

2.14.1. Status of FOSS adoption in Africa

Very few studies have been found that seek to establish the adoption levels and the reasons for the low adoption of FOSS products in the world and mainly in Africa. These observations were made by Morgan & Finnegan (2007) who noted that the majority of the studies have been conducted on motivations of OSS programmers and the organisation of specific products. The same sentiments were echoed by Dedrick and West (2004) who noted that, major research gaps existed in the area of OSS adoption. The few studies that exist on OSS adoption have mainly been conducted outside the African continent as observed by Kamau and Namuye (2012) who emphasized the need for further research in Africa regarding OSS adoption.

2.14.2. OSS Total cost of ownership

Many authors have argued that OSS is cheaper than proprietary software and indeed many organisations have achieved notable savings in their technology expenditure budgets (Nagy, Yasssin, & Bhattacherjee, 2010; Dedrick & West, 2004; Bretthauer, 2001, Williams, 2002). The lower or non-existent licence cost of OSS is an important reason why organisations consider using OSS products (Ven & Verelst, 2006). A study conducted by Ven & Verelst, (2006) revealed that many organisations do not make formal calculations of the Total Cost of Ownership (TCO), to estimate the long-term costs of OSS.

According to Ven & Verelst (2006), it is a challenge to calculate the TCO of OSS due to the many hidden costs. Although the TCO for OSS is normally significantly lower than that of PS this is different for every case study (James & Belle, 2008). The TCO issue is highly contentious with each company approaching it in a different manner (Shaikh & Cornford, 2011). There is a need to develop a standard framework for determining the TCO of a desired OSS product which will guide the adoption decisions in organizations. Developing a framework or formula for calculating the total ownership cost of free OSS is not within the scope of this study.

2.14.3. Factors of adoption

The factors contributing to FOSS adoption by individuals is an area that has received very little attention opposed to that of organizational adoption (Li, et al., 2011). There are very few academic studies attempting to explain how an individual user chooses to adopt OSS (Gallego, et al., 2008; Li, et al., 2011). Li et al., (2008) further noted that a few studies *have* been conducted in an attempt to explain the organisational adoption of OSS while other studies have focused on *individual developers'* motivation to contribute to OSS projects, OSS project coordination and the OSS development model.

The studies conducted in organisations have revealed that some traditionally perceived factors of adoption such as the low cost of OSS and the liberty to view source code are not the main factors that organisations consider while making adoption decisions (Dedrick & West, 2004). Their study revealed that factors such as compatibility with current technologies and skills, organizational resources and tasks, and the availability of external technological resources were instrumental in OSS adoption decisions. Other studies such as the one conducted by Johnston et al., (2013) in the South African Western Cape schools, revealed different factors of adoption in a different environment. The actual factors of OSS adoption seem to vary depending on the environment (Gurusamy & Campbell, 2012). A study conducted by Kamau and Sanders (2013)

noted that usability is one of the main factors contributing to the adoption of Desktop OSS among university students in Kenya. They also noted that further studies needed to be conducted in this environment in order to establish the other factors contributing to the adoption of desktop OSS in this environment. It is also not clear whether adoption of the different OSS products is dependent on the same factors or there is a variation depending on the OSS product in question (Gurusamy & Campbell, 2012).

2.15. Summary of literature review

From the literature review we note that since the inception of OSS in the 1970's, OSS has made some remarkable progress. To date a good number of OSS products have been developed both for the server and the desktop devices. Although generally OSS adoption around the world is low compared to what most researchers expected, we note that there are some countries such as Brazil that are leading in OSS adoption.

There are a number of notable advantages of OSS such as cost saving, security, ability to customise, reliability, quality, good customer support escaping vendor lock-in, encouraging innovations among others. A number of disadvantages have also been identified such as complexity of the software, lack of product awareness, lack of user support agreement, proliferation of versions among others.

Some studies have been conducted in an effort to determine the adoption levels and have revealed that many western countries use OSS to some degree, while in some Latin American countries such as Brazil, the adoption levels are also quite high. In certain Asian countries, particularly China and India, OSS adoption is also relatively high and there are clear government policies encouraging its adoption. As revealed by the literature, African countries are lagging behind in OSS adoption.

A number of factors are believed to contribute to OSS adoption such as usability, user training, cost, compatibility with other software, skills compatibility, trialability, availability of support, fitness to task among others. These technology adoption factors could be classified into technological, organisational and environmental factors as proposed by Dedrick & West (2004).

Technology adoption models have been developed in order to explain how users decide and why they decide to use a technology. Some of the widely used ones are TAM, TRA, TPB, MPCU, DoI, SCT, UTAUT and the Extended UTAUT. Based on these models, studies have been conducted in an effort to explain adoption of OSS. This study has established that EUTAUT inherited constructs from its major predecessors including widely tested models/theories such as

TAM and UTAUT. The inclusion of the constructs from EUTAUT predecessors makes it more appropriate in contemporary IS adoption research as a basis for a/the theoretical framework for discretionary use of IS scenarios. Recent studies have employed EUTAUT as a theoretical framework although in some cases the studies have included additional constructs in order to make the model more appropriate in those scenarios.

The studies that have been conducted have revealed that there is need to do more research in the area. The current OSS adoption levels in many African countries are not known. One of the aims of this study is to contribute to existing knowledge by establishing the actual adoption levels in one sector (university students) in Kenya which is an African country. Conducting a continent wide study is beyond the scope of this study. Despite the fact that many researchers concur that OSS products are relatively cheap, the total cost of ownership of the products cannot be easily determined. The factors contributing to the adoption of OSS differ depending on the environment. Currently the factors affecting the adoption in developing countries in African are not known.

This study has also established that students in tertiary institution are likely to adopt information systems fast because they mainly use the technologies for learning. Popular technology adoption models/theories such as TAM were developed and tested with students as participants. Tertiary institution students are a suitable population for conducting Free Desktop OSS adoption studies because they are literate and they also use software for learning related tasks such as research and doing assignments.

Finally, although a number of mature technology acceptance models exist, there is no evidence that they are suitable in the adoption of OSS products in developing counties in Africa. The few that have been developed specifically for OSS adoption were found to be deficient and there is no evidence that they could be applicable in a developing country scenario.

The next chapter presents a detailed discussion of the existing technology adoption models in the context of OSS adoption. The review assesses the appropriateness of the popular models in predicting free desktop OSS adoption in African developing countries.

Chapter 3

Assessing existing models in context

3.0. Introduction

In chapter 2 this study established that although a number of mature technology acceptance models exist, there is no evidence that they are appropriate in the adoption of OSS products in developing counties in Africa. The few models that have been developed specifically for OSS adoption were found to be deficient and there is no evidence that they could be applicable in a developing country scenario.

This chapter assesses the existing technology acceptance models in the context of OSS adoption in order to assess their appropriateness in a developing country scenario. The chapter also reviews their development methodology as well as the criticism of these models by other scholars in terms of their deficiencies and gaps that need to be addressed in the future. The chapter seeks to address the research objective number three (3) and make a contribution in answering the research question number three (3) respectively. Research question number three (3) aims to investigate the applicability of the existing technology acceptance models to free OSS desktop applications in the Kenyan situation and in particular to Kenyan university students.

The review of existing literature has been used in this chapter in order to establish the appropriateness of the existing models in the context of desktop OSS adoption. Publications and conference papers on technology adoption theories have been studied and discussed in order to understand how they were developed and their appropriateness in predicting adoption of Desktop OSS. The chapter also analyses published studies on the popular technology adoption models and then uses these studies to identify areas of omission or weakness of the models as reported in these sources.

3.1. Diffusion of Innovations (DoI)

The DoI was first published by Rogers in 1962 in a book entitled Diffusion of Innovations (Rogers, 1995). Although the author refers to the theory as Diffusion of Innovations, in many publications the theory is referred to as Innovations Diffusion Theory (IDT). The author developed the theory by synthesizing the existing studies which according to him were about 405 in number. There have been amendments into the theory by the same author which according to him are based on newer empirical research reports and publications. The changes have been widely accepted by other authors and applied in research.

As discussed in section 2.8.7., the DoI identifies five attributes of an innovation that influence the adoption and acceptance behaviour which are; relative advantage, complexity, compatibility, trialability, and observability. The section also discusses each of the above attributes. Rogers developed a conceptual framework showing the variables that determine the rate of adoption of an innovation which is shown in Figure 3.1-1;

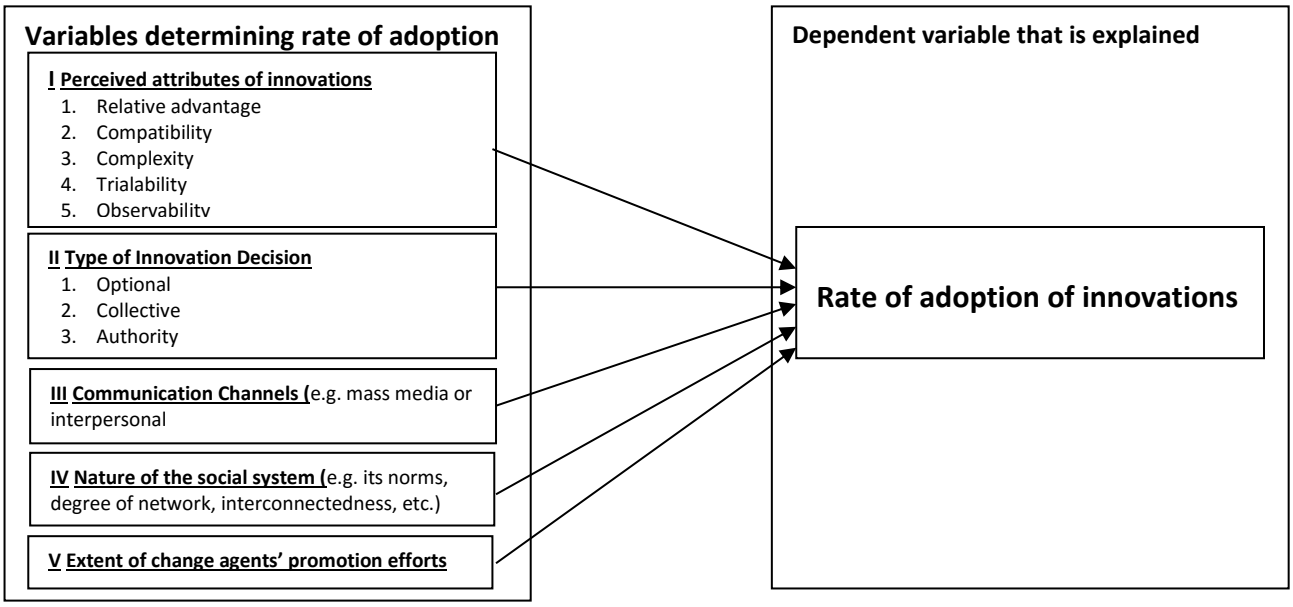

Figure 3.1-1: The Diffusion of Innovations

Source: (Rogers, 1995)

Rogers (1995) reports that the first research on attributes of innovation was conducted with farmers although according to Rogers (1995), a similar study of teachers and school administrators by Holloway (1977), gave the same results. The study on attributes of innovation with 100 high school principals had factor analysed Likert-type scale questions measuring respondents' perceptions of fresh educational ideas to develop the attributes (Holloway, 1977). The study identified relative advantage, complexity, compatibility, trialability, and observability as the attributes of innovations although according to Rogers (1995), the distinction between relative advantage and compatibility was not very clear-cut.

According to Rogers (1995), individuals generally adopt optional innovations more rapidly than when an innovation is adopted by an organization and argues that the more individuals involved in adopting an innovation the slower the rate of adoption. He also noted that the degree of interconnectedness of a communication network structure of a social system also affects the rate of adoption of an innovation as well as the promotion efforts made by the change agents.

Application of DoI in information systems research

DoI has been used and adapted in various research studies such as E-business, E-procurement, enterprise resource planning, web site, intranet, materials requirements planning among other areas (Oliveira & Martins, 2011). The theory is one of the common models that are used in studying adoption and post adoption behaviours in ICT (Al-Mamary, et al., 2016). In research the model has been used to predict and explain use of innovation and diffusion behaviours by consumers in multiple disciplines (Jen, et al., 2009; Rambocas & Arjoon, 2012).

In the development of UTAUT, tests that were conducted using DoI demonstrated that relative advantage, which is similar to performance expectancy, was the most significant predictor of intention (Venkatesh, et al., 2003). The same study established that ease of use which is equivalent to complexity and effort expectancy is significant in both voluntary and mandatory settings before the users gain knowledge to use the technology.

DoI has been used to identify the determinants of Internet banking by young customers in Trinidad and Tobago (Rambocas & Arjoon, 2012). The study extended the DoI model to include government support and consumer trust. The study established that perceived relative advantage was the most significant determinant of Internet banking loyalty followed by government support to a lesser extent (Rambocas & Arjoon, 2012).

In Uganda DoI has been used to investigate the adoption of Internet as an innovation (Kasse, et al., 2015). The study noted that the predictors of Internet adoption are compatibility, relative advantage, trialability and complexity. Relative advantage of the Internet was found to be the most significant factor contributing to Internet adoption in rural urban areas of Uganda (Kasse, et al., 2015).

Limitations of DoI

There are limited literature and studies discussing the limitations of DoI especially in the area of information technology. The author notes that the theory is rich in terms of the social factors contributing to the adoption of a technology such as the nature of social system and change agents' promotion efforts.

Experience in using a technology is an important factor that contributes to the adoption of a similar technology. This factor is salient in a number of technology adoption theories and features prominently in the UTAUT. In DoI experience does not feature anywhere probably because it is assumed that no one has experience in using a new innovation. This fact is not true for information technology/systems because if one has used similar software before, he/she is likely

to have an easier time when using the new one. The DoI theory seems to have been developed purposely for new technological innovations and is not best suited for predicting OSS adoption in developing countries such as Africa.

3.2. Theory of Reasoned Action (TRA)

The Theory of Reasoned Action was developed by first developing a conceptual framework where beliefs were a fundamental building block in the field of psychology (Fishbein & Ajzen, 1975). This conceptual framework was grounded on empirical studies conducted by other researchers. According to Fishbein & Ajzen (1975), the totality of an individual's beliefs serves as the informational base that finally determines his attitudes, intentions, and behaviours. Their conceptual framework also suggests that a person's attitude towards an object is related to the set of his beliefs about the object but not necessarily to any particular belief. They further argued that attitude towards an object will usually not be related to any specific intention with respect to the object. In their view, attitude is a general tendency that does not influence the person to perform any specific behaviour but rather leads to a set of intentions that indicate a certain amount of affect towards the object in question. Their study was based on the conceptual framework in Figure 2.7-1;

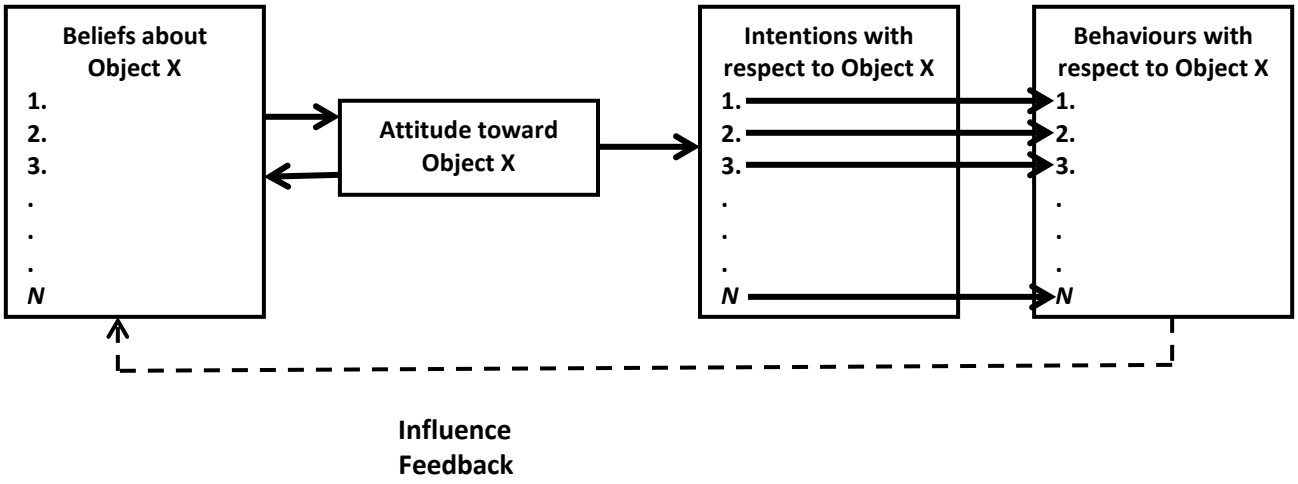

Figure 3.2-1: Theory of Reasoned Action

Source: Fishbein & Ajzen, 1975

According to Fishbein & Ajzen (1975), attitude can be measured using a measurement procedure whereby a person assigns some concept to a position on a bipolar evaluative dimension. In the bipolar measurement, a scale such as the one shown in Figure 3.2-2 is used;

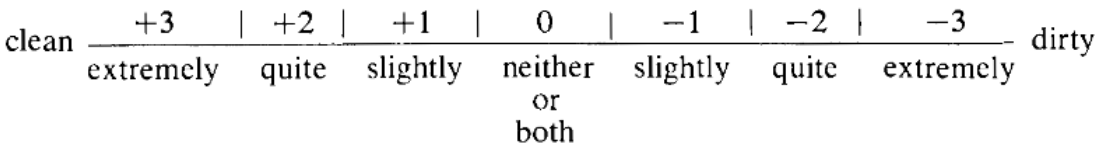

Figure 3.2-2: bipolar measurement scale

Source: Fishbein & Ajzen, 1975

On the other hand in order to measure belief, the attribute that is linked to the object is identified first, because a belief associates an object and an attribute (Fishbein & Ajzen, 1975). For example cleanliness as a belief can be measured with the attributes; very clean, clean, dirty etc. The attribute can then be measured using a bipolar scale. According to them, most beliefs are shaped on the basis of direct observation which provides information to an individual which in turn influences their beliefs towards an object. They further argued that a person's attitude is related to the totality of his beliefs but not automatically to any specific belief he holds. Intention to perform a specified behaviour relates to particular kinds of attitudes and beliefs namely attitudes toward the behaviour, and subjective norms concerning performance of the behaviour. They further noted that there is a systematic set of relationships linking beliefs to attitudes, attitudes to intentions and intentions to behaviour and finally an individual can form new beliefs only by performing some behaviour. According to them in order for a person to change beliefs, intentions, attitudes, and behaviours the individual has to be exposed to information and an environment which produces changes in some of his beliefs.

Application of TRA in information systems research

TRA is an imported theory because it was not specifically developed to be used in information systems research (Moody, et al., 2010). The theory has been used in different disciplines and in a variety of studies such as condom use, dieting, consumption of genetically modified foods etc. (Hoffmann, et al., 1999). Studies in information systems have widely adopted the theory on the basis that adoption is an attitude issue which can be studied using TRA (Otieno, et al., 2016).

TRA has been applied in the area of Internet banking as a technology in Malaysia to determine factors that influence an individual's intention to use a technology (Nor, et al., 2008). The study supported TRA by confirming that an 'individual behaviour intention to use Internet banking is influenced by their attitude and subjective norm' (Nor, et al., 2008, p. 1). A study conducted in America that applied TRA in the area of social networking established that attitude and subjective norm influence intention to use social networking (Peslak, et al., 2012). The study by Peslak et

al., (2012) however noted that although subjective norm influences intention, it does not have a direct influence on behaviour.

All the studies discussed above based the intention to use information systems on attitude and subjective norm. Application of TRA in information systems studies ignores other important factors such as perceived ease of use and perceived usefulness which are significant in the adoption of information systems. TRA has not been used extensively to evaluate technology adoption but mainly to conceptualise the behavioural pattern of an individual in decision making on the adoption of a technology or innovation (Otieno, et al., 2016). TRA is also referred to as an intention based model and has been used by many researchers to investigate the relationship between attitude and intention (Maduku, 2013). Information Systems literature has demonstrated that TRA has only been used in scenarios where the theory identifies users' behaviours and attitudes in issues relating to online buying, Internet use, household computer use, and online privacy (Otieno, et al., 2016).

Some studies have combined TRA and TAM in order to improve the prediction power of TRA. A study conducted in Australia to predict mobile phone usage banking behaviour employed both the constructs of TRA and those of TAM such as perceived usefulness and ease of use in order to improve on both theories (Talukder, et al., 2014). Another study by Maduku (2013), conducted in South Africa that sought to predict the attitude of retail banking customers towards Internet banking services equally applied constructs of both TRA and TAM.

TRA has been used in the prediction of digital piracy among the youths in South Africa (Belle, et al., 2007). Although this study largely employed the constructs of TRA, the study borrowed constructs such as personal values from other models to make it more predictive. Many other studies around the world in areas of electronic management adoption, adherence to information security policies, predicting user trust on information systems just to mention a few have introduced additional constructs into TRA to improve on the model (Alzubi, et al., 2015; Siponen, et al., 2007; Li, et al., 2004).

Limitations of the Theory of Reasoned Action (TRA)

One of the limitations of the model that was highlighted by the authors is that the theory was developed to deal with behaviours (e.g., buying a car) and not outcomes or events that result from behaviours (e.g., losing weight), (Sheppard, et al., 1988). According to them, the model deals

with only those behaviours that are under a person's volitional control and consequently, actions that are at least partially determined by factors beyond individuals' voluntary control fall outside the boundary conditions established for the model. They further noted that the model is not suitable to study goals for which attainment involves a degree of uncertainty and in cases where a person is presented with several choices. This is because many of the attributes and results linked with various substitutes in the choice set are apt to be somewhat alike.

The TRA model is largely based on the argument that beliefs influence behaviour only via their indirect influence on attitudes which has been challenged by other authors. A study conducted by Davis et al., (1989) established that attitudes do not fully mediate the effect of perceived usefulness and perceived ease of use on behaviour. They further observed that the conceptualization of subjective norm based on TRA has theoretical and psychometric problems.

Due to the above highlighted weaknesses of the model, the TRA theory is inadequate for explaining the use behaviour of computer systems in general and in particular adoption of Desktop OSS software.

3.3. Social Cognitive Theory (SCT)

The theory was developed by Bandura (1986) and is founded on a causal model of triadic reciprocal causation. In this model, personal factors in the form of cognitive, affective and biological events, behavioural patterns, and environmental events wholly function as interacting determinants that influence one another bidirectionally (Bandura, 1999). According to Bandura (1986), human behaviour is commonly explained in terms of unidirectional causation in which behaviour is represented as either being formed and governed by environmental influence or driven by internal dispositions.

The social cognitive theory was developed from studies conducted in the area of psychology by Bandura and others. In a study that aimed to demonstrate that people learn from watching others, a series of experiments involving 72 children participants were conducted using a Bobo doll (Bandura, et al., 1961). The study consisted of three experiments which aimed at demonstrating how children imitate aggressive behaviours from adults. In the experiments, the children were exposed to aggression, non-aggression and mild aggression environments. The results of these experiments revealed that children in the aggressive conditions exhibited more aggressive behaviour than those in the non-aggressive conditions with boys performing more aggressive behaviour than girls in the same conditions (Bandura, et al., 1961).

Application of SCT in information systems research

The SCT theory is regarded common in the area of information systems (Venkatesh, et al., 2003). SCT has been applied to a wide range of areas of study such as career choice, mental and physical health, organisational behaviour (Al-Mamary, et al., 2016). The theory can also be applied to areas of Internet usage and gratification as well as computer utilisation (Al-Mamary, et al., 2016).

SCT's concept of self-efficacy has been used in the study of end-user training in computing (Compeau & Higgins, 1995). The results of their study did not support outcome expectations although the study noted that SCT is applicable to the training context but needed some adjustments.

Another study applied SCT to investigate self-regulated learning using a web-based learning system called Netports (Wang & Lin, 2007). The study revealed that self-efficacy and collective efficacy contribute to students' learning behaviours. The study by Wang & Lin (2007) validated the use of SCT to predict web based learning while using the Netports system.

SCT was applied in a study that sought to understand the adoption behaviour of Australian youths towards mobile banking (Ratten & Ratten, 2007). The study established that the youths are influenced by media exposure and outcome values to adopt the technology. The study however established that self-efficacy, outcome expectancy, and modelling of others were insignificant in this scenario (Ratten & Ratten, 2007).

Another study that explored the social cognitive determinants and examined their associations with social media usage employed SCT (Khang, et al., 2014). The social cognitive determinants considered in this study were; self-efficacy, habit, self-regulation and past experiences. The study established that habit was the most significant determinant of social media usage because people use social media in a habitual manner (Khang, et al., 2014).

In the development of UTAUT, tests were conducted to examine the constructs of SCT. The study demonstrated that outcome expectations was a strong predictor to usage intentions for both first time users and afterwards (Venkatesh, et al., 2003). The study established that, during first time use of a technology, self-efficacy and anxiety were significant determinants of intention but non-significant over time.

SCT has also been applied in Botswana to investigate the relationship between computer self-efficacy and general self-efficacy, computer anxiety, locus of control and academic self-esteem (Mogotsi, 2013). The study found all the factors investigated related to computer self-efficacy. Self-efficacy construct of SCT has been employed to measure the impact of ICT in teaching

experiences on two different groups in a study conducted in both Brazil and South Africa. (Fanni, et al., 2013). One of the studies confirmed the role of self-efficacy in relation to teaching experiences while the other did not.

Limitations of Social Cognitive Theory

A good number of Information Systems studies have been conducted applying the social cognitive theory while investigating individual behaviour (Carillo, 2010). Although the model has been used in IS research, the model lacks in a number of ways. The model does not have constructs relating to the attributes of the IS product being investigated but rather concentrates on social influence and other social aspects that influence an individual's behavioural intention (Ratten & Ratten, 2007).

The model lacks constructs such as the usability of the product being used. The author opines that reason for this omission is that the model was not originally developed to study technology adoption behaviour but to study other behaviour in the field of psychology. This study noted that the model is suited to predict adoption of a technology through the learning and training process as demonstrated in the literature reviewed.

It is for the above reasons that the author disqualifies the model as an adequate model for predicting OSS adoption behaviour in developing countries.

3.4. Technology Acceptance Model (TAM)

As explained in section 2.7.2, TAM is a widely cited and used model that seeks to explain the reasons why people accept or reject technology (Davis, 1989). The development of the model was based on some theoretical foundations such as the impact of perceived usefulness on system utilization which was proposed by the work of Schultz and Slevin in 1975. TAM also borrowed from the self-efficacy theory, the channel disposition model, the cost-benefit paradigm, behavioural decision theory among others. The different theories were in agreement that perceived usefulness and ease of use are significant determinants of behaviour (Davis, 1989).

The model was developed by first conducting a pilot study which involved 112 users in order to refine the data collection instrument (Davis, 1989). The pilot study concerned two different interactive computer systems. After the pilot study, the data collection instrument was streamlined in order to evaluate the six item usefulness and ease of use scales. A second study was then conducted involving 40 participants and two graphics systems (Davis, 1989). Data from the two studies was then used to examine the relationship between usefulness, ease of use, and reported usage. The study established that both perceived usefulness and ease of use are

significantly correlated with self-reported indicators of system use. The study further revealed that usefulness was considerably more strongly related to usage than was ease of use.

Application of TAM in information systems research

TAM is one of the most tested acceptance models in a variety of information technologies (Yousafzai, et al., 2007). Empirical studies have found that TAM is a robust and powerful model that explains a fair proportion of the variance in usage intentions and behaviour (Venkatesh, 2000). TAM is also regarded as a stronger model than TRA and it is much simpler and easier to use (Igbaria, 1993).

TAM has been tested in the adoption of learning technologies in Korea using the LISREL program (Park, 2009). The study by Park (2009), established that TAM is a good theoretical model that would help understand users acceptance of e-learning. The study however included the constructs e-learning self-efficacy, subjective norm and system accessibility into TAM in order to improve on the model and make it more predictable in this context (Park, 2009).

A study conducted in the US that sought to establish how attitudes determine Internet usage employed TAM with additional constructs (Porter & Donthu, 2006). Age, education, income perceived access barriers and race were added to TAM as external variables which resulted to a stronger model. The study established that the basic constructs of TAM: perceived ease of use and perceived usefulness were important constructs in the context of Internet use (Porter & Donthu, 2006). The additional constructs to TAM perceived access barriers and the external variables were also found to be significant in the Porter and Donthu (2006) study.

A study conducted in Nigeria on general use of computers which employed TAM established that perceived usefulness and perceived enjoyment do not motivate individuals to use computers in a less developed country such as Nigeria (Anandarajan, et al., 2002). The study further established that social pressure and organisational support are significant determinants of microcomputer technology adoption. Anandarajan et al., (2002) noted that the findings were different from those conducted in America because of the differences in national culture. Although the literature of TAM suggests that research results are convergent, Averweg (2010) notes that there are scenarios where they are conflicting.

Another cross cultural study conducted in three developing countries; Saudi Arabia, Malaysia and South Africa revealed that TAM was suitable in Saudi Arabia and Malaysia but not in South Africa (Averweg, 2010). Averweg (2010) suggests the inclusion of variables related to human and social change processes to TAM in order to make it a more robust model.

A cross-cultural test of TAM (on E-mail technology adoption) in the US, Switzerland and in Japan proved that TAM did not hold in Japan indicating that the model may not predict technology use across all cultures (Straub, et al., 1997). In the study, Straub et al., (1997) noted that in Japan there was a culture of avoiding uncertainty, being assertive, great distances of power between managers and workers and collectivist sentiments which limited E-mail use which was not the case in Switzerland and America.

The above are just a few case scenarios where TAM has been applied in IS adoption studies. TAM has been extended to the adoption of email, voice mail, graphics, personal computer, computer applications, the World Wide Web, telemedicine technology, debugging tools, among other areas (Yousafzai, et al., 2007; Legris, et al., 2003). A meta-analysis of TAM as applied in research conducted by Legris et al., (2003) reviewed a total of 22 studies in different countries. Out of the 22 studies reviewed, only 6 had purely applied TAM as a model in the studies. The majority of the studies (16) had incorporated other models such as TRA and TPB while other studies had incorporated additional constructs such as subjective norm, perceived behavioural control, social norms etc. (Legris, et al., 2003). The study further noted that although TAM is a good model, it does not explain more than 40% of the variance and it therefore needs to be improved.

Limitations of Technology Acceptance Model

One of the limitations of TAM is that perceived ease of use is not a good indicator when predicting actual technology use (Turner, et al., 2010). Behavioural intention predicts actual technology use better. Turner et al., (2010) further caution that, researchers and users of TAM need to be aware that they may be measuring perceived use and not actual system usage. They further argue that TAM could be appropriate while evaluating pre-prototype systems where the aim is to measure the perceived ease of use of the pre-prototype. Another concern regarding perceived ease of use is that little is known about its determinants and little has been done to understand it (Venkatesh, 2000).

Another limitation identified by scholars is that despite the fact that TAM is predictive, it does not provide sufficient information regarding system design attributes that could improve user acceptance for new systems (Mathieson, 1991). This fact was also acknowledged by its own author who admitted that TAM does not provide enough information regarding a system's acceptance in ways that guide development but only suggests that system characteristics impact on ease of use and usefulness perceptions (Venkatesh & Davis, 1996).

Social influence is another aspect not catered for by the TAM model (Davis, et al., 1989). Davis et al., (1989) also noted that there was need to conduct further research in order to comprehend the nature of social influences in a better way and to examine conditions and mechanisms governing the impact of social influences on usage behaviour.

TAM was developed and tested in developed countries and may not exactly fit in an African setup because of the cultural difference unless it is modified (Anandarajan, et al., 2002). TAM has been tested in the context of a developing country in the adoption of web based learning technologies. That study established that perceived usefulness might not be a predictor of adoption and established that perceived ease of use plays a more significant role (Brown, 2002).

Due to the above highlighted weaknesses, TAM is inadequate as a model for predicting usage and adoption behaviour of OSS products in Africa. This conclusion is guided by the fact that TAM does not take into account the effect of social influence on usage behaviour and does not provide sufficient information regarding system design attributes that could improve user acceptance for new systems as observed by Mathieson (1991). Social influence plays a significant role in the adoption of technologies and cannot be ignored. Perceived ease of use is used in TAM but according to Turner et al., (2010), it is not a good indicator compared to behavioural intention while predicting actual usage of a system making TAM unsuitable as an OSS adoption prediction model.

3.5. Theory of Planned Behaviour (TPB)

TPB is an extension of TRA which was developed with the aim of addressing the weaknesses of TRA (Ajzen, 1991). One of the major weaknesses of TRA is that it deals with only those behaviours that are under a person's volitional control (Ajzen, 1991). As a result, actions that are at least partially determined by factors beyond individuals' voluntary control fall outside the boundary conditions established for the model.

A principal factor in TPB is the individual's intention to accomplish a particular behaviour just as in TRA (Ajzen, 1991). The difference between TPB and TRA is the inclusion of perceived behavioural control which plays an important part in the theory of planned behaviour. Ajzen (1991), defines perceived behavioural control as people's perception of the ease or difficulty of performing the behaviour of interest. The supporting theory of behavioural control was provided by the research work carried out by Bandura and others which established that people's behaviour is highly influenced by their confidence in their ability to perform it (Bandura, et al., 1977; Bandura, et al., 1980).

TPB "places the construct of self-efficacy belief or perceived behavioral control within a more general framework of the relations among beliefs, attitudes, intentions, and behavior" (Ajzen, 1991 pg. 184). Hypothetically behavioural achievement can be predicted using perceived behavioural control together with behavioural intention (Ajzen, 1991). TPB assumes that performance of a behaviour is a combined function of intentions and perceived behavioural control. Intentions and perceptions of control have to be evaluated in relation to the specific behaviour under study, and the stated context must be the same as that in which the behaviour is to happen (Ajzen, 1991). A second condition in behavioural prediction is that perceived behavioural control must remain stable in the interval between their assessment and observation of the behaviour.

As mentioned earlier, the supporting theory of behavioural control was provided by the research work carried out by Bandura and others as an extension of TRA. The studies conducted by other researchers revealed that actions performed by an individual are partially determined by factors beyond the individuals' voluntary control. Although TBP largely borrowed from TRA the additions were informed by research work of Bandura (1977) and Bandura (1982) which provided support for the relationship between perceived control and behavioural performance.

In the development of TPB, Ajzen (1982) further argued that past performance of behaviour influences present behaviour. The present behaviour is free of behavioural intentions, attitudes or subjective norms (Bandura, 1982; Bentler & Speckart, 1979). This argument was founded on the study conducted by Bentler and Speckart (1979) that revealed that intentions could be directly influenced by factors other than attitudes and subjective norms. The final result was the TPB which is represented in Figure 2.7-2: Theory of Planned Behaviour.

Application of TPB in information systems research

TPB has been commonly used in past studies in the issues of human behaviour and psychology (Ahmad, et al., 2016; Barnett & Presley, 2004). Apart from human behaviour related studies the model has also been used to predict intentions and behaviour in other domains (Armitage & Conner, 2001). A comparative study of TAM and TPB established that, although TAM predicts actual usage better, TPB provides a better understanding of the determinants of behavioural intentions (Lin, 2007).

TPB has been applied to investigate consumer acceptance of online video and television services in France (Truong, 2009). The study established that TPB is an appropriate model for predicting user acceptance of online video services. The study further noted that the perceived behavioural

control construct is more significant in predicting acceptance of the online video services (Truong, 2009).

A cross-cultural study investigating the drivers of e-commerce that was conducted in both China and the U.S. employed TPB (Pavlou & Chai, 2002). The study related online transaction intentions with attitude, behavioural control and subjective norm. In this study cultural dimensions such as individualism/collectivism and power distance were included as moderators of the effect of TPB variables on online consumer behavior (Pavlou & Chai, 2002).

Another study that sought to predict the determinants of online auction adoption by consumers in China employed TPB but included DoI constructs (Quaddus, et al., 2005). The study indicated that trust, behavioural control and subject norm, plays an important role on the purchasing intention through on-line auction. The results indicated that personal innovativeness and attitude do not play an important role on the buying intention (Quaddus, et al., 2005).

TPB has been applied in Africa to investigate the factors influencing IT workers' green computing intention in a study that was conducted in South Africa (Buisson & Naidoo, 2014). The study included environmental concern antecedent of attitude towards green computing and extended subjective norm to include social influence and media influence. The study established that social influence, media influence, perceived behavioural control and environmental concern positively influence the intention to practice green computing (Buisson & Naidoo, 2014).

A number of studies conducted in African countries seeking to establish the factors of IS adoption have incorporated the constructs of models such as TAM and TPB in order to increase the prediction power of TPB. In Nigeria, a study conducted to investigate the factors influencing the adoption of e-health services employed TPB integrated with TAM and DoI constructs (Okuboyejo & Ochiotu, 2006). Another study that sought to establish the factors inhibiting consumer adoption of Internet banking in Kenya integrated TPB with TAM constructs (Karungu, 2014).

Limitations of TPB

TPB is difficult to apply across different user contexts because it requires a pilot study to be carried out to identify relevant outcomes, referent groups, and control variables in every context in which it is used (Mathieson, 1991). A study that sought to investigate the Internet and web technologies adoption behaviour conducted a pilot study in the US before conducting the main study (Barnett & Presley, 2004). Application of TPB is complex if different user clusters

concentrate on different outcomes from use of the same system (Mathieson, 1991). For example university students using an open source computer based learning system could be interested in improving their grades while their tutors' interest is in saving class time. A similar conclusion was drawn by Taylor & Todd (1995), who concluded that TPB is difficult to operationalize because the belief sets especially those relating to attitude, are peculiar to each context.

Another limitation identified by Mathieson (1991), is that some TPB items require an explicit behavioural alternative to make them as specific as possible. For example potential users of an Open source word processing software might be asked to respond to the following question "Using Microsoft word instead of Open office writer saves me time while writing a thesis report (Agree/Disagree).". This approach may not apply to all individuals because in our example not all users might have used Open office writer and may not yield useful feedback.

In the light of the above highlighted weaknesses of TPB, the model is not suitable for predicting adoption of Desktop OSS in Africa. This is because OSS is used by different users in different contexts to perform different tasks. In order to apply TPB it means that the researcher would need to perform a pilot study for each scenario in order to identify relevant outcomes, referent groups, and control variables in every context. The researcher would also need to identify the different OS product alternatives available in the market for performing a certain tasks. This will not only be difficult to achieve but it will consume time.

3.6. Model of PC Utilisation (MPCU)

The MPCU model was based on a subset of Triandis' (1971;1980) theory of attitudes and behaviour (Thompson, et al., 1991). One of the main bases of the theory of attitudes and behaviour is that social factors and observed consequences affect behavioural intentions which consequently influence behaviour (Triandis, 1980). He further states that habits are both direct and indirect causes of behaviour and accepts that even when intentions are high behaviour may not occur if the conditions are unfavourable.

While developing their model Thompson et. al., (1991), tested a subset of Triandis' (1980) theory in relation to PC use where they specifically examined the direct effects of social factors, affect, perceived consequences, and facilitating conditions on behaviour as discussed below;

Social factors: As argued by Triandis (1980), this is the person's adoption of the reference group's subjective culture, alongside particular interpersonal agreements that the person has made with others, in particular situations. Behaviour is influenced by social norms which are dependent on messages received from others and reflect what individuals think they should do

in particular situations (Triandis, 1971). According to Thompson et. al., (1991), there is empirical support for the relationship between social norms and behaviour in many studies.

Affect: is defined by Triandis (1980) as "the feelings of joy, elation, or pleasure, or depression, disgust, displeasure, or hate associated by an individual with a particular act" (p. 211).

Perceived consequences: According to Triandis (1980), each act performed by an individual is perceived as having potential consequences that have an associated value and a probability that the consequence will occur. He argues that perceived consequences could have many dimensions and he cites the example of enhanced job satisfaction and job flexibility as two different constructs that could be referred to as perceived consequences.

Facilitating conditions: Triandis (1980) defines facilitating conditions as objective factors within the environment that are generally agreed by observers as making an act easier to perform. According to Thompson et. al., (1991) user support and training are facilitating conditions on the context of PC use.

Other factors tested in their study are job-fit, long term consequence of use and habit which formed part of the hypothesis in their study.

Using a Likert-type scale questionnaire, the study was conducted in a large multinational manufacturing organization where the target population was knowledge workers who used personal computers (PCs) in their jobs.

After collecting the data Thompson et. al., (1991) used the partial least squares (PLS) analysis to test the research hypothesis. The results showed that the hypothesis test provided a moderate support for the MPCU. The results established that "social factors, complexity, job fit, and long-term consequences had significant effects on PC use" (Thompson et. al., 1991 pg. 137).

Application of MPCU in information systems research

MPCU differs from TRA because it differentiates between affective and cognitive components of attitude (Sharma & Mishra, 2014). This study found very limited literature on studies that solely applied MPCU as a model to predict adoption of information systems. MPCU is not one of the commonly used technology acceptance model in the area of information systems (Samaradiwakara & Gunawardena, 2014; Al-Mamary, et al., 2016).

PC utilisation among knowledge workers in Saudi Arabia has been analysed using some constructs of MPCU (Al-Khaldi & Wallace, 1999). The study by Al-Khaldi & Wallace (1999) also borrowed from Triandis (1971) theory which proposes that behaviour is controlled by

attitudes, habits, social norms, and expected consequences of behaviour. The study used the constructs; social factors, affect, cognitive factors, facilitating conditions, perceived complexity, long-term consequences experience, perceived job fit, training and degree of PC access. The study established that personal characteristics, such as PC experience, individual attitudes, facilitating conditions, such as PC access and social factors determine PC utilization (Al-Khaldi & Wallace, 1999).

MPCU has been applied to predict Internet/World Wide Web (WWW) usage at work in a study conducted in China (Cheung, et al., 2000). The intention construct was dropped because the study intended to predict the actual usage behaviour and not the intention. Their study investigated the direct effects of affect, perceived consequences, and social factors on current usage behaviour (Cheung, et al., 2000). The study confirmed that social factors and facilitating conditions are the two most significant factors affecting Internet/WWW usage. Perceived near-term consequences and perceived complexity were also found to be significant (Cheung, et al., 2000).

In a comparison of the popular technology acceptance models job-fit is the only construct of MPCU that was found to be significant in both mandatory and voluntary settings over time (Venkatesh, et al., 2003). The social factors of the MPCU model were found to be significant only in mandatory settings.

Limitations of Model of PC Utilisation

The Model of PC utilisation provides a test of Triandis (1980) theory in a PC use environment. In their empirical test of the theory Thompson et. al., (1991), the test relied on the perceptions of respondents and was not backed by actual usage statistics to confirm or disconfirm the perceptions of the respondents. A study that applied the model dropped the intention construct because the construct does not predict the actual usage (Cheung, et al., 2000).

MPCU is very specific and limiting as it is generally designed to apply in PC utilisation setups and for the model to perform well in other setups, additional constructs need to be included. This study has also established the Model of PC utilisation ignores the cost factor which is important in the adoption of OSS products. OSS products provide a solution to the user that is supposed to lead to cost savings in adopting the OSS technology as opposed to the proprietary products. According to the Rogers (1995) Diffusion of Innovations theory (see section 3.1) lower priced innovations are likely to be adopted faster than higher priced ones.

3.7. Motivational Model (MM)

The model was developed as a result of a study that was conducted to establish and understand what motivates people to accept or reject computers in the workplace (Davis, et al., 1992). Their study intended to compare the influence of perceived usefulness and enjoyment on intentions to use computers in the workplace. From the literature they reviewed they established that there are two broad classes of motivation to perform an activity which are; extrinsic motivation and intrinsic motivation.

Davis et al., (1992), further established from literature that extrinsic motivation is the performance of a task because it is perceived to be helpful in accomplishing valued results that are different from the task itself such as increased job performance, remuneration or promotions (Davis, et al., 1992). They further defined intrinsic motivation as the "performance of an activity for no apparent reinforcement other than the process of performing the activity per se" (Davis, Bagozzi, & Warshaw, 1992. pg. 1112).

Davis et al., (1992), conducted a study at a Midwestern university in the U.S. regarding the use of word processing software in two public laboratories. In this study 200 MBA students participated by filling in a questionnaire where perceived usefulness was measured using four seven point likely/unlikely items. The majority of the participants had little or no experience with personal computers and word processing programs in general (Davis, et al., 1992). A second study was conducted by Davis et al., (1992), at an eastern university in the U.S. which involved forty MBA evening students who participated in a 2- hour laboratory session. In this study the participants had a range of experience from limited to extensive although they were not familiar with the two programs used in the study.

After conducting the study the results established that "people's intentions to use computers in the workplace are mainly influenced by their perceptions of how useful the computers are in improving their job performance" (Davis, Bagozzi, & Warshaw, 1992. pg 1124). The study further revealed that the degree of enjoyment employees experience in using computers is a secondary factor that influences the use of computers in the workplace.

Application of MM in information systems research

MM is regarded as a popular technology adoption model (Venkatesh, et al., 2003). Many studies have also integrated MM's popular constructs, extrinsic motivation and intrinsic motivation into other models such as TAM. This study found very limited literature on studies that solely employed MM as a model to predict adoption of Information systems.

A study that sought to establish the significance of extrinsic motivation and intrinsic motivation on Internet usage incorporated both perceived ease of use and perceived usefulness into their research model (Teo, et al., 1999). The study revealed that individuals use the Internet because they perceive that it is useful in helping them accomplish their duties and it is also easy to use. The study which was conducted in Singapore revealed that extrinsic motivation is usually stronger than intrinsic motivation (Teo, et al., 1999).

The construct intrinsic motivation of MM was integrated with TAM in a study aimed at understanding how users' perceptions form and change over time (Venkatesh, 2000). The study which was conducted in three different organisations established that intrinsic motivation (computer playfulness) contributed to the perceived ease of use of a new system.

A study conducted by Abduljalil & Zainuddin (2015) which sought to establish the role of intrinsic and extrinsic motivation towards adoption of accounting information systems in Libyan SMEs employed MM. This study incorporated IT innovativeness, IT knowledge and IT trust as additional constructs. The study established that intrinsic and extrinsic motivation contributes to the users' intention to adopt information systems (Abduljalil & Zainuddin, 2015).

Another study conducted in two different countries (China and Canada) investigating the role of intrinsic motivation in the adoption of eLearning technologies by learners applied the intrinsic motivation construct of MM and integrated it with TAM constructs (Saadé, et al., 2009). The study established that intrinsic motivation plays a limited role in influencing adoption of eLearning among the Canadian students while in China, the role played by intrinsic motivation is significant.

Extrinsic motivation and intrinsic motivation were integrated with TAM in a study that sought to identify the determinants of usage intentions in social network games (Chang & Chin, 2011). The study which was conducted in Taiwan established that both extrinsic motivation and intrinsic motivation contribute to the intention to use social networking games.

The studies reviewed above reveal that in many studies, MM has been used to complement TAM in understanding information systems users' behaviour. This is a demonstration that MM as a model has limited constructs and has to be integrated with other models such as TAM to make it useful in research. This study notes that the extrinsic motivation and intrinsic motivation constructs have been found to be useful determinants in prediction of intention to adopt a technology.

Limitations of motivational model

One of the limitations noted by Davis et al., (1992), is that the theory has limited constructs lowering the model's prediction power. They suggest that in the future there is a need to examine the role of additional constructs. They further point out that there is a need to establish how widely their findings generalise to other systems and user populations.

The author notes that the motivational model ignores a number of factors that are instrumental in the adoption of computers in the workplace. The motivational model only identifies perception of usefulness and enjoyment as the main factors contributing to adoption of computers in the workplace. The model ignores social influence, facilitating conditions (such as user training and user support) which are important computer technology adoption determinants as noted by Venkatesh et al., (2003).

The above highlighted weaknesses suggest that the MM is not a strong model for predicting adoption of OSS software in developing countries such as in Africa unless additional constructs such as social influence are added to make it more appropriate in an African set up.

3.8. Combined TAM and TBP

The research that led to the combination of TAM and TBP was grounded from the models from social psychology such as the TRA, and TBP (Taylor & Todd, 1995). The study employed TAM which according to them has developed as an authoritative and parsimonious way to characterise the antecedents of computer systems usage. They however noted that TAM had not been tested with actual measures of usage behaviour but had been applied to measure usage intention or self-reported measures of usage which in most cases are collected with the measurement of beliefs, attitudes and intention.

The study by Taylor & Todd (1995), compared TAM and TPB models as well as an integrated version of TAM and TPB. The study noted that TAM's measures of ease of use and usefulness were based on well developed, refined and validated measures (Davis, 1989). The study also noted that, TRA and TPB belief measures were not ideal because they are based on a salient belief elicitation measure which makes a scale idiosyncratic to a particular setting (Taylor & Todd, 1995).

Combined TAM and TPB model was developed in order to address the weaknesses of the two models. The resultant model recommended a set of stable, decomposed structures where attitudinal, normative and control beliefs were decomposed into multi-dimensional belief constructs (Taylor & Todd, 1995). According to them, the reason for decomposing these

constructs was to provide a stable set of belief constructs which can be applied across a variety of settings and help in pointing to specific factors that could influence adoption and usage. They finally identified attitude toward behaviour, subjective norm, perceived behavioural control and perceived usefulness as the core constructs of their model.

Taylor & Todd (1995), tested the three models (TAM, TPB, and Combined TAM and TPB) in a computing resource centre (CRC) setup where business school students use different computer applications.

According to Taylor & Todd (1995), the decomposed theory of planned behaviour (Combined TAM and TPB), was found to be better than TAM and TPB as it provides a more comprehensive understanding of usage behaviour and intention. They further argued that TAM is applicable in occasions where the only objective is to predict usage. They concluded that the combined TAM and TPB model is more useful to researchers and IT managers who have an interest in studying system implementation.

Application of TAM and TPB in information systems research

A study investigating the factors affecting the adoption of electronic banking that was conducted in Jordan combined both TAM and TPB (Al-Smadi, 2012). The study added five cultural dimensions and perceived risk into the constructs of TAM and TPB. The study revealed that perceived ease of use and perceived usefulness contributes positively to the customers' attitude towards electronic banking services (Al-Smadi, 2012). The study also noted that among the cultural dimensions (power distance, uncertainty avoidance, individualism vs. collectivism, masculinity vs. femininity, long term vs. short term orientation) uncertainty avoidance has a positive and significant impact on perceived ease of use and perceived usefulness (Al-Smadi, 2012).

Combined TAM and TPB as a model has been applied in investigating the factors contributing to Internet purchasing (Sentosa & Mat, 2012). The study sought to examine the relationships between perceived usefulness, attitude, perceived behaviour control, perceived ease of use and subjective norm toward intention and Internet purchasing behaviour. The combined TAM and TPB was found to be better in explaining the Internet purchasing behaviour than TAM and TPB individually (Sentosa & Mat, 2012).

Limitations of combined TAM and TPB

The combined TAM and TBP has attracted limited studies either validating it or otherwise. A literature search by the author established that at this time are no existing studies invalidating the

model. In the view of the desktop OSS adoption, the author disqualifies the combined TAM and TBP in prediction of use behaviour because the combined TAM and TBP does not include some important factors of adoption such as prior experience in using a similar technology and the social economic status of the individual. In the OSS adoption scenario, there is already a proprietary product which in this case is an alternative technology that is not only a competitor but provides an alternative at a price. Although prior experience can be seen as a facilitating condition in the combined TAM and TBP model, the author feels that it should be treated as a separate factor.

3.9. Unified theory of Acceptance and Use of Technology (UTAUT)

As discussed in Section 2.8.9., the UTAUT was developed with the aim of harmonising several models that have been used in the past to predict and explain technology adoption. The unified theory does this by integrating elements across eight models namely, Theory of Reasoned Action, Technology Acceptance Model, Motivation Model, Theory of Planned Behaviour, Combined TAM and TBC, Model of PC Utilisation, Diffusion of Innovations and Social Cognitive theory (Venkatesh, et al., 2003).

The model was developed by first assessing the similarities and differences across the eight common models (Venkatesh, et al., 2003). They later conducted a longitudinal validation and comparison of the eight models using data from individuals at four organisations where a new technology was being introduced in the workplace. A work place is regarded as a mandatory setting not a voluntary setting (Venkatesh, et al., 2012). The data collection was scheduled to take place in concurrence with a training program connected with introduction of the new technology. According to Venkatesh et al., (2003), a questionnaire which was already pretested was administered at three different points in time at post training, one month after implementation and three months after implementation. The questionnaire contained items measuring constructs from all the eight models using a seven point scale with one being the negative end of the scale and seven being the positive end of the scale.

The results revealed that the models “explained individual acceptance with variance in intention explained ranging from 17 per cent to 42 per cent” (Venkatesh et al., 2003 pg 439).

After conducting the empirical tests they concluded that seven constructs seemed to be significant direct determinants of either intention to use a technology or actual usage in one or more of the individual models under study. From the seven constructs they considered four as direct determinants of user acceptance and usage behaviour, namely, performance expectancy, effort

expectancy, social influence, and facilitating conditions. They further theorised that attitude towards using a technology, self-efficacy and anxiety are not direct determinants of intention.

Having identified the constructs of their proposed model as well as their moderators (Venkatesh et al., (2003) as shown in Section 2.8.9.) they empirically validated the model where all constructs apart from use were modelled using reflective indicators. Their results proved that UTAUT was a better predictor of usage intention than any of the eight original models as well as their extensions.

Application of UTAUT in information systems research

In the past UTAUT has played an important role in technology acceptance research and has provided a solid theoretical base to explain why users accept or reject a technology (Samaradiwakara & Gunawardena, 2014). UTAUT has been used in many countries such as the USA, China, Taiwan, Malaysia, Australia, India, Belgum, and Tanzania although the majority of the studies that have employed UTAUT have been conducted in the USA (Williams, et al., 2015). Although the theory has been cited numerous times, the actual studies that have utilised the theory in research are significantly less (Dwivedi, et al., 2011). UTAUT has been tested and improved by researchers utilizing existing models in conjunction with UTAUT, and by introducing constructs and exploring different relationships between its constituent constructs in various contexts (Williams, et al., 2015).

UTAUT has been used in the US to study the adoption of established and emerging information technology in higher education classrooms (Lewis, et al., 2013). The study established that, the most essential antecedents of intention to use IT "are performance expectancy, effort expectancy, social influence, and habit with more complex effects when gender is added as an interaction term" (Lewis, et al., 2013, pg. 22). The study recommended a cross cultural study of technology adoption technologies using UTAUT in order to understand the implications of cultural variations to technology adoption.

A modified UTAUT model has been used in a study that investigated the factors that influence academics to use m-banking and in particular SMS-based mobile banking in Nigeria (Olasina, 2015). The modified model used the constructs; social influence, perceived usefulness, perceived ease of use, behavioural intention, user expectation, ICT skills, perceived value, type of bank, gender and customer service (Olasina, 2015). All the factors were found to influence the use of m-banking in Nigeria.

Another study conducted in Kenya investigating the factors influencing use of mobile phones as a tool in ecommerce employed a modified UTAUT model (Wamuyu & Maharaj, 2011). The study established that the factors usage and appropriateness directly and substantially affected organizational performance while user acceptance and appropriateness were significant determinants of usage (Wamuyu & Maharaj, 2011). In the same study, only performance risks was found to be insignificant from the hypothesised barriers of adoption, security risks, affordability and performance risks.

Apart from the few studies cited above, UTAUT has been applied in various areas of research such as the Internet, Hospital Information Systems, web sites, mobile technology and tax payment systems among others (Williams, et al., 2015). A study that reviewed 43 research reports, noted that 22 of the studies reviewed had introduced external constructs that are not in the original UTAUT model (Dwivedi, et al., 2011). Some of the common constructs Dwivedi, et al., (2011) noted were introduced in the studies are; anxiety, attitude, self-efficacy, trust, PEOU, PU, perceived credibility and perceived risk.

Limitations of UTAUT

In relation to the prediction of OSS adoption UTAUT misses one important factor which is cost which is an important consideration when predicting adoption in voluntary use settings (Lewis, et al., 2013). This omission was noted by some of its own authors Venkatesh et al., (2012) after noting that the amount of money to be spent in relation to the perceived benefits is an important factor to be considered while adopting a technology especially in voluntary settings. Cost is a major determinant in the adoption of a technology and can also be seen as a facilitating condition or a constraining condition (Brown & Venkatesh, 2005).

This study also notes that the UTAUT model does not put much weight on usability of the product under study. In studies pertaining to a software product, the Human Computer Interface (HCI) design of the product is a very important aspect which determines the usability of the software product under study.

Another limitation of UTAUT which has been noted and reported in many studies is its applicability across country, culture, organization, department, agency, person, or age group (Williams, et al., 2015).

This study concludes that UTAUT is inadequate as a predictor for explaining adoption of OSS products because it lacks constructs dealing with cost and the lack of emphasis on usability.

3.10. Extended Unified theory of Acceptance and Use of Technology (EUTAUT)

After UTAUT was developed it gained popularity and was used in many studies in some cases wholly and in others partially (Venkatesh, et al., 2012). The original model had been extended in a number of studies which informed Venkatesh, et al., (2012) extension of the original model. This was done in order to improve the original model and overcome its limitations as well as to identify the salient factors that would apply to a consumer technology use context (Venkatesh, Thong, & Xu, 2012). The original UTAUT was extended and applied in the areas of collaborative technology and health information systems. The UTAUT model was also applied in new populations and even new cultural settings such as in China and India.

The original UTAUT was extended by identifying additional key constructs and relationships with the aim of tailoring it to a consumer use context as shown in Figure 2.7-7 (Venkatesh, Thong, & Xu, 2012). The new constructs supported by other earlier empirical studies are hedonic motivation, price, and habit. They dropped voluntariness from the original UTAUT as a moderator and added a link between facilitating conditions and behavioural intention.

Hedonic motivation is defined as the pleasure or fun resulting from using a technology (Brown & Venkatesh, 2005). The hedonic motivation construct was supported by empirical studies carried out by Brown & Venkatesh (2005), among others which revealed that hedonic motivation was an important determinant of technology acceptance and use. They further hypothesised that "the cost and pricing structure may have a significant impact on consumers' technology use" (Venkatesh, Thong, & Xu, 2012 pg. 161).

According to Venkatesh et al., (2012), experience as conceptualised in prior research "reflects an opportunity to use a target technology and is typically operationalized as the passage of time from the initial use of a technology by an individual" (Venkatesh, Thong, & Xu, 2012 pg. 161).

The empirical study undertaken to validate the proposed extended model was carried out in Hong Kong among users of mobile Internet technology (Venkatesh et al., 2012). In this scenario the decision to use a mobile device to exchange messages, pictures and emails etc. in a consumer context is a voluntary decision. The measurement was done using a "seven-point Likert scale with the anchors being strongly disagree and strongly agree" (Venkatesh et al., 2012 pg. 166). The data collection was done through a two stage online survey with 4,127 and 2,220 valid respondents respectively.

Data analysis was done using partial least squares to test the model as it was found appropriate because of the many interaction terms (Venkatesh et al., 2012). Their results revealed that age

and gender moderated the facilitating conditions effect on behavioural intention. The study also revealed that "age, gender and experience will moderate the effect of hedonic motivation on behavioural intention" (Venkatesh, et al., 2012 pg. 171) as well as price value on behavioural intention. The study further established that the effects of behavioural intention will deteriorate with increasing experience.

Application of EUTAUT in information systems research

Many studies have been conducted after the development of the model with the aim of predicting voluntary technology adoption in a variety of contexts as discussed in section 2.12.

A study conducted by Raman and Don (2014) that aimed at establishing the relationships between the constructs that influence pre-service teachers' adoption of Moodle (a FOSS) in their learning process was conducted in Malaysia. The study used EUTAUT model to examine the factors that contribute to the adoption of Moodle. The findings were consistent with those of Venkatesh et al., (2012) EUTAUT apart from the habit construct which was not significant because in this context the respondents were using Moodle for academic purposes only (Raman & Don, 2013). Raman and Don (2014) concluded that the model was less suitable in educational settings and recommended more variables such as security and time of access to be included in order to make the model more appropriate for the context.

EUTAUT has been tested in Turkey in the context of educational technology adoption. The study recommended the incorporation of cultural dimensions as a construct in order to make it more predictive across different cultures (Göğüş, et al., 2012). The study further noted that including computer literacy as a variable of the EUTAUT model is likely to become the strongest independent variable. Göğüş et al., (2012) note that although EUTAUT has included facilitating conditions which encompass computer anxiety, EUTAUT can be more explicative if computer anxiety can be included as a construct on its own.

Another study that aimed at validating EUTAUT was conducted in Spain that aimed at establishing the determinants of consumer purchase of website airline tickets (Escobar-Rodríguez & Carvajal-Trujillo, 2013). The study established that the main determinants of online purchase intention are, in order of significance, habit, price saving, performance expectancy, and facilitating conditions (Escobar-Rodríguez & Carvajal-Trujillo, 2013). The study further noted that there was no "significant impact of effort expectancy on the online purchase intention, social influence from referents; and hedonic motivation to use the website" (Escobar-Rodríguez & Carvajal-Trujillo, 2013 pp 58).

EUTAUT has also been tested in a study that was conducted in a Spanish public university which aimed at identifying the factors that contribute to the adoption of social media technologies in learning (Escobar-Rodríguez, et al., 2014). The study established that, facilitating conditions, hedonic motivation, effort expectancy, social influence, performance expectancy and habit were found to be useful in predicting students' intention to adopt social media technologies in learning.

In the context of mobile money payment adoption in the UK, EUTAUT was found to be lacking perceived risk and trust constructs that were considered important in this context (Slade, et al., 2013). The addition of the two constructs in the study resulted in EUTAUT becoming more appropriate in this scenario. A similar study conducted in Saudi Arabia had consistent findings with the UK study because the two constructs (trust and risk) were incorporated into EUTAUT in order to make it more predictive in the mobile technologies consumer adoption scenario (Baabdullah, et al., 2014).

A study conducted in Tanzania that employed EUTAUT revealed that apart from performance expectancy all other constructs in EUTAUT were significant in determining the adoption of multimedia enhanced content in secondary schools (Mtebe, et al., 2016). Their study noted that EUTAUT needed to be improved by adding constructs such as information quality, attitude and awareness in order to make the model more predictive in this situation.

Limitations of EUTAUT

Many studies have been conducted to test or validate EUTAUT despite the fact that it is a relatively recent extension. The model also currently seems to be one of the latest technology acceptance models in the information systems domain which is likely to attract attention from researchers just like its precursor UTAUT. The author however notes that studies that have tested the model have had to incorporate extra constructs to make the model more predictive. For example the study that used the model to predict mobile money payments added trust and risk constructs. It is not clear how the model would perform if applied in Africa to predict the adoption of free desktop OSS.

This study established that the EUTAUT model bundles some important constructs into one construct making it impossible to measure the impact of the individual factors influencing the uptake of free OSS adoption in Africa. Facilitating conditions includes too many items in one and in this case user training, usability and compatibility with other competing applications can be termed as facilitating conditions. The author opines that it is important to measure the impact

of these individual factors/constructs in the adoption of free OSS products and even determine their moderating variables.

3.11. Chapter summary

The chapter reviews ten (10) popular technology acceptance models namely the TRA, TAM, MM, TPB, Combined TAM and TBP, MPCU, DOI, SCT, UTAUT and EUTAUT which were introduced in the previous chapter (chapter 2). The chapter discusses how these models were developed as well as their main constructs. The author finally discusses their weaknesses in the context of predicting OSS adoption in developing countries such as in Africa.

All the models discussed above were found to be lacking in some aspects that are useful in predicting OSS adoption in developing countries such as in Africa. The review has established that majority of the models were developed and tested in America. This study notes that a subsequent model includes most of which is of value from the earlier but adds new constructs or "repackages" them in order to achieve parsimony.

Developing countries have their own dynamics compared to developed countries such as the USA and China where the majority of the models were developed. The culture in developing countries is quite different from that of developed countries. The social economic status of individuals in developed countries is quite different from that of developing counties. The generalizability of the models as proved by some reviewed studies is highly questionable due to the cross-cultural and psychometric differences as discussed in section 2.12 (Straub, et al., 1997; Igbaria, 1993; Anandarajan, et al., 2002; Saadé, et al., 2009).

The usability is one of the important features that determine the adoption of free desktop OSS in a voluntary setting. Some models such as SCT and UTAUT do not have this important construct. Many models discussed do not take into account the role played by important factors such as social influence, cost, user training, and social economic status which are critical in predicting the adoption of free desktop OSS. This study however notes that EUTAUT has the majority of constructs that are needed for the prediction of free OSS adoption in a developing nation. The constructs present in EUTAUT that are likely to be useful in predicting free OSS adoptions are; effort expectancy, social influence and facilitating conditions. This study used a model with many constructs from EUTAUT because the model (EUTAUT) was developed specifically for predicting voluntary technology adoption like in the case of Free Desktop OSS among university students. In addition EUTAUT has majority of the constructs that are required for predicting adoption of Free Desktop OSS.

The Table 3.11-1summarises the weaknesses of the different models that were identified after the review.

Table 3.11-1: A summary of the weaknesses of the different models

Model	Limitations
TRA	1. The theory was developed to deal with behaviours (e.g., buying a car) and not outcomes or events that result from behaviours 2. The model deals with only those behaviours that are under a person's volitional control 3. The model is not suitable to study goals for which attainment involves a degree of uncertainty and in cases where a person is presented with several choices.
TAM	1. Perceived ease of use is not a good indicator when predicting actual technology use 2. Little is known about perceived ease of use and its determinants 3. Although TAM is predictive, it does not provide sufficient information regarding system design attributes that could improve user acceptance for new systems 4. Social influence factor is not catered for by the TAM model
MM	1. The theory has limited constructs 2. The model ignores social influence, facilitating conditions (such as user training and user support) which are important computer technology adoption determinants
TPB	1. TPB is difficult to apply across different user contexts because it requires a pilot study to be carried out to identify relevant outcomes, referent groups, and control variables in every context in which it is used. 2. Some TPB items require an explicit behavioural alternative to make them as specific as possible.
Combined TAM and TBP	1. The model does not include some important factors of adoption such as prior experience in using a similar technology and the social economic status of the individual

MPCU	1. The model ignores the cost factor which is important in the adoption of OSS products. 2. Very specific and limiting. Generally designed to apply in PC utilisation setups.
DOI	1. Experience in using a technology has been ignored as a factor that contributes to the adoption of a technology in the model 2. DOI theory was developed purposely for new technological innovations
SCT	1. The model does not have constructs relating to the attributes of the IS product being investigated such as usability but rather concentrates on social influence and other social aspects that influence an individual's behaviour 2. The model was not originally developed to study technology adoption
UTAUT	1. The cost factor as a determinant in the adoption of a technology has been ignored in the model 2. The model does not put much weight on usability of the product which in relation to a software product is very much dependent on the Human computer Interface (HCI) design of the product.
EUTAUT	1. The model bundles some important constructs into one construct making it impossible to measure the impact of the individual factors influencing the uptake of OSS adoption in Africa.

The points above indicate that there is no single technology adoption model that is adequate to predict OSS adoption in Africa. A technology adoption model that is suitable to predict free OSS adoption in the African setup needs to be developed.

The next chapter presents an OSS adoption model for developing countries as proposed by the author in an effort to bridge the existing gap identified by the literature review.

Chapter 4

Proposed new adoption model for the African context

4.0. Introduction

The previous chapter concluded that there is no single technology adoption model that is adequate to predict OSS adoption in Africa. The study recommended the development of a suitable model that is capable of predicting OSS adoption in emerging economies and low resource environments in Africa. This chapter presents a proposal and a discussion of a new model that will be tested statistically in order to assess its suitability in the African scenario. The chapter presents the OSS adoption model in an African setup which has OSS adoption as the dependent variable and user training, OSS usability, OSS compatibility with other applications, Social influence, Prior experience and Social economic status as the independent variables.

4.1. Conceptual model

The shows the conceptual model on which this research is based

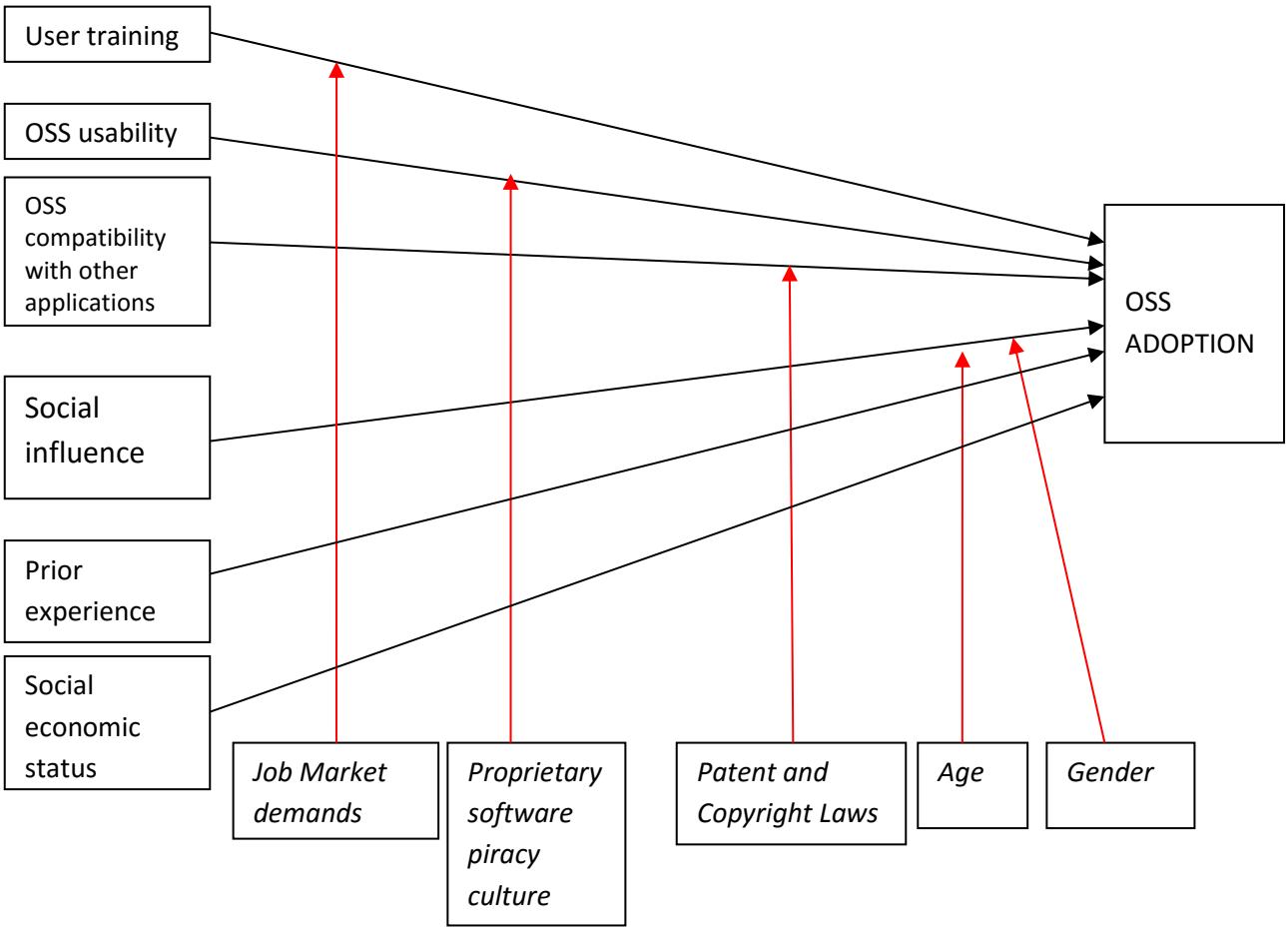

Figure 4.1-1: OSS in developing countries conceptual model

Source: researcher

The variables shown in italics are the moderating variables which are: Job Market demands, Proprietary software piracy culture, Patent and Copyright Laws, Age and Gender.

And thus the hypotheses:

Hypothesis 1 (H1): user training has a positive and direct effect on OSS Adoption

Hypothesis 2 (H2): OSS usability has a positive and direct effect on OSS Adoption

Hypothesis 3 (H3): OSS compatibility with other applications has a positive and direct effect on OSS Adoption

Hypothesis 4 (H4): social influence has a positive and direct effect on OSS Adoption

Hypothesis 5 (H5): prior experience has a positive and direct effect on OSS Adoption

Hypothesis 6 (H6): social economic status has a positive and direct effect on OSS Adoption

Hypothesis 7 (H7): job market demands has a moderating effect on the relationship between user training and OSS Adoption

Hypothesis 8 (H8): proprietary software piracy culture has a moderating effect on the relationship between OSS usability and OSS Adoption

Hypothesis 9 (H9): patent and copyright laws have a moderating effect on the relationship between OSS compatibility with other applications and OSS Adoption

Hypothesis 11 (H11): Age has a moderating effect on the relationship between social influence and OSS Adoption

Hypothesis 12 (H12): Gender has a moderating effect on the relationship between social influence and OSS Adoption

4.2. Justification for the hypothesis

Hypothesis 1 (H1): user training has a positive and direct effect on OSS Adoption

The author hypothesises that if users are trained on OSS use, they will be motivated to use OSS because they are less likely to have challenges while using OSS. In this case training will encourage adoption of Desktop OSS by users.

As discussed in Section 2.8 user training plays a very important role in the adoption of computer applications and technology (Igbaria, 1993; Venkatesh & Morris, 2000; Venkatesh, 2000). Studies have proved that user training programs on computer skills have a strong influence on the acceptance and sustained usage of new systems (Venkatesh, 2000). This hypothesis is also supported by TPB which has a construct called perceived behavioural control which is discussed in section 2.7.1.3 (Ajzen, 1991). User training enhances behavioural control because it increases an individual's confidence in their ability to use a computer application. Similarly SCT has the self-efficacy construct which refers to people's judgements about their capability to perform a task. Self-efficacy can be enhanced through user training because the users will develop a positive attitude regarding their capability to use the free Desktop OSS. Studies have proved that computer training enhances computer self-efficacy and consecutively their performance (Webster & Martocchio, 1992; Igbaria, et al., 1997).

Hypothesis 2 (H2): OSS usability has a positive and direct effect on OSS Adoption

The author hypothesises that if OSS is usable, many users will enjoy using the software as they can easily perform the tasks. When users enjoy performing tasks in particular software, they are likely to adopt that software. The construct is supported by many models although in different

terms. In TAM it is equivalent to perceived ease of use, in MPCU and DoI, it can be equated to complexity, in UTAUT and E-UTAUT it is effort expectancy. Effort expectancy in UTAUT and EU-UTAUT means the level of ease associated with the use of an application (Venkatesh, et al., 2003). Studies on discretionary use of information systems have proved that effort expectancy is a major determinant of the intention to use a system (Venkatesh, et al., 2012).

Hypothesis 3 (H3): OSS compatibility with other applications has a positive and direct effect on OSS Adoption

This hypothesis is based on the fact that many OSS products are not compatible with proprietary products. The human computer interaction features such as icons for example used by PS are different from the ones used by OSS software. In this case a user who is used to PS may not find it easy to use OSS because the PS knowledge is not transferable to the equivalent OSS product. Another aspect of compatibility is in document portability from OSS application software to an equivalent PS product. If users for example can open documents prepared in OSS using a PS they are more likely to use the OSS because they will not have challenges if they want to open the document in a computer that doesn't have the OSS product the document was prepared in. Compatibility of OSS with PS in terms of the output from OSS being integrated directly, with no human intervention, with PS software is an important aspect that could contribute to adoption.

The concept of compatibility is deemed important in the adoption of an innovation and it is one important aspect that Rogers (1983) considered to be a determinant of technology adoption. In DoI, an innovation is adopted faster if it is consistent with past ideas and past experiences (Rogers, 1983). A study investigating adoption of Internet in Uganda established that compatibility of the Internet with past experiences and ideas is a significant factor contributing to Internet adoption in rural urban areas (Kasse, et al., 2015).

Hypothesis 4 (H4): social influence has a positive and direct effect on OSS Adoption

Empirical studies have demonstrated that social influence is a determinant of technology adoption (Venkatesh et al., 2012). This study hypothesises that peers can influence the adoption of OSS products among university students. University students are subject to influence from peers, lecturers etc.

Social influence as a construct appears in several technology adoption models as discussed in section 2.11. The construct is equivalent to social norms in TRA, social factors in MPCU and image in DoI (Almatari, et al., 2012). Although the construct has different names in the models (TRA, MPCU, UTAUT) it bears the same meaning as the constructs contain the implicit or

explicit belief that the behaviour of a consumer is influenced by the way they believe others will view them as a result of using a technology (Venkatesh, et al., 2003). There is a wide body of literature indicating that social influence is a significant factor that influences behaviour in a number of domains (Venkatesh & Morris, 2000).

Hypothesis 5 (H5): prior experience has a positive and direct effect on OSS Adoption

In this instance the author hypothesises that if a computer user has used an OSS product before either at a school that he/she attended earlier, in a cybercafé or another place, that user is more likely to adopt that OSS product.

Studies have proved that users with prior experience of a technology are more likely to use it because experience makes knowledge more accessible in memory (Fazio & Zanna, 1978). Knowledge gained from past behaviour helps to shape intention to use a technology implying that IT usage may be more effectively modelled for experienced users (Ajzen, 1991). This hypothesis is also supported by TPB which has a construct called perceived behavioural control which is discussed in section 2.7.1.3 (Ajzen, 1991). Prior experience develops behavioural control because it increases an individual's confidence in their ability to use a computer application.

Hypothesis 6 (H6): social economic status has a positive and direct effect on OSS Adoption

The author hypothesises that users that have limited financial resources are more likely to adopt OSS. This is because OSS is obtained for free or at a very minimal downloading cost. Computer users with unlimited financial resources are less likely to adopt OSS because they can easily afford PS. This study expects that majority of the students in developing countries come from poor backgrounds and therefore are not able to afford PS because of its exorbitant cost.

Software price value has been proved to be a major determinant of adoption of technologies in voluntary setup because the consumer usually bears the monetary cost of use (Venkatesh, et al., 2012). Although the construct is not present in other technology adoption models, Venkatesh, et al., (2012) proved that the construct played a significant role in a consumer technology use setup.

Other studies that have used E-UTAUT in a voluntary setup have proved that price value is a determinant of behavioural intention (Slade, et al., 2013; Baabdullah, et al., 2014; Mtebe, et al., 2016). Since FOSS has a very minimal price value, it is expected that students who have a low social economic status will be more likely to adopt the software.

Hypothesis 7 (H7): job market demands has a moderating effect on the relationship between user training and OSS Adoption.

The author hypothesises that the job market demands dictate the kind of software the students want to be conversant with. In the case where many employers are seeking graduates with OSS skills, students will seek to gain adequate skills in OSS and consequently the training institutions will be compelled to offer training in the OSS products.

Hypothesis 8 (H8): proprietary software piracy culture has a moderating effect on the relationship between OSS usability and OSS Adoption

The author hypothesises that piracy enables users to obtain a PS product at a little or no fee. In this case, if university students get PS freely they will get used to it such that even if OSS usability is improved, they may not get a chance to try it out. Piracy denies the users a chance to have an experience of OSS which affects its adoption.

Software piracy is a common phenomenon that makes PS easily available to personal computer (PC) users, either at a small cost or none at all. A recent study conducted by the Business Software Alliance (2010), shows that PS piracy is rampant and is on the increase in emerging economies such as Kenya. The inclusion of cultural dimensions in technology adoption models has been suggested in past studies in order to make them more predictive across cultures (Göğüş, et al., 2012; Anandarajan, et al., 2002; Straub, 2012). The fact that software is a common culture in developing economies, inclusion of the construct is likely to enhance the prediction power of the proposed model.

Hypothesis 9 (H9): patent and copyright laws have a moderating effect on the relationship between OSS compatibility with other applications and OSS Adoption

Icons and other interface objects used by PS are patented and therefore cannot be used by OSS software developers. The author hypothesises that this aspect makes it difficult for users to transfer the knowledge they have in PS to OSS products.

Hypothesis 11 (H11): Age has a moderating effect on the relationship between social influence and OSS Adoption.

The age is a factor that determines the level of social influence according to this hypothesis. Younger students or users are more likely to be influenced by their peers while making OSS adoption decisions. In UTAUT, age was proved to have a moderating effect on social influence (Venkatesh, et al., 2003).

Hypothesis 12 (H12): Gender has a moderating effect on the relationship between social influence and OSS Adoption

The gender of the student or user determines the level of social influence while making OSS adoption decisions according to this hypothesis. In UTAUT, gender was proved to have a moderating effect on social influence (Venkatesh, et al., 2003).

Conclusion

This chapter clearly presents a proposed model for the African developing countries scenario which can be referred to as the OSS Adoption model in developing countries. The chapter further articulates the dependent and independent variables. The dependent variable is OSS adoption while the independent variables are; user training, OSS usability, OSS compatibility with other applications, social influence, prior experience, and social economic status. The moderating variables are Job Market demands, Proprietary software piracy culture, Patent and Copyright Laws, Age and Gender. The author's hypothesis that will guide the development of the model is presented and explained.

The next chapter explains in detail the methodology that was used in testing the hypothesis and validating the proposed model.

Chapter 5

Research design and methodology

5.0. Introduction

Chapter 3 concluded that the existing technology adoption models are not suitable in predicting OSS adoption in developing countries such as those in Africa. In the previous chapter (Chapter 4), a model was presented which hypothesised the different factors that contribute to the adoption of OSS. A set of moderating variables was also hypothesised.

This chapter discusses the research methods used to test and validate the model hypothesised. The chapter also explains the target population as well as the sampling methods used in the study. The data collection methods used which include questionnaires and interviews are discussed. The reasons for choosing those particular methods are also discussed.

5.1. Research process

According to Kothari (2004), the process of conducting research comprises a series of steps that are necessary to effectively conduct research and the desired sequencing of these steps. The steps are shown in the diagram below;

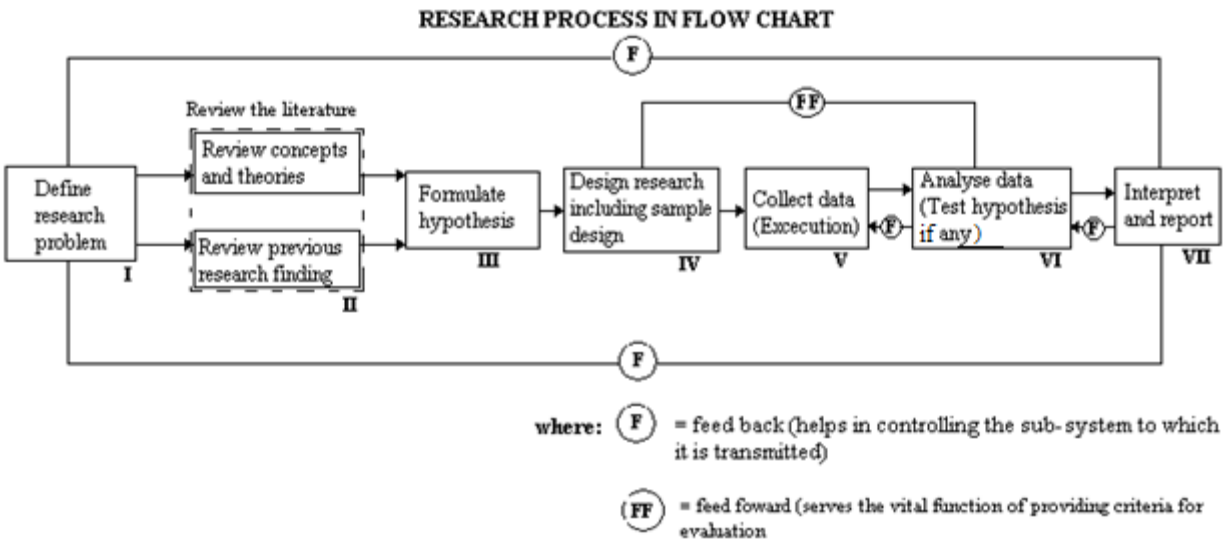

Figure 5.1-1: Research process

Source: Kothari (2004)

The quantitative research process generally comprises of the following steps (Kothari, 2004);

1. Formulating the research problem
2. Extensive literature survey

3. Hypothesis development
4. Preparation of research design
5. Determination of sample design
6. Data collection
7. Execution of the project
8. Data Analysis
9. Testing of hypothesis
10. Generalisations and interpretations
11. Presentation of results and reporting

1. Formulating the research problem: Kothari (2004) categorises research problems into two. The first category consists of problems that relate to states of nature while the second category deals with those that relate to relationships between variables. Before research can be conducted, the researcher must identify the problem that he wants to study by identifying the general area of interest or subject matter that he wishes to study (Kothari 2004). Formulating the general topic in a specific research problem is the first deliverable in a scientific study (Kothari, 2004). *In this thesis, the research problem is formulated in section 1.0.*

2. Extensive literature survey: After the problem has been formulated a deep literature search connected with the problem is conducted (Kothari 2004). This entails "locating, reading, and evaluating reports of previous studies, observations and opinions related to the planned study" (Mugenda and Mugenda 2003 pg. 14). This "leads to appreciating and understanding the research that has already" been conducted in the area of interest (Mugenda and Mugenda 2003 pg. 14). *A thorough literature review has been done for this thesis in chapter 2.*

3. Hypothesis development: After the literature review has been conducted the researcher is able to state clearly the working hypothesis or hypotheses (Kothari 2004). A hypothesis is a "testable proposition about the relationship between two or more events or concepts" (Saunders et al., pg. 593). A hypothesis provides a focal point for a study and affects the manner in which tests must be conducted in the analysis of data (Kothari 2004).

   A hypothesis can be developed by:

   a) Discussing with knowledgeable people in the area of study
   b) If data and records are available concerning the problem being studied, the data can be analysed in order to depict trends and get clues of possible relationships

c) Review of related studies
d) Personal investigation involving original field interviews

In this thesis the hypotheses were developed by reviewing related studies. The hypothesis is stated and discussed in chapter 4.

4. Preparing the research design: After the research problem has been formulated, the researcher needs to prepare a research design (Kothari 2004). In the design a conceptual structure is stated which enables the researcher to conduct the study in an efficient manner. Kothari (2004) groups research purposes into four, which are; (i) Exploration (ii) Description (iii) Diagnosis, and (iv) Experimentation. Kothari (2004) further explains that there are several research designs, such as experimental and non-experimental hypothesis testing. "Experimental designs can be either informal designs (such as before-and -after without control, after-only with control, before-and-after with control) or formal designs (such as completely randomised design, randomised block design, Latin square design, simple and complex factorial designs)" from which a researcher can choose (Kothari 2004 pg.14).

   In this study both descriptive and explanatory research designs were employed in answering the research questions.

5. Determining sample design: All items under consideration in a study constitute a population and when all the items are enumerated it is referred to as a census inquiry (Kothari 2004). Kothari (2004) explains that, when a census inquiry is conducted in a study, it is presumed that the highest level of accuracy is achieved. It is not always possible to conduct a census due to the expenses involved and instead a few items are selected from the population to form a sample. A sample design needs to be determined in order to establish how to select a sample (Kothari 2004). According to him a sample design is a definite plan which is determined before any data are collected for obtaining a sample from a given population. Kothari (2004) classifies sampling into two categories namely; probability sampling and non-probability sampling. Probability sampling is defined as a technique "where the chance or probability of each case being selected from the population is known and is not zero" (Saunders 2009 pg. 598). Non-probability sampling on the other hand is a technique "in which the chance or probability of each case being selected is not known" (Saunders 2009 pg. 596). "Probability samples are based on simple random sampling, systematic sampling, stratified sampling and cluster/area sampling whereas non-probability samples are those based on convenience

sampling, judgement sampling and quota sampling techniques" (Kothari 2004 pg. 15). According to Kothari (2004) the following are common sample designs: Deliberate sampling, simple random sampling, systematic sampling, stratified sampling, Quota sampling, cluster sampling and area sampling, multi-stage sampling and sequential sampling.

In this thesis the sampling procedures are detailed in sections 5.8, 5.9 and 5.10.

6. Data collection: Data collection is done due to lack of enough data at hand while solving a real life problem (Kothari 2004). Primary data can be collected either through experiment or through survey in one of the following ways; Observation, personal interview, telephone interview, mailing questionnaires, or through schedules where trained enumerators collect data using pre-set questions (Kothari, 2004).

   In this thesis the data collection procedures are detailed in section 5.11.

7. Execution of the project: This involves performing the actual project work such as making arrangements for selection and training interviewers and conducting the interviews and issuing questionnaires (Kothari 2004).

   Details of how the project was executed are explained in section 5.11.

8. Data Analysis: Data analysis involves analysing the data that has been collected by conducting a number of closely related "operations such as establishment of categories, the application of these categories to raw data through coding, tabulation and then drawing statistical inferences" (Kothari 2004 pg.18). Once the data has been tabulated, it can be analysed by computing various percentages, coefficients etc. by use of various statistical formulae (Kothari, 2004).

   In this thesis the data analysis results of the interviews and questionnaire are presented in chapter 6.

9. Hypothesis testing: once the data has been analysed, it is possible to test the hypothesis formulated earlier in an effort to establish whether the facts support the hypothesis or otherwise (Kothari 2004). Several statistical tests such as Chi square tests, t-test, f-test, Partial Least Squares can be performed in order to either reject or accept the hypothesis.

   The procedures that were followed in testing the hypotheses together with the results are presented in sections 6.2.1, 6.2.2.

10. Generalisations and interpretation: In the event a hypothesis has been tested and upheld severally a researcher can possibly build a theory which is called generalisation (Kothari 2004). Kothari (2000) explains that being able to arrive at certain generalisations is the

real value of research. If a researcher did not have a hypothesis, the findings can be explained based on a theory (Kothari, 2004).

In this thesis, the generalisation and interpretation of results is done in chapter 7.

11. Presentation of results and reporting: once the research findings have been obtained, the researcher has to prepare the report of what he has done (Kothari 2004).

This study followed all the above research process steps. The results of each step and the final output of this study are detailed in this thesis.

5.2. Research paradigm

A research paradigm or worldview is broadly conceived research believes which guide the research approaches that will be employed while conducting a study (Creswell, 2009). Generally there are four different paradigms which are; post-positivism, constructivism, advocacy/participatory, and pragmatism (Creswell, 2009). The paradigms/worldviews are discussed below.

Post-positivism worldview

In the post-positivism paradigm, studies are centred on the causes that determine or influence outcomes (Creswell, 2009). The ideas are reduced into variables that consist of hypothesis that determine the effects and outcomes (Creswell, 2009). The post-positivism paradigm is also referred to as the scientific method, positivist and empirical science because the assumptions represent the traditional form of research (Creswell, 2009). The scientific form of research mainly employs quantitative research rather than the qualitative research approach (Creswell, 2009).

In the scientific method of research, the researcher begins with a theory, collects data that either supports or negates the theory and then makes needed adjustments before other tests are made (Creswell, 2009).

The Social constructivist worldview

Social constructivists "hold assumptions that individuals seek understanding of the world in which they live and work" (Creswell 2009, p. 8). In this worldview individuals develop subjective meanings focussed toward certain objects or things based on their experiences (Creswell, 2009). These meanings are diverse and many, leading the researcher to identify the complexity of opinions rather than reducing meanings into a few categories or ideas with the aim of relying on the participants view as much as possible (Creswell, 2009).

In the social constructivist world view, researchers do not start with a theory but instead the pattern of meaning or theory is generated in the course of research (Creswell, 2009).

The advocacy and participatory worldview

The advocacy/participatory worldview "holds that a research enquiry needs to be to be intertwined with politics and political agenda" (Creswell 2009, p. 8). The advocacy/participatory worldview concentrate on the needs of individuals and groups in the society that may be disenfranchised or subjugated (Creswell, 2009). Therefore the study contains an action plan for reform that is meant to transform the lives of participants in which the individuals live or work and the life of the researcher (Creswell, 2009).

The pragmatic worldview

The pragmatic worldview focuses on "actions, situations and consequences rather than antecedent conditions" (Creswell 2009, p. 9). The focus is on investigating the best solutions to problems instead of focusing on methods (Creswell, 2009). Pragmatic studies employ all approaches available to understand the problem and therefore providing a philosophical basis for research (Creswell, 2009).

This thesis employed the post-positivist world view because it aimed at proving a set of hypothesis true or false based on the data collected in the study. The thesis was also centred on the causes that determine or influence the adoption of free desktop OSS. The main research approach used was quantitative research in order to empirically test the hypothesis.

5.3. Research approach

There are three common research approaches namely; Quantitative approach, Qualitative approach and the mixed method.

Quantitative approach

The quantitative approach is a data collection approach that seeks to explain phenomena by collecting data of a numerical nature that are analysed using mathematically based methods and techniques (Aliaga & Gunderson, 2006). The measures used in this approach produce discrete numerical or quantifiable data (Mugenda & Mugenda, 1999). The approach is commonly used for data collection techniques such as questionnaires that generate or use numerical data (Saunders, et al., 2009). When researchers want to test objective theories by examining the relationship among variables, the quantitative approach is a good means (Creswell, 2009).

According to him, the variables in turn can be measured, normally on instruments, so that numbered data can be analysed using statistical processes.

Qualitative approach

A quantitative methodology is applied where the data collected contains some form of magnitude, usually expressed in numbers while a qualitative methodology is used where data cannot be accurately measured and counted, and are generally expressed in words rather than numbers (Walliman, 2011). This approach includes designs, techniques and measures that do not produce discrete numerical data (Mugenda & Mugenda, 1999). A qualitative approach is useful in exploring and understanding individuals' or groups' social or human problem (Creswell, 2009). Data analysis in this approach is done inductively by building from specifics to general themes, and the researcher making interpretations of the significance of the data (Creswell, 2009).

Mixed methods approach

This method of research combines both qualitative and quantitative approaches from data collection to analysis of that data (Creswell, 2009). Both methods are used in tandem in order to take advantage of the strength of both methods in a study. In this study both quantitative and qualitative approaches were employed in order to take advantage of combining both methods (Creswell, 2009). Some known advantages of employing both approaches (Mugenda & Mugenda, 1999) are;

1. In a study that has several objectives, some objectives are better assessed using qualitative methods while others are better assessed using quantitative methods
2. Both methods supplement each other because quantitative approaches provide hard data needed to meet the required objectives and to test the hypothesis while qualitative approaches produce in-depth explanations of a phenomenon
3. Qualitative and quantitative approaches have their own bias, using both types helps avoid such bias

It is for the above reasons that this study employed a mixed approach. The mixed methods approach was implemented in the literature survey, data collection and presentation of results stages of this study.

5.4. Research design

Descriptive design

Descriptive research aims at describing the state of affairs as it exists presently. In this kind of study the researcher does not control any variables but only reports on what is happening (Kothari, 2004). Descriptive research employs surveys, case study and fact-finding enquiries of different kinds (Kothari, 2004).

Explanatory (analytical research)

Explanatory research seeks to explain the patterns of the phenomenon being studied and to identify relationships between aspects of the phenomenon (Robson, 2002). An explanatory study aims at finding causal relationships between variables (Saunders, et al., 2009). Data collected in a study can be subjected to statistical tests such as correlation in order to get a clear understanding of the relationship (Saunders, et al., 2009).

Research design employed

The research employed descriptive research design in seeking to answer research question 1. The descriptive research was used to establish the current adoption levels of OSS among Kenyan university students. The descriptive research design was found to be ideal for the research question because the data to be collected was both quantitative and qualitative in nature. The research did not control any of the variables but reported on the current state of OSS adoption at the time of study.

In answering research question 2 on the factors affecting free desktop OSS adoption, explanatory or analytical research design was used to measure the relationship between the independent and dependent variables.

In answering question 3, a literature review was conducted to inform the study on the appropriateness of existing models in predicting adoption of OSS. The weaknesses of the existing models were also identified in the context of OSS adoption. Chapter 3 informed the empirical studies conducted and discussed in chapter 4, 5 and 6. In order to fully answer question 3, explanatory research design was employed in order to identify and test the constructs and prove causal relationships between the constructs of an appropriate model.

In order to answer the research questions 4 and 5, an explanatory or analytical research design was used. The research sought to measure the causal relationships between the variables in research question 2. Explanatory research enabled the researcher to understand the nature or

mechanisms of the relationship between the independent and dependent variables identified in question 2 and to identify cause and effect.

The explanatory research design was the most appropriate design because it enabled the researcher to build an OSS adoption theory and elaborate on it using the proven causal relationships between the variables.

5.5. Data collection tools

The collection of data was conducted through the following methods;

1. Questionnaires: Closed ended questionnaires with a general structure of Likert scale questions were prepared with a pre-existing set of answers. A sample population of students in Kenyan universities was used as respondents. The method was used because the questionnaires can collect information from a large sample within a short time in a standardized way and in a cost-effective way. Before the actual survey was undertaken, the researcher tested the questionnaire as a data collection instrument by conducting a pilot survey involving ten students in one Kenyan university employing purposive sampling. The questionnaire was improved based on the findings of the pilot study. After the pilot study, purposive sampling was used to determine the respondents of the actual study which was determined by the number of universities in Kenya and the total number of students.

2. Interviews

   An interview is defined as an oral "administration of a questionnaire or an interview schedule" which means it is a face to face encounter with the respondent (Mugenda & Mugenda, 1999 pg. 83). It is desirable that the interviewer creates rapport with the interviewee in order for a smooth interview process to take place. Interviews are perceived to have the following advantages according to Mugenda and Mugenda (1999).

   i. They provide more detailed data which is not possible to get using questionnaires.
   ii. They make it possible to obtain data needed to meet specific objectives of the study.
   iii. Confusion is not possible during the study as the interviewer will clarify if the question is not clear.
   iv. Interviews are flexible enabling the interviewer to adapt to the situation in order to get as much information as possible.

v. Personal information can be obtained from the interviewee through an honest and personal interaction.
vi. They give the interviewer an opportunity to explain the purpose of the study which gives a chance for more complete and honest information.
vii. The interviewer can get more detailed information through probing.
viii. They give higher response rates because once the interview has been booked the respondent is unlikely to decline answering questions.

Interviews also have some disadvantages as listed below (Mugenda & Mugenda, 1999);

i. Interviews are quite expensive because the researchers have to go to meet the respondents which in most cases involves travelling.
ii. Interviews require communication and interpersonal skills which the researcher should possess.
iii. In order to avoid biased results the interviewer needs to be trained.
iv. Interviews are time consuming and if the researcher is interested in a big sample, interviews become a constraint.

There are three general types of interviews namely; Structured, unstructured and semi structured interviews (Mugenda & Mugenda, 1999).

In a structured interview, at the outset it is known what information is needed and the interviewer has a list of pre-determined questions to be asked (Sekaran, 2003). An unstructured interview on the other hand is where an interviewer does not enter the interview setting with a planned sequence of questions to be asked of the respondent (Sekaran, 2003). Finally the semi structured interview is where structured questions are asked together with some open ended ones (Mugenda & Mugenda, 1999).

In this study semi-structured interviews were used in collecting qualitative data, where the interviewer had a set of open-ended questions prepared in advance to guide the interview. This method was found beneficial because the respondents were able to express their views in their own terms. Interviews were used to confirm the findings of the questionnaires study. The interview also presented an opportunity to gain new ideas about the subject especially in the research question 1 and 2 outside what was covered by the questionnaire because the questionnaire had a pre-existing set of answers. The interview method was used in order to collect more information on reasons why the respondents adopt or do not adopt free desktop OSS. Before the actual study was undertaken, the researcher conducted pilot interviews in order to improve on the open

ended questions to be used in the actual interviews. The data collection instrument was improved informed by the findings of the pilot interviews.

The interviews were conducted by the researcher in English and transcribed by a research assistant into Microsoft word before being counterchecked by the researcher.

5.6. Questionnaire design

According to Sekaran (2003), good questionnaire design should concentrate on three areas. The first one is the wording of the questions, the second is the planning of issues and how the variables will be categorised, scaled and coded after the responses have been received. Finally the last issue is about the general appearance of the questionnaire (Sekaran, 2003).

The questionnaire used in this study had two sections in general. The first section had the demographic data and the second section contained Likert scale questions that were intended to collect data in the areas of; usability, social influence, user training, OSS compatibility with other software, patent and copyright laws, social economic status, prior experience, job market, software piracy culture and OSS adoption. The decision to have the areas above was informed by the existing literature on factors that contribute to the adoption of software products as established by the reviewed studies.

The first section intended to collect the demographic data of the respondent such as the name of the university, year of study, age, gender, and their area of study. The questions in this section are shown below;

Demographic data

Respondent Number _____

1. Name of University _____
2. Year of study

□ Year 1 □ year 2 □ Year 3 □Year 4 □Year 5

3. Age

□ 18-20yrs □ 21-23yrs □ 24-26yrs □ 27-30 yrs □ 31 and above

4. Gender

□ Male □ Female

Area of study (i.e Business) _____

The second section contained Likert scale questions where the respondents were required to check one response from the strongly agree to the strongly disagree range of five responses. This study used the scale ranges from strongly agree = 1, agree = 2, neutral = 3, disagree = 4, strongly disagree 5.

The second section had the following thematic areas based on the constructs hypothesised in the conceptual framework in section 4.1.;

Usability; This subsection contained five questions. Each of these questions test the perception of users regarding different aspects of usability of OSS products such as open office compared to their proprietary competitors. The questions cover perceptions in the areas of user friendliness, recognisable icons, help facilities, ease in performing tasks and ease in formatting documents.

Table 5.6-1: Questionnaire usability questions

1	Open source software such as Linux and Open Office is more user friendly than proprietary software such as Microsoft office and Windows.
2	Open source software such as Linux and Open Office has familiar icons that are more easily recognizable than proprietary software such as Microsoft office and Windows.
3	Open source software such as Linux and Open Office has better help facilities, tutorials and wizards than proprietary software such as Microsoft office and Windows.
4	Navigation while performing tasks in Open source software such as Linux and Open Office is easier than in proprietary software such as Microsoft office and Windows.
5	I find it easier to format a document using Open office writer than Ms Office Word

Social influence; this subsection contained five questions. Each of these questions tests the perception of users regarding different aspects of social influence. The questions were designed to establish to what degree peers, seniors, lecturers, class mates, and college mates influence the use of OSS.

Table 5.6-2: Questionnaire social influence questions

1	People who influence my behaviour think that I should use Open source software.
2	People who are important to me think that I should use Open source software.
3	Most of my university lecturers use Open source software
4	Most of my friends use Open source software
5	Most of my class and college mates use Open source software

User training; this subsection contained five questions. Each of these questions tests the perception of users regarding OSS training. The questions were designed to establish whether the users have been trained to use OSS, whether the training is useful in enabling them use OSS, and finally whether OSS training is easy to find.

Table 5.6-3: Questionnaire user training questions

1	I have been trained to use Open source software such as Linux and Open Office
2	Training on Open source software could increase my productivity while using the software
3	The general computer training offered as a common course in the university covers open source software as an area of training
4	I have the knowledge necessary to use Open source software
5	I can easily find training on the use of Open source software

OSS compatibility with other software; this subsection contained five questions. Each of these questions tests the perception of users regarding the compatibility of OSS products with their proprietary counterparts in the areas of knowledge transfer from proprietary software to OSS. The other areas tested are software compatibility such as being able to open a document created in an OSS document in a PS and whether such a document can be opened without losing any format properties.

Table 5.6-4: Questionnaire OSS compatibility with other software questions

1	The knowledge I have in using proprietary software can be transferred to Open Source software without requiring further training
2	I can easily open an Microsoft word document in Open office Writer without losing any format properties
3	I can easily open an Open office writer document in Microsoft Word without losing any format properties
4	I can easily install any software on Ubuntu or Linux platform
5	An Ms Excel document can easily open in Open Office calc without reporting any conversion errors

Patent and copyright laws; this subsection contained five questions. Each of these questions tests the perception of users regarding the effects of patent and copyright laws on the adoption of OSS. The researcher hypothesised that if the patent and copyright laws did not restrict use of icons, and other HCI attributes, OSS would be more user friendly and consequently increase OSS adoption. The questions below were designed to aid in testing that hypothesis.

Table 5.6-5: Questionnaire Patent and copyright laws questions

1	I would find Open office easier to use if it used the same icons as Microsoft Office for in its interface
2	I would find Open office easier to use if it used similar menus as Microsoft Office in its interface
3	I would find Ubuntu easier to use if it used a similar desktop and start menu as the Microsoft Windows 7
4	I would find Ubuntu easier to use if tasks were performed in a similar way as they are performed in Microsoft Windows 7
5	I would prefer the Windows 8 start button to be used in Ubuntu

Social economic status; this subsection contained five questions. The questions were designed to collect data in order to aid in establishing whether the majority of users find PS expensive to acquire and whether they would afford it in their current status. One of the questions was designed to establish the users perception on whether they would buy PS if they could afford it as opposed to acquiring OSS at a minimal or no cost.

Table 5.6-6: Questionnaire Social economic status questions

1	Open source software is more affordable than proprietary software
2	If I earned a good salary then I would buy Proprietary Software rather than Open Source Software
3	Students like me generally have limited resources
4	Proprietary software is exorbitantly expensive to students
5	I would easily raise Kshs. 15,000 to buy an Ms Office 2010 licence

Prior experience; this subsection contained five questions. The questions were designed to establish whether the respondents had used OSS in their previous schools, cybercafés and other forums before they joined the institution of higher learning they are currently in.

Table 5.6-7: Questionnaire prior experience questions

1	I was using Open source software before I joined the university
2	Computer training in the school I attended was conducted using open source software
3	I have limited opportunities to use Open source software
4	Learning institutions I attended before joining the university supported the use of Open source software
5	I have used OSS in cybercafés and other places before I joined the university

Job Market; this subsection contained five questions. Each of these questions tests the perception of users regarding the level of marketability of OSS skills in the job market in Kenya.

Table 5.6-8: Questionnaire job market questions

1	Majority of the potential employers require employees who can use Open source software
2	The job adverts I have seen require candidates who can use Open source software as a mandatory requirement
3	The jobs my friends do require candidates who can use Open source software as a mandatory requirement
4	I could miss employment opportunities if I did not have Opens source software skills
5	The career guidance I have received indicates that I need OSS skills in order to easily secure a job

Piracy culture; this subsection contained five questions. Each of these questions tests the perception of users regarding software piracy. The questions were designed to establish whether they manly buy PS or they pirate the software and whether it is a general culture to pirate software among this population.

Table 5.6-9: Questionnaire piracy culture questions

1	All the proprietary software I have in my computer has a licence that is not shared with other users
2	There is no need to purchase proprietary software such as Microsoft office and Windows from software stores such as PC world because I can easily get it from my friends.
3	I can spend large amounts of money to buy licensed proprietary software such as Microsoft Office 2010 which costs about 15,000 Kshs in my current financial status.
4	I get the same value from the unlicensed software as a computer owner who has licensed software
5	Most of My friends buy genuine software for their computers

OSS adoption; this subsection contained five questions. Each of these questions tests the perception of users regarding OSS adoption. The questions were designed to establish whether the students and their colleagues like using OSS, whether their computers only have PS and whether the software was already installed in their computers when they bought them.

Table 5.6-10: Questionnaire OSS adoption questions

	Open source software Adoption (OSSA)
1	Using Open source software makes my work more interesting
2	I like using open source software
3	The Windows I use was already pre-installed in the computer when I bought the computer
4	My computer only has Proprietary software such as windows and Microsoft Office installed and has no Open source software such as Open office and Ubuntu
5	Many students at campus prefer open source software

5.7. Interview schedule design

In this study an interview schedule was prepared which had a set of questions. Mugenda and Mugenda (1999), opines that an interview schedule makes it possible to obtain data needed to satisfy specific objectives of the study. The schedule in this study contained questions in the areas of; usability, social influence, user training, OSS compatibility with other software, patent and copyright laws, social economic status, prior experience, job market, software piracy culture and OSS adoption.

Open source software usability – The purpose of this section was to get opinions from the users regarding what makes software more user friendly and also probe more on what human computer interaction features of OSS make the software are difficult to use. Below are the exact questions before further probing;

i. How was the experience compared to using proprietary products such as Ms Windows, Ms Office?
ii. How easy is it to achieve a task using open source software compared to proprietary software

Social Influence (SI) - The purpose of this section was to get opinions from the users regarding to what extent the society influences the decision to use software. It also intends to establish the actual group of people that influence their use behaviour. Below is the exact question before further probing;

i. Do your friends and age mates influence the kind of software that you mostly use?

User training – The purpose of this section was to get opinions from the users regarding the kind of training that is offered by the different institutions in the country and how much is covered on OSS training by these institutions.

i. Have you ever been trained to use Proprietary software and was it formal training?
ii. Have you ever been trained to use Open source software and was it formal training?

OSS compatibility with other software - The purpose of this section was to get opinions from the users regarding the level of compatibility of OSS with other software. It also got opinions regarding the aspects of OSS that are most incompatible with competing products such as icons.

i. Are the icons and interfaces in use in Open source software similar to those found in proprietary software?

Patent and Copyright Laws - The purpose of this section was to get opinions from the users regarding the level of effect of copyright laws and whether the computer users would prefer similar icons and interfaces.

i. Would you prefer to have the same icons and interfaces in Proprietary software such as Ms Office in Open source software?

Social economic status - The purpose of this section was to get opinions from the users regarding the extent to which their current financial status influences their software acquisition decisions. The section also intended to establish the current social economic factors in the country that influence users during the acquisition of software.

i. What is your view concerning the licence fees of proprietary software?

Prior experience - The purpose of this section was to get information regarding the users' prior experience in using OSS and how that compares with other competing software.

i. Before you joined the university, were you using Open source software?

Job market demands - The purpose of this section was to get information regarding the current job market and the skills desired by Kenyan employers for different positions in the organisations.

i. Are students with Open source software skills more marketable than those without?

Proprietary software piracy culture – The purpose of this section was to get information regarding how deeply rooted piracy culture is among this population and whether law enforcement agencies in the country have been fighting it.

i. Can you easily obtain a copy of proprietary software from friends and other informal sources to install in your computer?
ii. Has a government enforcing agent ever challenged you to produce a licence for software installed in your computer and if so how frequent is it?

OSS Adoption - The purpose of this section was to get information regarding the motivation for OSS adoption, actual products that are commonly adopted by Kenyan users and the reasons why the users adopt those particular products.

i. Have you ever used Open source software such as Ubuntu, Linux, Open Office etc?

5.8. Target population

Population is defined as an entire group of individuals, events or objects which possess a common observable characteristic (Mugenda & Mugenda, 1999). Mugenda & Mugenda (1999) further opine that when a population is clearly described it is referred to as the target population.

The target population in this study comprised of students in Kenyan universities. Kenya had about 182,253 students in the year 2010/2011 and 16 universities (Kenya National Bureau of Statistics, 2011). This was the latest credible student population data in Kenya at the time of the study.

The choice of the university students as the respondents was based on the fact that students fall in the category of the most literate in developing countries. They also generally use computers to a great extent in their studies and research as noted by empirical studies conducted in the past (U.S. Institute of Education Sciences, 2006).

5.9. Sample size

Although it is recommended that a researcher should take as big a sample as possible, in some cases time and resources are a major constraint (Mugenda & Mugenda, 1999). In this study a

formula proposed by Kothari (2004), was used to determine the sample size. The population of students in Kenyan universities is finite and the formula below was used to determine the sample size (Kothari, 2004).

$$n = \frac{Z^2 \cdot p \cdot q \cdot N}{e^2 (N - 1) + Z^2 \cdot p \cdot q}$$

Where:

p = sample proportion, $q = 1 - p$;

z = the value of the standard variate at a given confidence level and to be worked out from the table showing the area under a Normal curve;

N = size of population

e = acceptable error (the precision)

n = sample size

Based on the above formula the sample size based on the total number of students of 182,253 students in the year 2010/2011 worked out to 384. A representative sample from each university was calculated based on the student population in each of the university as shown in the Table 5.9-1.

Table 5.9-1: Sample size per university

No.	Name of University	Sample size drawn
1.	MOUNT KENYA UNI	50
2.	KENYATTA UNI	61
3.	JKUAT	39
4.	MOI UNI	36
5.	NAIROBI UNI	50
6.	DAYSTAR	15
7.	BARATON	10
8.	CATHOLIC	20
9.	USIU	10
10.	SCOTT THEOLOL	10
11.	AGA KHAN	10
12.	STRATHMORE	12
13.	KABARACK	7
14.	KEMU	20
15.	KERIRI WOMEN	5
16.	MASENO	18
17.	MASINDE MULIRO	11
	Total	384

The above sample per university participated in filling in the questionnaires. For the interview study 20 respondents responded in the study as opposed to the total 384 participants. The interview respondents were drawn from the questionnaire respondents who had shown interest in participating in interviews.

5.10. Sampling method

Purposive sampling technique was used in this study. Purposive sampling is a technique that allows a researcher to use items that possess the required information as guided by the objectives of the study (Mugenda & Mugenda, 1999).

A purposive sample was selected in 17 universities (16 from the National Bureau of statistics list and 1 new fast growing university) to identify a sample of students to be involved in the study. Purposive sampling was used because not all the university students have used desktop OSS and for that reason any student selected from the population would not have given useful feedback. Therefore, purposive sampling was used to select respondents who have used OSS and actually own a personal computer. The students to be used in the study needed to satisfy the following criteria;

i. Must have used desktop OSS before
ii. Own or have access to a personal computer in which they can install software without authorisation restrictions

5.11. Data collection and ethical considerations

Before the study was conducted ethical clearance was sought from UNISA College of Science, Engineering and Technology Research and Ethics Committee. The researcher also sought clearance locally in Kenya by applying for clearance from National Commission for Science, Technology and Innovation (NACOSTI). Both of the above applications were successful as indicated in the research permit in Appendix C.

All the participants were made aware of the implications of participating in the study through an informed consent document which is attached in Appendix B. Participants who consented to participate in the study signed the informed consent form.

5.12. Validity and reliability of the instrument

In order to ensure credible results the researcher conducted pilot and statistical tests in order to ensure that the instruments were valid and reliable as explained in the subsections that follow.

Reliability of the instrument

Reliability as "a measure of the degree to which a research instrument yields consistent results or data after repeated trials" (Mugenda & Mugenda, 1999 pg. 95).

In this study, reliability of the research instrument was done using Cronbach's alpha reliability coefficient. Cronbach's alpha is a reliability coefficient which "indicates how well the items in a set are positively correlated to one another" (Sekaran, 2003 pg. 323). According to Sekaran (2003), Cronbach's alpha is worked out based on the average inter-correlations between the items measuring the concept. The results of the Cronbach's alpha reliability coefficient are shown in Table 5.12-1;

Table 5.12-1: Cronbach's alpha reliability coefficient

Measurement Items (Interval Scale)	**Items**	**Cronbach' Alpha**	**Reliability Results**	**Inter-Item Correlation**	**Item-to-total correlation**	**Kaiser-Meyer-Olkin (KMO)**
OSS usability	*5*	*0.758*	Acceptable	*0.742-0.825*	*0.821-0.864*	*0.492*
User training	*5*	*0.757*	Acceptable	*0.520-0.769*	*0.650-0.821*	*0.515*
OSS compatibility with other applications	*5*	*0.837*	Good	*0.767-0.841*	*0.734-0.869*	*0.573*
Social influence	*5*	*0.829*	Good	*0.502-0.651*	*0.556-0.757*	*0.582*
Prior experience	*5*	*0.843*	Good	*0.506-0.915*	*0.506-0.834*	*0.580*
Social economic status	*5*	*0.764*	Acceptable	*0.760-0.785*	*0.645-0.867*	*0.650*
Job Market demands	*5*	*0.927*	Good	*0.590-0.864*	*0.556-0.699*	*0.565*
Proprietary software piracy culture	*5*	*0.767*	Acceptable	*0.678-0.691*	*0.897-0. 921*	*0.675*
Patent and Copyright Laws	*5*	*0.724*	Acceptable	*0.760-0.794*	*0.876-0.892*	*0.580*
OSS adoption	*5*	*0.781*	Acceptable	*0.807-0.890*	*0.594-0.673*	*0.571*

Source: Researcher

The above tested consistency reliabilities for measurement of items which were based on Cronbach's alpha reliability. The measurement items were found to be suitable because Cronbach' Alpha values were greater than 0.70. According to Sekaran (2003), the closer the Cronbach's alpha is to 1, the greater the internal consistency reliability. This was an indication that the questionnaire items in each set of questions testing an area of interest such as OSS usability were positively correlated to each other. Kaiser-Meyer-Olkin (KMO) tests how suitable the data is for factor analysis (Sekaran 2003). The test measures sampling adequacy for each variable in the model (Sekaran 2003). KMO returns values between zero and one. When the KMO value ranges between 0.4 to 1, it means that the variable sampling is adequate (Sekaran 2003). In the table Table 5.12-2, all the KMO values are above 0.4 meaning that the variable sampling was adequate for factor analysis.

Another commonly used measure that assesses the internal consistency as discussed by Sekaran (2003), is called the item-to-total correlation which examines each item in a set. This measure determines how well an item in a set independently measures the concept so that the subjects can have the same overall meaning in each of the questionnaire items (Sekaran, 2003). In this study the results of the item-to-total correlation was above 0.5, which was an indication that individual items were consistent with each other.

Validity of the instrument

Validity is defined as the accuracy and significance of inferences which are based on the research results or in other words the degree to which the results achieved after analysing the data actually represent the phenomenon being studied (Mugenda & Mugenda, 1999). Validity is mainly "determined by the presence or absence of systematic error in data" (Mugenda and Mugenda 1999 pg. 100). There are three types of validity tests which test the goodness of measures although different authors have in the past used different terms to refer to them. The tests are; construct validity, content validity and criterion-related validity (Sekaran, 2003).

Construct validity

Construct validity is defined as "a measure of the degree to which data obtained from an instrument meaningfully and accurately reflects or represents a theoretical approach" (Mugenda and Mugenda 1999 pg. 100). This approach is used in a domain where no established criterion is generally accepted as an appropriate measure of a concept (Mugenda & Mugenda, 1999). There are two types of construct validity measures which are convergent validity and discriminant validity (Sekaran, 2003). Convergent validity is obtained by determining the correlation of scores

obtained by two different instruments measuring the same concept. Discriminant validity is determined "based on theory, two variables are predicted to be uncorrelated, and the scores obtained by measuring them are indeed empirically found to be so" (Sekaran, 2003 pg. 207).

In this study, construct validity was determined using the item-to-total correlations as shown in table 5-12. Item-to-total correlation values of above 0.5 are considered have a good correlation (Cohen, 1988). The results of item-to-total correlations in this study were found to be acceptable as they were above 0.5.

Content validity

Content validity is defined as "a measure of the degree to which data collected using a particular instrument represents a specific domain of indicators or content of a particular concept" (Mugenda and Mugenda 1999 pg. 102). The ordinary procedure of evaluating content validity is to use professionals or experts in the field. In this study the research instrument was given to a number of experts including the supervisor who gave an expert opinion regarding the suitability of the instrument (Mugenda & Mugenda, 1999). A pilot study was conducted as an effort to validate the content. A number of items in the questionnaire were amended in order to make them valid.

Criterion related validity

Criterion-related validity can be defined as the "use of a measure in assessing subjects' behaviour in specific situations" (Mugenda and Mugenda 1999 pg. 102). Criterion-related validity can be classified into two types namely; predictive and concurrent (Mugenda & Mugenda, 1999).

Predictive validity is a measure that determines the extent to which obtained data predict future behaviour of subjects (Mugenda & Mugenda, 1999). Concurrent validity can be defined as the extent to which data are able to predict the behaviour of the respondents presently and not in the future (Mugenda & Mugenda, 1999). In this study concurrent validity was carried out by assessing the adoption levels of a respondent compared with the responses of the different questionnaire items by that respondent.

5.13. Response rate

Questionnaires were distributed physically by the researcher and the research assistants to the various universities. The questionnaires were issued to respondents during their free time and they were given time to fill in and return the questionnaire while the research assistant waited.

This approach was adopted in order to get a high response rate. The response rate was 100 percent because of taking this approach.

5.14. Data analysis and OSS adoption model development

Once data was collected using questionnaires, the different Likert scale responses were coded using numeric values. The different questionnaire responses were then entered manually into the SPSS for Windows software. The data were then analysed using descriptive statistics and inferential statistics.

Quantitative research was conducted in this study using questionnaires because the Likert scale responses were coded using numeric values. Qualitative research was conducted using interviews in this study. Qualitative research involves collecting of detailed information from participants which is arranged into categories or themes (Creswell, 2009). The themes in this study were developed into broad patterns, theories or generalisations.

The model development was done after the factors affecting adoption of OSS in Kenyan universities were identified using the questionnaire and interview methods. The study also identified the different variables such as the independent and moderating variables. The author was able to formulate a model which was empirically tested to assess its applicability in the scenario under study. Validation of the model was done using statistical measures of relationship such as analysis of variance (ANOVA), the square of the multiple correlation coefficient and the coefficient of multiple determination (R- Square) as suggested by Kothari (2004), to validate the relationship between the variables in the proposed model. ANOVA was used because it is one of the best measures of relationship that can be used in a study where several variables are involved (Kothari, 2004). The above analysis was done using R which is an OSS statistical package.

5.15. Summary

This chapter details the methods that were used in collecting data and the reasons for choosing those particular methods. The study used a mixed methods approach and employed both descriptive and explanatory research designs. Both questionnaires and interviews were used as data collection tools. The population under study comprised of university students in Kenya and due to the high number of students, a purposive sample was used for the study. Data was analysed using various statistical measures such as ANOVA. The findings of the study are reported in the next chapter.

Chapter 6

Results

6.0. Introduction

This chapter presents the results of the study conducted as explained in Chapter 5. The chapter contains descriptive and inferential statistics results which are drawn from the questionnaire and interview analysis. The results presented in this chapter comprise descriptive data analysis for the bio data such as the year of study, age, and gender of the respondents. The next section covers the descriptive statistics on usability, social influence, user training, OSS compatibility with other software, patent and copyright laws, social economic status, prior experience, job market demands, piracy culture and OSS adoption. The next section covers the model development which was done using regression and correlation analysis of the questionnaire data. The model was tested using Analysis of variance (ANOVA) and R square tests.

This chapter sought to answer the following research questions;

- What is the level of OSS adoption among Kenyan university students? (Research question number 1).
- What factors affect the adoption of desktop OSS among Kenyan students? (Research question number 2).
- Which is the best OSS adoption model which is applicable to the situation in Kenya? (Research question number 4).
- Is the model developed in four above (4) valid in the Kenyan situation? (Research question number 5).

6.1. Questionnaire results

The questionnaire results were analysed using a descriptive approach in order to depict certain trends from the data and to determine the factors affecting adoption of OSS. Regression analysis was used to establish the nature of the relationship between the different variables.

6.1.1. Descriptive statistics

This section shows the data analysis from the bio data section of the questionnaire.

Table 6.1-1 Questionnaire respondents per university

	SN	Name of University	Number of respondents	Percent of respondents	Valid Percent	Cumulative Percent
Valid	1.	MOUNT KENYA UNI	50	13.0	13.0	13.0
	2.	KENYATTA UNI	61	15.9	15.9	28.9
	3.	JKUAT	39	10.2	10.2	39.1
	4.	MOI UNI	36	9.4	9.4	48.4
	5.	NAIROBI UNI	50	13.0	13.0	61.5
	6.	DAYSTAR	15	3.9	3.9	65.4
	7.	BARATON	10	2.6	2.6	68.0
	8.	CATHOLIC	20	5.2	5.2	73.2
	9.	USIU	10	2.6	2.6	75.8
	10.	SCOTT THEOLOL	10	2.6	2.6	78.4
	11.	AGA KHAN	10	2.6	2.6	81.0
	12.	STRATHMORE	12	3.1	3.1	84.1
	13.	KABARACK	7	1.8	1.8	85.9
	14.	KEMU	20	5.2	5.2	91.1
	15.	KERIRI WOMEN	5	1.3	1.3	92.4
	16.	MASENO	18	4.7	4.7	97.1
	17.	MASINDE MULIRO	11	2.9	2.9	100.0
		Total	384	100.0	100.0	

The data above shows the list of universities whose students were involved in the study. The data also shows the number of students that responded to the questionnaire questions in each of the university. The total number of respondents from each university was 384.

Table 6.1-2: Questionnaire respondents per year of Study

	Year of study	Frequency	Percent	Valid Percent	Cumulative Percent
Valid	YEAR 1	23	6.0	6.0	6.0
	YEAR 2	65	16.9	16.9	22.9
	YEAR 3	208	54.2	54.2	77.1
	YEAR 4	88	22.9	22.9	100.0
	Total	384	100.0	100.0	

The data analysis above from the bio data section shows the year of study of the respondents. Majority of the respondents were in year 3 of their study.

Table 6.1-3: Age of the questionnaire respondents

	Age	Frequency	Percent	Valid Percent	Cumulative Percent
Valid	18-20	23	6.0	6.0	6.0
	21-23	332	86.5	86.5	92.4
	24-26	29	7.6	7.6	100.0
	Total	384	100.0	100.0	

The data analysis above from the bio data section shows the age of the respondents. The majority of the respondents were 21-23 years of age.

Table 6.1-4: Questionnaire respondents per gender

	Gender	Frequency	Percent	Valid Percent	Cumulative Percent
Valid	MALE	214	55.7	55.7	55.7
	FEMALE	170	44.3	44.3	100.0
	Total	384	100.0	100.0	

The data analysis above from the bio data section shows the gender of the respondents. The majority of the respondents were male.

Table 6.1-5: Questionnaire respondents' area of study

The data analysis above from the bio data section shows the area of study of the respondents. The majority of the respondents were taking computing courses.

	Area of study	Frequency	Per cent	Valid per cent	Cumulative per cent
Valid	COMPUTING	192	50.0	50.0	50.0
	BUSINESS	63	16.4	16.4	66.4
	ENGINEERING	24	6.2	6.2	72.7
	MEDICINE	18	4.7	4.7	77.3
	LAW	5	1.3	1.3	78.6
	EDUCATION	32	8.3	8.3	87.0
	MATHEMATICS	16	4.2	4.2	91.1
	SOCIOLOGY	12	3.1	3.1	94.3
	ZOOLOGY	2	.5	.5	94.8
	JOURNALISM	1	.3	.3	95.1
	DEVELOPMENT	7	1.8	1.8	96.9
	PHARMACY	2	.5	.5	97.4
	THEOLOGY	10	2.6	2.6	100.0
	Total	384	100.0	100.0	

Questionnaire responses

This section contains the questionnaire responses from the usability section which had five questions.

Table 6.1-6: Usability questionnaire responses analysis

	STRONGLY DISAGREE	DISAGREE	NEUTRAL	AGREE	STROGNLY AGREE
	Row N %	Row N %	Row N %	Row N %	Row N %
Open source software such as Linux and Open Office is more user friendly than the proprietary software such as Microsoft office and Windows.	90.6%	8.9%	.3%	.3%	.0%
Open source software such as Linux and Open Office has familiar icons that are easily recognizable than the proprietary software such as Microsoft office and Windows.	39.3%	59.9%	.8%	.0%	.0%
Open source software such as Linux and Open Office has better help facilities, tutorials and wizards than the proprietary software such as Microsoft office and Windows.	19.8%	77.6%	1.8%	.8%	.0%
Navigation while performing tasks in Open source software such as Linux and Open Office is easier than in the proprietary software such as Microsoft office and Windows.	93.5%	4.2%	2.3%	.0%	.0%
I find it easier to format a document using Open office writer than Ms Office Word	88.5%	10.7%	.5%	.3%	.0%

The usability results above indicate that majority of the users feel that Open source software is not user friendly, icons are not easily recognizable, and their help facilities are not as good as those of proprietary software. Respondents also felt that navigation and performance of tasks in OSS is more difficult compared to proprietary software.

Table 6.1-7: Social influence questionnaire responses analysis

	STRONGLY DISAGREE	DISAGREE	NEUTRAL	AGREE	STRONGLY AGREE
	Row N %	Row N %	Row N %	Row N %	Row N %
People who influence my behaviour think that I should use Open source software	12.5%	83.9%	3.4%	.3%	.0%
People who are important to me think that I should use Open source software.	90.6%	8.6%	.8%	.0%	.0%
Most of my university lecturers use Open source software	35.7%	62.0%	1.8%	.5%	.0%
Most of my friends use Open source software	31.0%	68.2%	.8%	.0%	.0%
Most of my class and college mates use Open source software	86.7%	8.6%	4.7%	.0%	.0%

The results above indicate that the students' peers, lecturers and others that influence their behaviour have also not been influencing the respondents to use OSS. This is also an indication that the lecturers and the college mates do not use OSS.

Table 6.1-8: User training questionnaire responses analysis

	STRONGLY DISAGREE	DISAGREE	NEUTRAL	AGREE	STRONGLY AGREE
	Row N %	Row N %	Row N %	Row N %	Row N %
I have been trained to use Open source software such as Linux and Open Office	96.6%	2.6%	.3%	.5%	.0%
Training on Open source software could increase my productivity while using the software	.0%	2.6%	2.6%	13.8%	81.0%
The general computer training offered as a common course in the university covers open source software as an area of training	91.4%	6.2%	2.1%	.3%	.0%
I have the knowledge necessary to use Open source software	18.0%	77.9%	3.4%	.8%	.0%
I can easily find training on the use of Open source software	21.9%	77.1%	1.0%	.0%	.0%

The above table shows the results of the respondents regarding OSS training. There is a clear indication that the majority of the respondents have not been trained in the use of OSS. Although the majority of the respondents acknowledge that training could increase their productivity while using OSS, the findings indicate that the general computer training offered as a common course in the university does not cover OSS as an area of training. OSS training for the respondents is not easily accessible.

Table 6.1-9: Compatibility questionnaire responses analysis

	STRONGLY DISAGREE	DISAGREE	NEUTRAL	AGREE	STRONGLY AGREE
	Row N %	Row N %	Row N %	Row N %	Row N %
The knowledge I have in using proprietary software can be transferred to Open Source software without requiring further training	12.0%	87.5%	.5%	.0%	.0%
I can easily open an Microsoft word document in Open office Writer without losing any format properties	19.0%	77.9%	3.1%	.0%	.0%
I can easily open an Open office writer document in Microsoft Word without losing any format properties	30.2%	66.4%	2.9%	.0%	.5%
I can easily install any software on Ubuntu or Linux platform	18.5%	78.1%	2.6%	.3%	.5%
An Ms Excel document can easily open in Open Office calc without reporting any conversion errors	98.4%	.8%	.3%	.0%	.5%

The above results reveal that OSS is not compatible with PS in several areas. The majority of users feel that knowledge gained from using PS cannot be transferred to OSS. They also feel that documents prepared in PS cannot be moved easily to OSS without losing some format properties.

Table 6.1-10: Patent and copyright laws questionnaire responses analysis

	STRONGLY DISAGREE	DISAGREE	NEUTRAL	AGREE	STRONGLY AGREE
	Row N %	Row N %	Row N %	Row N %	Row N %
I would find Open office easier to use if it used the same icons as Microsoft Office for in its interface	13.3%	7.6%	2.3%	.0%	76.8%
I would find Open office easier to use if it used similar menus as Microsoft Office in its interface	.0%	5.2%	7.8%	56.2%	30.7%
I would find Ubuntu easier to use if it used a similar desktop and start menu as the Microsoft Windows 7	.0%	4.7%	7.6%	60.2%	27.6%
I would find Ubuntu easier to use if tasks were performed in a similar way as they are performed in Microsoft Windows 7	.0%	.3%	1.0%	93.8%	4.9%
I would prefer the Windows 8 start button to be used in Ubuntu	.0%	.3%	.8%	92.2%	6.8%

The results above reveal that the majority of the users feel that OSS uses very different icons, menus and interfaces from those used by PS. The results also show that respondents feel that if OSS was using the same icons, menus and interfaces, OSS would be easier to use.

Table 6.1-11: Social economic status questionnaire responses analysis

	STRONGLY DISAGREE	DISAGREE	NEUTRAL	AGREE	STRONGLY AGREE
	Row N %	Row N %	Row N %	Row N %	Row N %
Open source software is more affordable than proprietary software	.0%	.0%	.5%	4.4%	95.1%
If I earned a good salary then I would buy Proprietary Software rather than Open Source Software	.0%	1.3%	1.6%	87.0%	10.2%
Students like me generally have limited resources	.3%	1.0%	1.8%	3.1%	93.8%
Proprietary software is exorbitantly expensive to students	.3%	.3%	1.6%	2.6%	95.3%
I would easily raise Kshs. 15,000 to buy an Ms Office 2010 licence	94.3%	1.8%	1.8%	1.6%	.5%

The results above indicate that the majority of the respondents cannot afford proprietary software in their current status due to their limited resources. The respondents also feel that PS is exorbitantly expensive to students.

Table 6.1-12 Prior experience questionnaire response analysis

	STRONGLY DISAGREE	DISAGREE	NEUTRAL	AGREE	STRONGLY AGREE
	Row N %	Row N %	Row N %	Row N %	Row N %
I was using Open source software before I joined the university	92.2%	5.2%	1.6%	1.0%	.0%
Computer training in the school I attended was conducted using open source software	92.2%	7.0%	.3%	.0%	.5%
I have limited opportunities to use Open source software	.3%	.8%	1.0%	84.6%	13.3%
Learning institutions I attended before joining the university supported the use of Open source software	7.8%	88.8%	2.1%	.5%	.8%
I have used OSS in cybercafés and other places before I joined the university	18.2%	38.3%	14.6%	24.0%	4.9%

The results above indicate that majority of the respondents have limited opportunities to use OSS. It is clear that majority of the training institutions do not have OSS installed in their computers and they also do not encourage the use of OSS. There is an indication that a good number of cybercafés have OSS in their computers, it is important to interrogate their motivation in installing OSS.

Table 6.1-13: Job market demands questionnaire responses analysis

	STRONGLY DISAGREE	DISAGREE	NEUTRAL	AGREE	STRONGLY AGREE
	Row N %	Row N %	Row N %	Row N %	Row N %
Majority of the potential employers require employees who can use Open source software	14.8%	24.2%	5.5%	51.8%	3.6%
The job adverts I have seen require candidates who can use Open source software as a mandatory requirement	9.6%	30.2%	4.2%	51.3%	4.7%
The jobs my friends do require candidates who can use Open source software as a mandatory requirement	18.0%	22.7%	5.5%	51.8%	2.1%
I could miss employment opportunities if I did not have Opens source software skills	20.8%	19.0%	5.5%	49.5%	5.2%
The career guidance I have received indicates that I need OSS skills in order to easily secure a job	19.5%	20.1%	6.0%	50.0%	4.4%

The results above indicate that a good number of employers require employees who can use OSS and also feel that they could miss employment opportunities for lack of knowledge in OSS. There is need to interrogate this data further to establish whether this finding is specific to specific careers or is applicable to all the careers.

Table 6.1-14: Piracy culture questionnaire responses analysis

	STRONGLY DISAGREE	DISAGREE	NEUTRAL	AGREE	STRONGLY AGREE
	Row N %	Row N %	Row N %	Row N %	Row N %
All the proprietary software I have in my computer has a licence that is not shared with other users	21.6%	68.5%	2.6%	2.3%	4.9%
There is no need to purchase proprietary software such as Microsoft office and Windows from software stores such as PC world because I can easily get it from my friends.	.0%	.0%	7.3%	28.9%	63.8%
I can spend large amounts of money to buy licensed proprietary software such as Microsoft Office 2010 which costs about 15,000 Kshs in my current financial status.	21.4%	68.2%	3.1%	2.9%	4.4%
I get the same value from the unlicensed software as a computer owner who has licensed software	4.4%	11.7%	4.9%	63.3%	15.6%
Most of My friends buy genuine software for their computers	20.6%	67.2%	4.7%	2.9%	4.7%

The findings above strongly indicate that software piracy is rampant among the students population since the majority do not purchase licensed software. It is clear that pirated software can be easily obtained from friends at a small fee or none at all. The high piracy rates can be attributed to the high cost of PS.

Table 6.1-15: Open source adoption questionnaire responses analysis

	STRONGLY DISAGREE	DISAGREE	NEUTRAL	AGREE	STRONGLY AGREE
	Row N %	Row N %	Row N %	Row N %	Row N %
Using Open source software makes my work more interesting	19.0%	68.5%	4.9%	3.1%	4.4%
I like using open source software	19.3%	69.0%	4.9%	2.6%	4.2%
The Windows I use was already pre-installed in the computer when I bought the computer	2.6%	6.0%	7.0%	59.1%	25.3%
My computer only has Proprietary software such as windows and Microsoft Office installed and has no Open source software such as Open office and Ubuntu	2.6%	6.5%	6.0%	53.9%	31.0%
Many students at campus prefer open source software	25.3%	63.3%	4.4%	2.3%	4.7%

The results from the OSS adoption questions indicate that majority of the respondents were not using OSS and they equally believe that the software does not make their work interesting. There is however an indication that those with PS such as the Windows Operating system was already pre-installed when they bought the computer meaning that it is not in their computers as a matter of choice. The responses obtained from this questionnaire item answers research question 1.

6.2. 6.1. hjhj

Kolmogorov-Smirnov test

Normality Test : Kolmogorov-Smirnov test

One-Sample Kolmogorov-Smirnov Test

		OSS ADOPTION
N		49
Normal Parameters[a]	Mean	8.3170619
	Std. Deviation	1.81962068
Most Extreme Differences	Absolute	.150
	Positive	.083
	Negative	-.150
Kolmogorov-Smirnov Z		1.047
Asymp. Sig. (2-tailed)		.223

a. Test distribution is Normal.

Ho: Data is normal in distribution

H1: Data is not normal in distribution

The above test reveals that data is normal in distribution.

6.2.1. Model development and testing using regression and correlation analysis

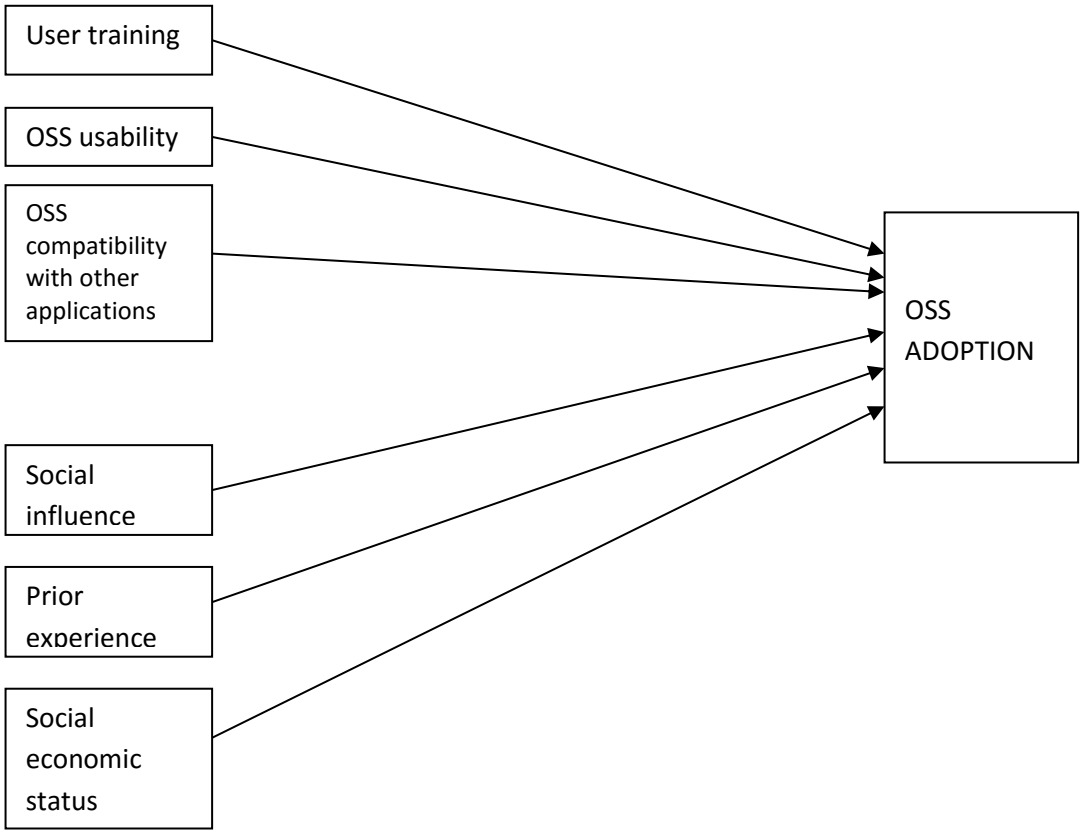

Figure 0-1: Proposed model without moderating variables

The tests below are testing the above proposed model where user training, usability, OSS compatibility, social influence, prior experience and social economic status are the independent variables and the OSS adoption is the dependent variable. The test is testing the effect of the independent variables on the dependent variable (OSS Adoption) in the absence of the perceived moderating variables. The tests conducted seek to answer research question 2 on the factors affecting adoption of free desktop open source software by university students in Kenya.

R-Square

This statistic measures how successful the fit is in explaining the variation of the data (Harnett & Soni, 1991). R-square is the square of the correlation between the response values and the predicted response values. This measure is also called the square of the multiple correlation coefficient and the coefficient of multiple determination (Harnett & Soni, 1991).

Table 0-1: R-Square test model summary

Model	R	R Square[b]	Adjusted R Square	Std. Error of the Estimate
1	.971[a]	.943	.942	2.02860

The overall model explains 94.3% of the variations in adoption using the **R square** goodness of fit. This percentage is acceptable since the minimum is about 70% (Harnett & Soni, 1991).

Analysis of Variance (ANOVA) test

Below are results of the ANOVA test. The ANOVA test is the primary step in discovering factors that are influencing a given data set (Harnett & Soni, 1991). After the ANOVA test is performed, the analyst is able to carry out additional analysis on the systematic factors that are statistically contributing to the data set's variability (Harnett & Soni, 1991). ANOVA is also known as analysis of variance (Billingsley & Huntsberger, 1993). According to Billingsley & Huntsberger (1993), ANOVA is useful in testing of both null and alternative hypothesis. In this study, ANOVA was used to test the hypothesis stipulated in chapter four (4).

Table 0-2: ANOVA test results

Model		Sum of Squares	Df	Mean Square	F	Sig.
1	Regression	25622.264	6	4270.377	1.038E3	.000
	Residual	1555.549	378	4.115		
	Total	27177.813[b]	384			

Since the p-value is less than 0.05, user training, usability, OSS compatibility, social influence, prior experience and social economic status have significant combined effect on OSS adoption.

The regression test below is testing for the level of significance of the individual independent variables in this relationship.

Table 0-3: Coefficients[a,b]

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	USER TRAINING	.138	.073	.084	1.905	.058
	USABILITY	.099	.070	.035	1.424	.155
	OSS COMPATIBILITY	.157	.073	.100	2.165	.031
	SOCIAL INFLUENCE	.032	.070	.015	.450	.653
	PRIOR EXPERIENCE	.026	.066	.020	.394	.694
	SOCIAL ECONOMIC STATUS	.540	.046	.730	11.796	.000

a. Dependent Variable: OSS ADOPTION

b. Linear Regression through the Origin

From the regression results above we can conclude that, user training, OSS compatibility and social economic status have significant individual influence on OSS adoption at 10% level of significance. Usability, social influence and prior experience have a significance of significance 0.155, 0.653 and 0.694 respectively. This means that in the overall model usability, social influence and prior experience have negligible influence on OSS adoption.

Y= 0.138 * user training + 0.099 * usability + 0.157 * OSS compatibility + 0.032* Social influence + 0.026 * prior experience + 0.540 * social economic status

6.2.2. Testing and validation of the moderating variables

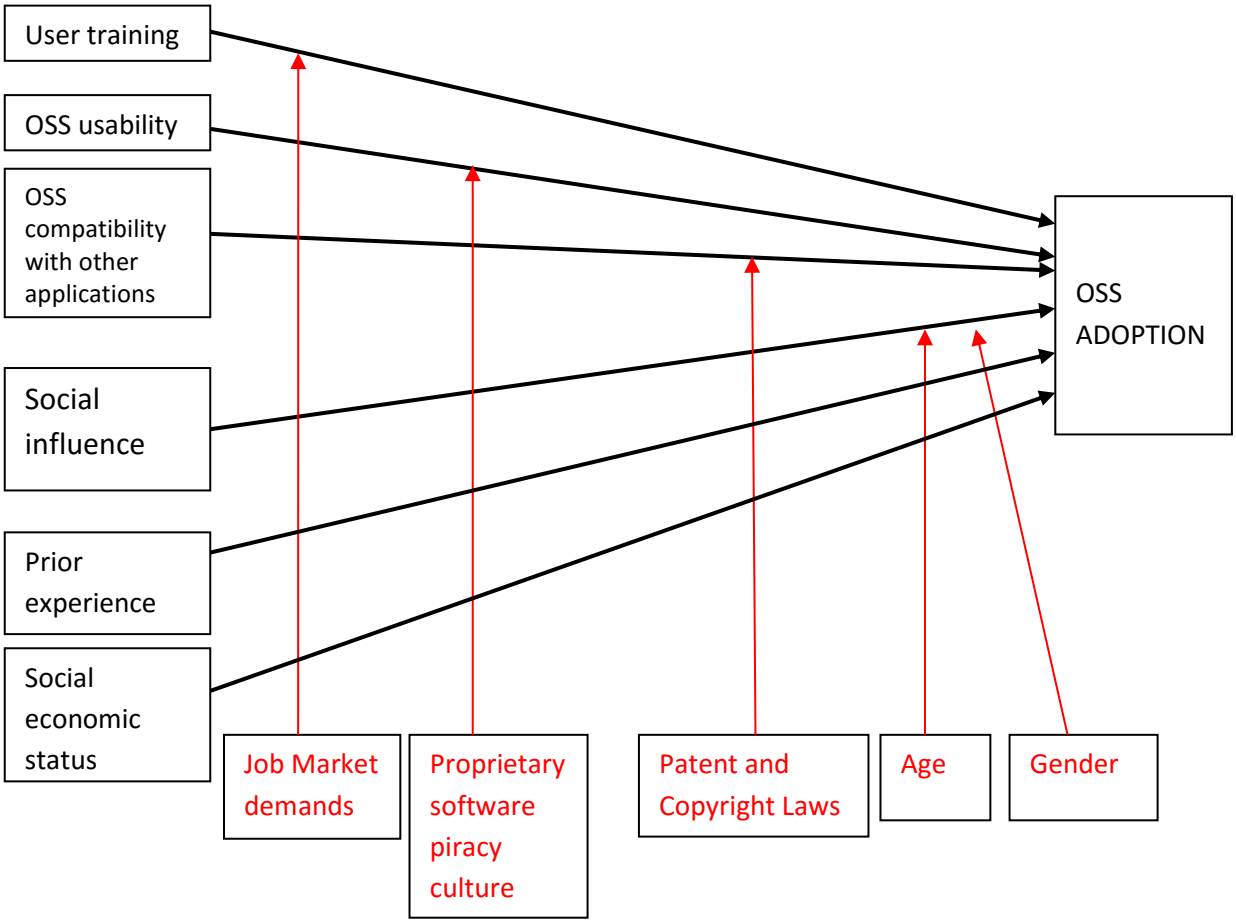

Figure 0-2: Proposed model with moderating variables

Source: Researcher

NB: The relationship between the independent and dependent variables are shown with darker lines while the interaction of the moderating variables and the independent variables is shown using lighter lines.

The tests in this section are testing the effect of the moderating variables in the proposed model. Below are the tests and their respective findings;

1. The first test is testing whether Gender has a moderating effect on the relationship between *Social Influence* and OSS Adoption. The results reveal that gender **has** a significant moderating effect on the relationship between *Social Influence* and OSS adoption. This relationship is validated by the tests.
2. The second test is testing whether age has a moderating effect on the relationship between *Social Influence* and OSS adoption. The results reveal that age **does not have** a significant moderating effect on the relationship between *Social Influence* and OSS adoption. This relationship is validated by the tests.

3. The third test is testing whether copyright and patent laws have a moderating effect on the relationship between OSS compatibility with other applications and OSS adoption. The results reveal that copyright and patent laws have a significant moderating effect on the relationship between OSS compatibility with other applications and OSS adoption. This relationship is validated by the tests.
4. The fourth test is testing whether proprietary software piracy culture has a moderating effect on the relationship between OSS usability and OSS adoption. The results reveal that proprietary software piracy culture has a significant moderating effect on the relationship between OSS usability and OSS adoption. This relationship is validated by the tests.
5. The fifth test is testing whether job market demands has a moderating effect on the relationship between user training and OSS adoption. The results reveal that job market demands has a significant moderating effect on the relationship between user training and OSS adoption. This relationship is validated by the tests.

1. Gender

Table 0-4: Model Summary for gender as a moderator for social influence

Model	R	R Square[b]	Adjusted R Square	Std. Error of the Estimate
1	.967[a]	.935	.934	2.15913

Table 0-5: ANOVA[c,d] test for gender as a moderator for social influence

Model		Sum of Squares	Df	Mean Square	F	Sig.
1	Regression	25401.659	3	8467.220	1.816E3	.000[a]
	Residual	1776.154	381	4.662		
	Total	27177.813[b]	384			

Table 0-6: Coefficients[a,b] for gender as a moderator for social influence

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	SOCIAL INFLUENCE	1.964	.085	.953	23.211	.000
	Gender	5.104	.199	.926	25.659	.000
	SocialInfluence*Gender	-1.219	.067	-.923	-18.175	.000

a. Dependent Variable: OSS ADOPTION

b. Linear Regression through the Origin

The fitted model was

$$Y = 1.964 * SocialInfluence + 5.104 * Gender - 1.219 * SocialInfluence * Gender$$

The coefficient for the interaction term (Social Influence *Gender) was found to be significant (P-value < 0.05) implying that gender had a significant moderating effect on the relationship between *Social Influence* and OSS Adoption.

2. Age

Table 0-7: Model Summary for age as a moderator for social influence

Model	R	R Square[b]	Adjusted R Square	Std. Error of the Estimate
1	.937[a]	.878	.877	2.95009

Table 0-8: ANOVA[c,d] test for age as a moderator for social influence

Model		Sum of Squares	Df	Mean Square	F	Sig.
1	Regression	23861.952	3	7953.984	913.931	.000[a]
	Residual	3315.861	381	8.703		
	Total	27177.813[b]	384			

Table 0-9: Coefficients[a,b] for age as a moderator for social influence

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	SOCIAL INFLUENCE	.842	.205	.409	4.108	.000
	Age	2.963	.219	.537	13.523	.000
	SocialInfluence*Age	.017	.091	.017	.189	.850

a. Dependent Variable: OSS ADOPTION

b. Linear Regression through the Origin

The fitted model was

$$Y = 0.842 * SocialInfluence + 2.963 * Age - 0.017 * SocialInfluence * Age$$

The coefficient for the interaction term (Social Influence *Age) was not found to be significant (P-value > 0.05) implying that Age did not have a significant moderating effect on the relationship between *Social Influence* and OSS adoption.

3. Patent laws

Table 0-10: Model Summary for patent laws as a moderator for OSS compatibility

Model	R	R Square[b]	Adjusted R Square	Std. Error of the Estimate
1	.973[a]	.946	.945	1.96448

Table 0-11: ANOVA[c,d] for patent laws as a moderator for OSS compatibility

Model		Sum of Squares	Df	Mean Square	F	Sig.
1	Regression	25707.468	3	8569.156	2.220E3	.000[a]
	Residual	1470.345	381	3.859		
	Total	27177.813[b]	384			

Table 0-12: Coefficientsa,b for patent laws as a moderator for OSS compatibility

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	OSS COMPATIBILITY	1.256	.121	.798	10.368	.000
	PATENT AND COPYRIGHT LAWS	.713	.035	.977	20.552	.000
	PatentLaws*Compatibility	-.110	.013	-.796	-8.265	.000

a. Dependent Variable: OSS ADOPTION

b. Linear Regression through the Origin

The fitted model was

$$Y = 1.256 * \text{OSSCompatibility} + 0.713 * \text{Patent \& C.Laws} - 0.110 * \text{OSSCompatibility} * \text{Patent \& C.laws}$$

The coefficient for the interaction term (OSS Compatibility *Patent and Copyright Laws) was found to be significant (P-value < 0.05) implying that Patent and Copyright Laws had significant moderating effect on the relationship between *OSS Adoption* and OSS Compatibility.

4. Piracy culture

Table 0-13: Model Summary for piracy culture as a moderator for usability

Model	R	R Square[b]	Adjusted R Square	Std. Error of the Estimate
1	.966[a]	.932	.932	2.19909

Table 0-14: ANOVA[c,d] test for piracy culture as a moderator for usability

Model		Sum of Squares	Df	Mean Square	F	Sig.
1	Regression	25335.307	3	8445.102	1.746E3	.000[a]
	Residual	1842.507	381	4.836		
	Total	27177.813[b]	384			

Table 0-15: Coefficients[a,b] for piracy culture as a moderator for usability

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	USABILITY	2.815	.166	1.003	16.929	.000
	PIRACY CULTURE	1.006	.029	.924	34.420	.000
	Usability*PiracyCulture	-.344	.022	-.975	-15.915	.000

a. Dependent Variable: OSS ADOPTION

b. Linear Regression through the Origin

The fitted model was

$$Y = 2.815 * Usability + 1.006 * Piracyculture - 0.344 * Usability * Piracyculture$$

The coefficient for the interaction term (Usability * Piracy culture) was found to be significant (P-value < 0.05) implying that Piracy culture had significant moderating effect on the relationship between *OSS Adoption* and *Usability*.

5. Job market demands

Table 0-16: Model Summary for job market demands as a moderator for user training

Model	R	R Square[b]	Adjusted R Square	Std. Error of the Estimate
1	.965[a]	.930	.930	2.22831

Table 0-17: ANOVA[c,d] test for job market demands as a moderator for user training

Model		Sum of Squares	Df	Mean Square	F	Sig.
1	Regression	25286.015	3	8428.672	1.697E3	.000[a]
	Residual	1891.798	381	4.965		
	Total	27177.813[b]	384			

Table 0-18: Coefficients[a,b] for job market demands as a moderator for user training

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	USER TRAINING	1.587	.050	.963	31.907	.000
	JOB MARKET	.961	.054	.888	17.685	.000
	UserTrainingJobMarket	-.188	.012	-.885	-15.343	.000

a. Dependent Variable: OSS ADOPTION

b. Linear Regression through the Origin

The fitted model was

$$Y = 1.587 * User\ Training + 0.961 * Job\ Market - 0.188 * User\ Training * Job\ Market$$

The coefficient for the interaction term (User Training * Job Market) was found to be significant (P-value < 0.05) implying that Job *Market* had significant moderating effect on the relationship between *OSS Adoption* and *User training*.

The tests conducted and reported in this in this section sought to establish the following;

1. Whether Gender has a moderating effect on the relationship between *Social Influence* and OSS Adoption. The results reveal that gender **has** a significant moderating effect on the

relationship between *Social Influence* and OSS adoption. This relationship is validated by the tests.

2. Whether age has a moderating effect on the relationship between *Social Influence* and OSS adoption. The results reveal that age **does not have** a significant moderating effect on the relationship between *Social Influence* and OSS adoption. This relationship is validated by the tests.
3. Whether copyright and patent laws have a moderating effect on the relationship between OSS compatibility with other applications and OSS adoption. The results reveal that copyright and patent laws **have a significant** moderating effect on the relationship between OSS compatibility with other applications and OSS adoption. This relationship is validated by the tests.
4. Whether proprietary software piracy culture has a moderating effect on the relationship between OSS usability and OSS adoption. The results reveal that proprietary software piracy culture has a significant moderating effect on the relationship between OSS usability and OSS adoption. This relationship is validated by the tests.
5. Whether job market demands has a moderating effect on the relationship between user training and OSS adoption. The results reveal that job market demands has a significant moderating effect on the relationship between user training and OSS adoption. This relationship is validated by the tests.

The results indicate that the model fairly fits in the prediction of Desktop OSS adoption among university students in Kenya based on the analysis of data collected.

6.3. Interview responses analysis

After data was collected using interviews, the detailed response from the participants was first noted and then arranged into categories or themes as proposed by Creswell (2009). The themes in this study were developed into broad patterns, theories or generalisations for ease of noting the trends in the data collected. Charts were also used in pattern analysis to make interpretation easier. Below are the responses for different interview questions

1. Have you ever used Open source software such as Ubuntu, Linux, Open Office etc? All the twenty respondents in this study have used OSS. Among the used OSS are Ubuntu, Linux and Open office. On further probing it was established that some users had used OSS in cybercafés. The study noted that the main reason why the cybercafés adopt OSS is to avoid being apprehended by anti-piracy law enforcing agents who are common in the capital city Nairobi. A pattern analysis on the responses is shown below.

Table 6.3-1: Summary for interview question 1 responses

Responses from 20 respondents	Frequency	Percentage %
Has used OSS	20	100%
Has used Ubuntu	8	40%
Has used Linux	7	35%
Has used Open Office	**2**	10%
Used OSS at a cyber	3	**15%**

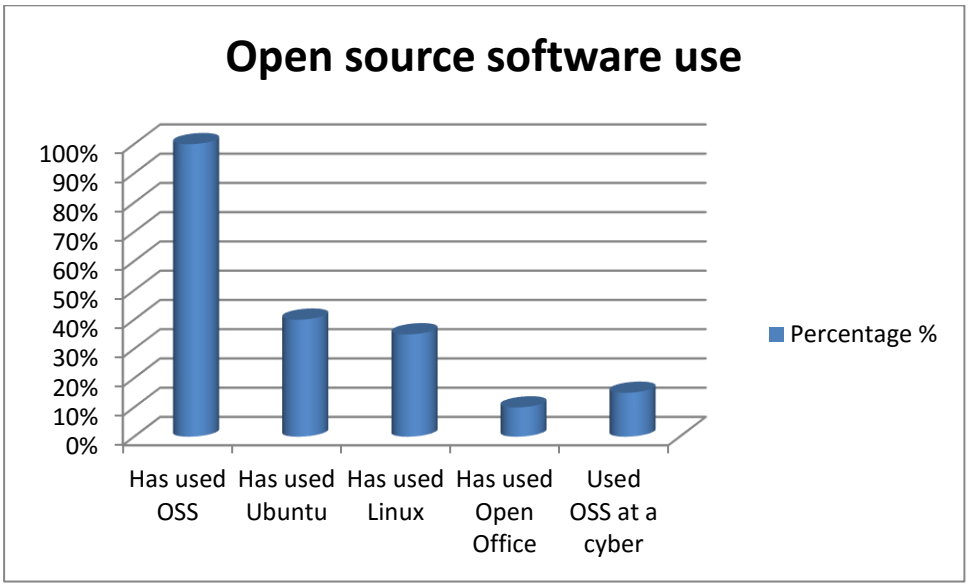

Figure 6.3-1: Summary for interview question 1 responses

2. How was the experience compared to using proprietary products such as Ms Windows, Ms Office?

The entire sample answered in affirmative that they prefer using PS as opposed to using OSS. Although all the respondents generally found PS better than OSS, some respondents had identified a few advantages of OSS over PS on further probing as follows:

i. OSS is not affected by viruses

ii. OSS is good for data recovery after a virus attack

Some users also thought that performing tasks in OSS is challenging while others thought that locating programs while using OSS operating systems like Ubuntu and Linux is difficult. The respondents said the reason for the difficulty in locating programs in Ubuntu and Linus is the difference in the icons, the start button for the two is completely different from Windows which they are used to. The presentation of the list of programs is also different in OSS. A pattern analysis on the responses is shown below.

Table 6.3-2: Summary for interview question 2 responses

Responses from 20 respondents	Frequency	Percentage %
Found PS better than OSS	20	100%
Found OSS better than PS	0	0%
Likes OSS because it's not affected by viruses	3	15%
Performing tasks was challenging	3	15%
Locating programs was difficult	2	10%
OSS is good for data recovery after a virus attack	2	10%

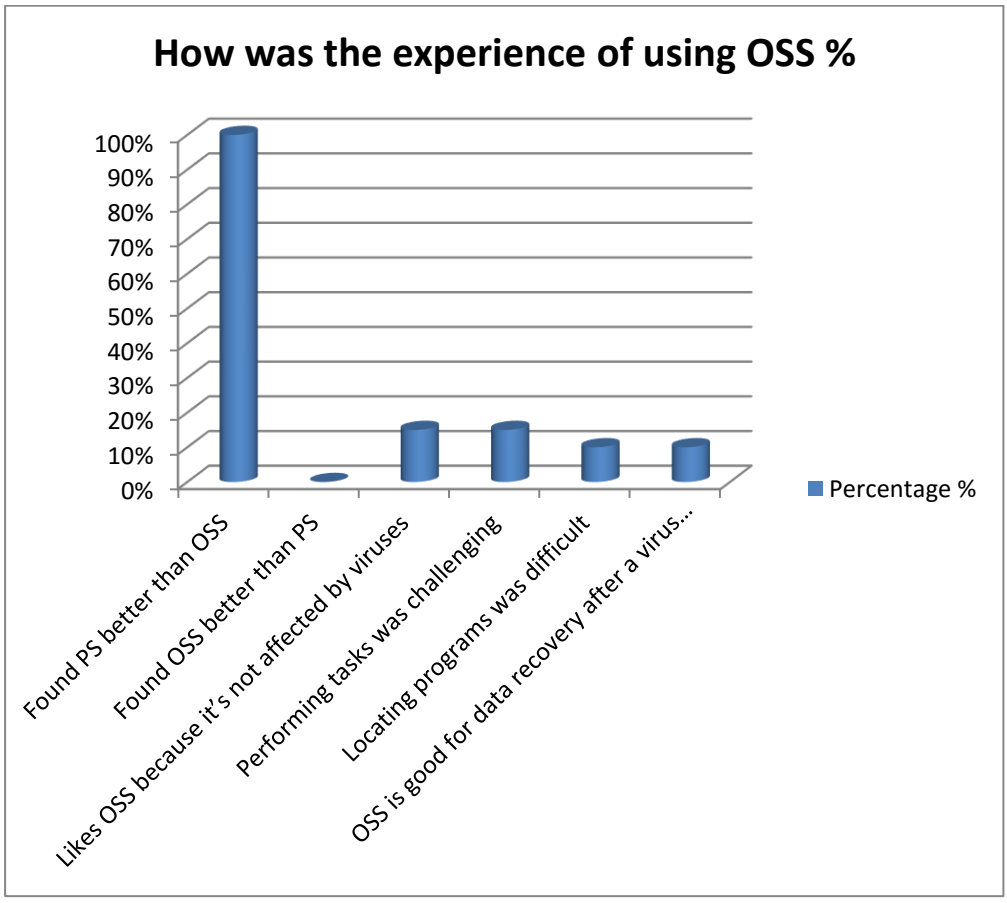

Figure 6.3-2: Summary for interview question 2 responses

3. Have you ever been trained to use Proprietary software and was it formal training?

The entire sample answered in affirmative that they have been trained to use PS. The study noted that some respondents were trained at small colleges before joining university while a few were trained at secondary school. It was also noted that PS software training is offered at campus in most cases as a common university unit which is offered to all the students. A pattern analysis on the responses is shown below.

Table 6.3-3: Summary for interview question 3 responses

Responses from 20 respondents	Frequency	Percentage %
Has been trained formally to use Proprietary software	20	100%
Has not been trained formally to use Proprietary software	0	0%
Was trained at a college before joining university	9	45%
I was trained at the secondary school I attended	3	15%
It was taught as a unit at campus	8	**40%**

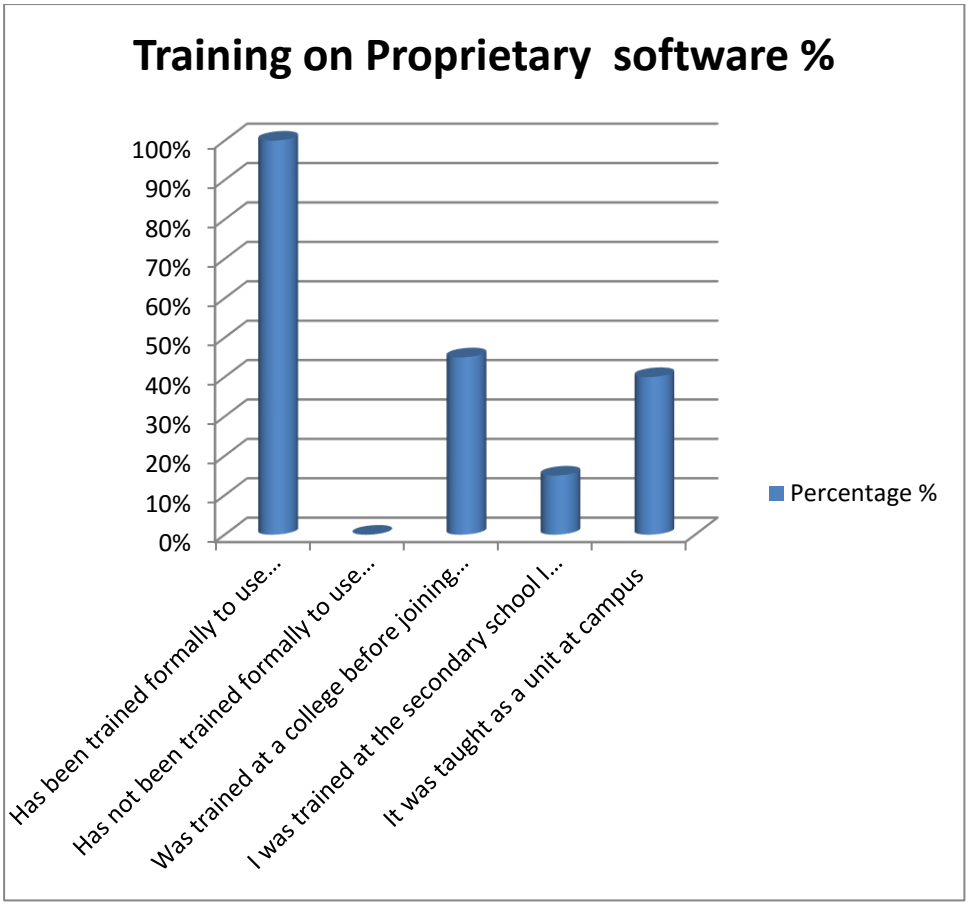

Figure 6.3-3: Summary for interview question 3 responses

4. Have you ever been trained to use Open source software and was it formal training?

   The entire sample answered in affirmative that they have not received formal training to use OSS. The study noted that the respondents learnt to use OSS from friends, Internet help manuals, others used trial and error while learning on their own. It was noted that two respondents who are computing students were introduced to Linux operating system while doing the Operating systems unit. After the introduction of OSS for computing students, further training was not conducted and that is why the computing students also felt that they had not been trained. A pattern analysis on the responses is shown below.

Table 6.3-4: Summary for interview question 4 responses

Responses from 20 respondents	Frequency	Percentage %
Has been trained formally to use Open source software	0	0%
Has not been trained formally to use Open source software	20	100%
Learnt from a friend	2	10%
Learnt from the Internet	**4**	20%
Learnt on my own although I have some difficulties	**12**	60%
Was introduced to Linux in the Operating Systems unit at campus	**2**	**10%**

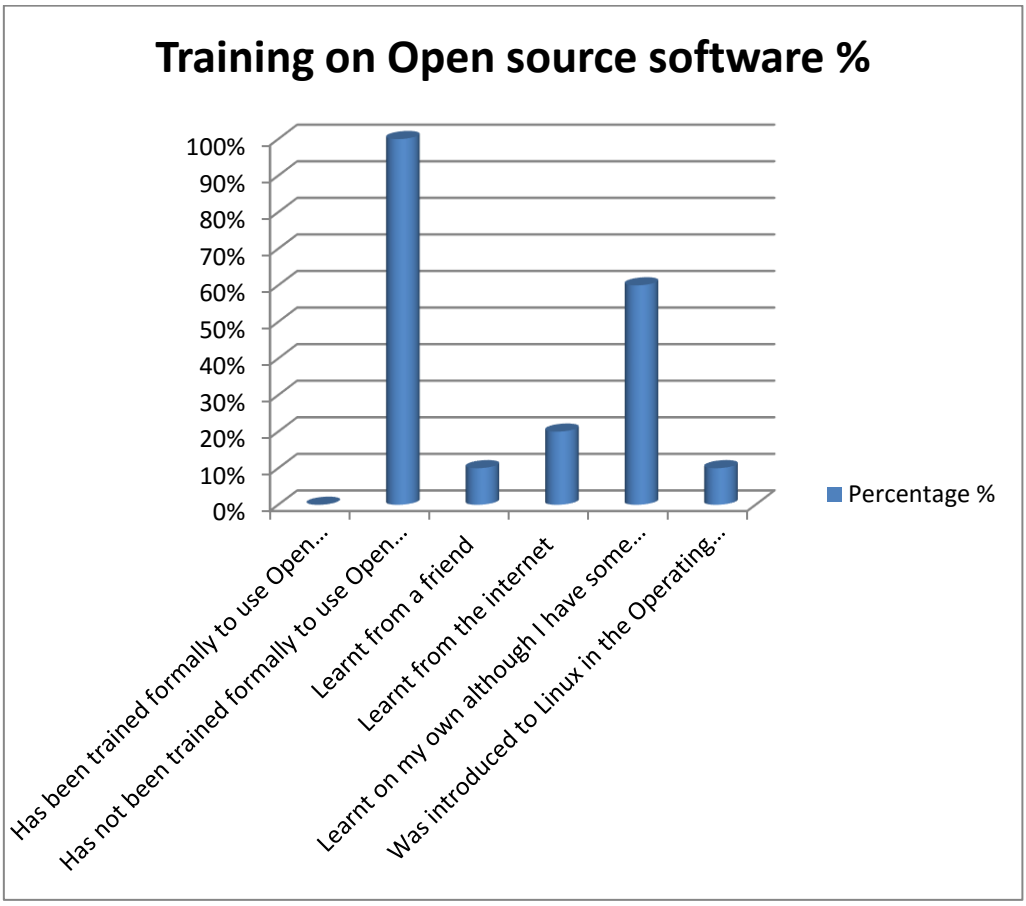

Figure 6.3-4: Summary for interview question 4 responses

5. How easy is it to achieve a task using open source software compared to proprietary software?

The entire sample answered in affirmative that they found OSS difficult in achieving a task. Some of the reasons given by the responds regarding the reasons they find it difficult are;

i. Lack of proper training on OSS
ii. The icons and graphical user interface (GUI) are unfamiliar
iii. The GUI of OSS is a complete departure from what they are used to

A pattern analysis on the responses is shown below.

Table 6.3-5: Summary for interview question 5 responses

Responses from 20 respondents	Frequency	Percentage %
If a user is very conversant it is easy	2	10%
It is relatively difficult	**18**	**90%**

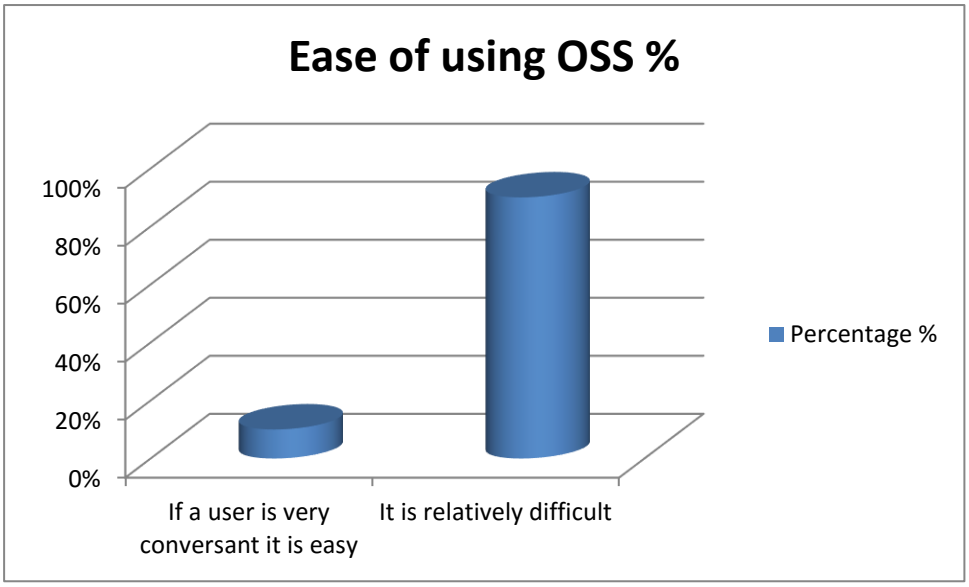

Figure 6.3-5: Summary for interview question 5 responses

6. What is your view concerning the licence fees of proprietary software

All the respondents find PS expensive; they gave various responses regarding the cost of software. Some said it was too expensive, others said it was not affordable while others said the price was exorbitant. Some said that they can only afford PS if it was sold for less than Kshs. 2000. A pattern analysis on the responses is shown below.

Table 6.3-6: Summary for interview question 6 responses

Responses from 20 respondents	Frequency	Percentage %
Proprietary software is too expensive	8	40%
Not affordable to students	9	45%
The price is exorbitant	**3**	**15%**

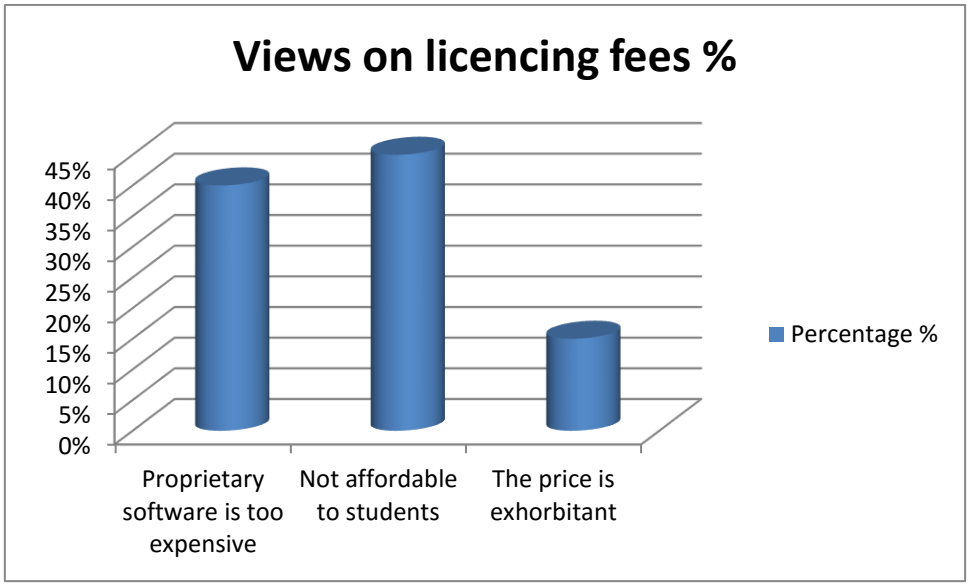

Figure 6.3-6: Summary for interview question 6 responses

7. Can you easily obtain a copy of proprietary software from friends and other informal sources to install in your computer?

All the respondents agreed that it was easily to get PS from informal sources. Some get this software from friends, others use trial versions while others download the software from the Internet. The study noted that activation of downloaded software was done using a crack from some Internet sources. Some respondents were also concerned that pirated software was risky. A pattern analysis on the responses is shown below.

Table 6.3-7: Summary for interview question 7 responses

Responses from 20 respondents	Frequency	Percentage %
Yes	20	100%
From friends	18	90%
At no or little fee	16	80%
Trial versions	5	25%
It is risky to use pirated software	2	10%
Cracked software from the Internet	4	20%
At a little fee of Kshs. 500	9	45%

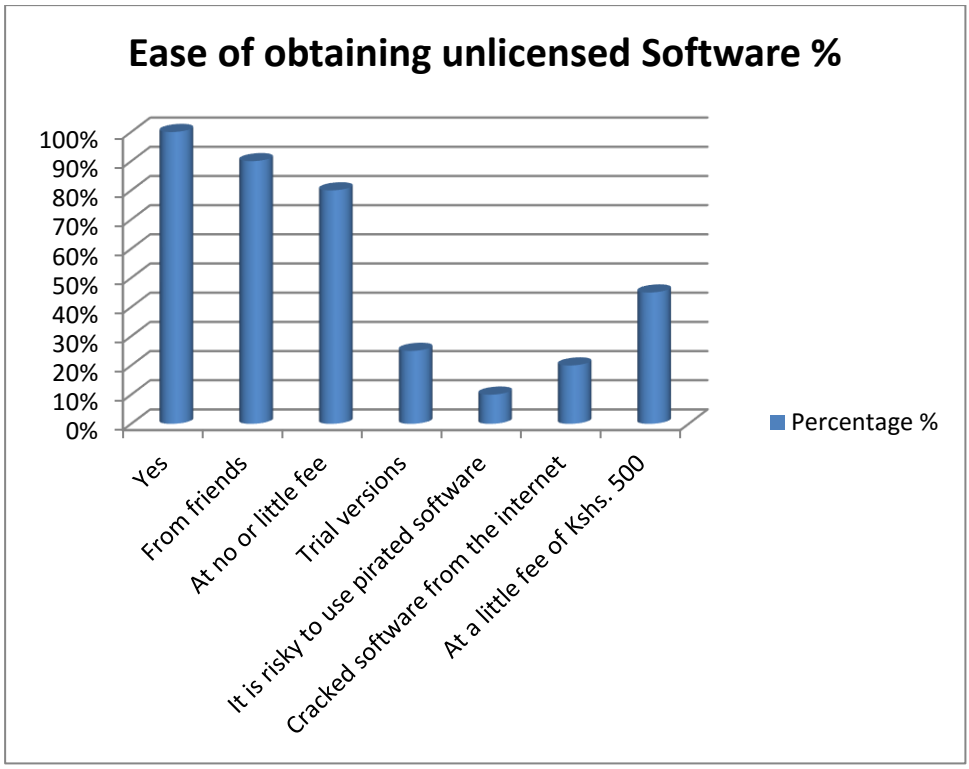

Figure 6.3-7: Summary for interview question 7 responses

8. Has a government enforcing agent ever challenged you to produce a licence for software installed in your computer and if so how frequent is it?

It was generally noted that government agents do not enforce software licence laws. It was however noted that in cybercafés law enforcement agencies normally check for software licences apart from cybercafés in some cases. A pattern analysis on the responses is shown below.

Table 6.3-8: Summary for interview question 8 responses

Responses from 20 respondents	Frequency	Percentage %
Yes	1	5%
No	19	95%
Government agents check in cybercafés	1	5%
Have been fined for using Pirated software when I was running a cybercafé	1	5%
I'm not aware that I could be asked for a licence	5	**25%**

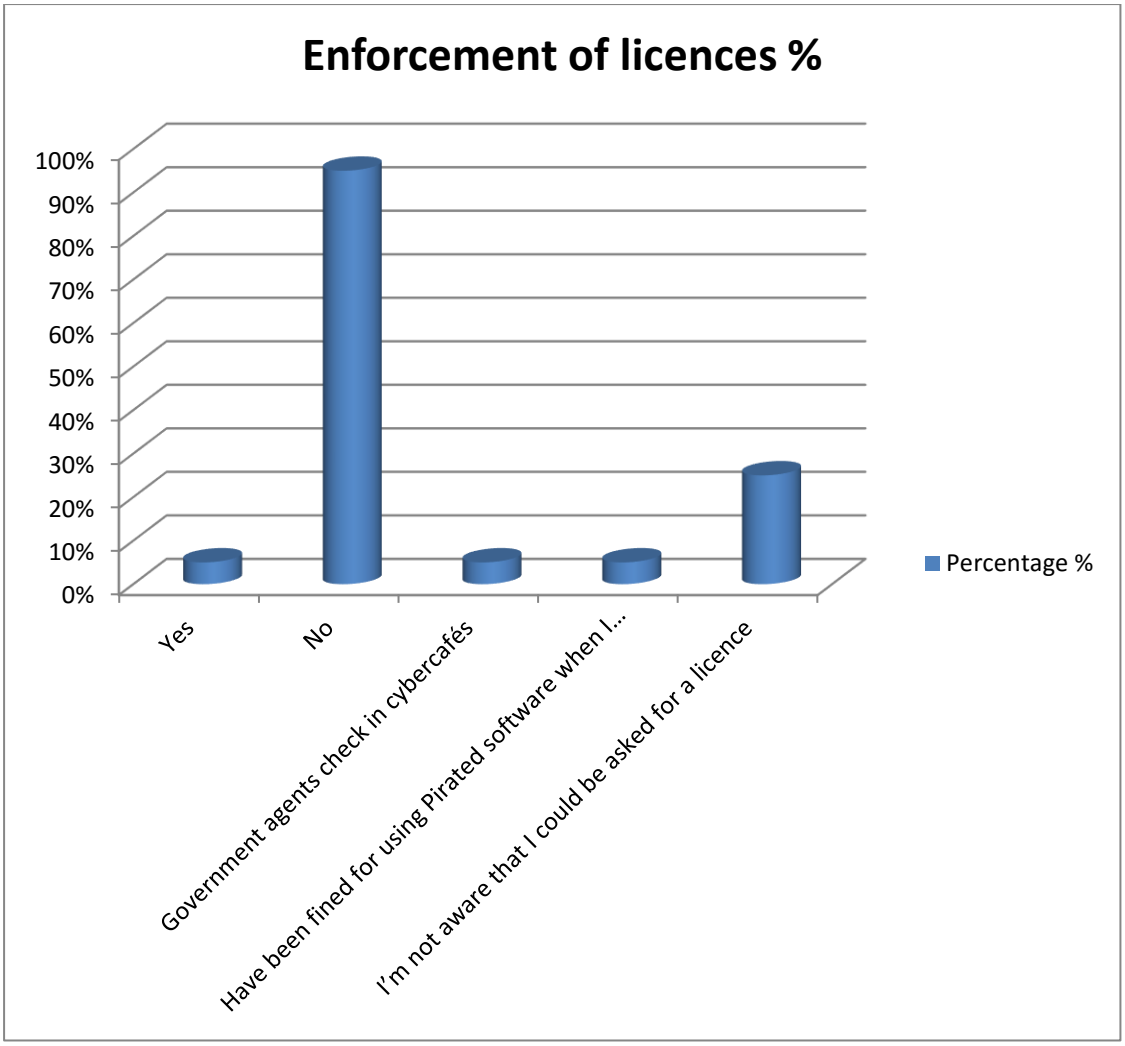

Figure 6.3-8: Summary for interview question 8 responses

9. Do your friends and age mates influence the kind of software that you mostly use?

The entire sample answered in affirmative that their friends and age mates influence the kind of software that they mostly use. The influence is done mainly through comments from their peers in terms of which software is better than the other which motivates them to adopt the software that is preferred by their peers. The study noted that the reasons for adopting the preferred software were as follows;

i. It is easy to get help from the peers if they get stuck while using the software
ii. It is easy to share files since they are using the same platform
iii. Others simply don't want to be different from their friends

A pattern analysis on the responses is shown below.

Table 6.3-9: Summary for interview question 9 responses

Responses from 20 respondents	Frequency	Percentage %
Yes	20	100%
No	**0**	**0%**

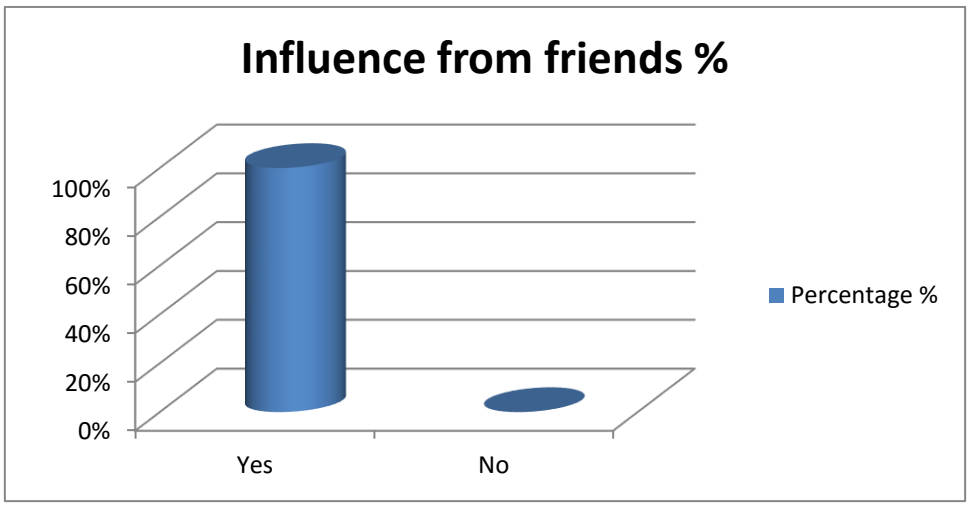

Figure 6.3-9: Summary for interview question 9 responses

10. How different are OSS applications from PS applications in terms of appearance and user interface?

All the respondents were in agreement that OSS applications differed from PS. Many respondents said that the icons and the interaction of PS were different from OSS. A good number of the respondents thought that OSS is quite complex. One respondent however thought that Linux OS interface is more attractive than windows. The reasons the respondent gave for finding the Linux OS interface more attractive is that he finds the colours and the icons in use attractive. Table 6.3-10 shows pattern analysis on the responses.

Table 6.3-10: Summary for interview question 10 responses

Responses from 20 respondents	Frequency	Percentage %
Quite different	20	100%
The icons and the interaction is different	7	35%
OSS is quite complex	4	20%
Linux is more attractive than windows	**1**	**5%**

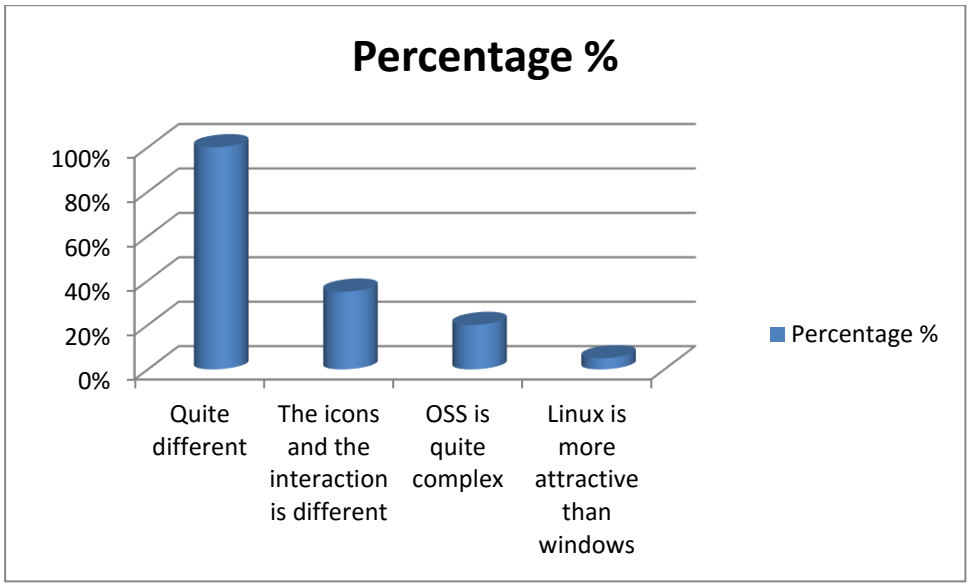

Figure 6.3-10: Summary for interview question 10 responses

11. Do you think OSS would be more usable if it had the same icons and interfaces with Proprietary software such as Ms Office?

The entire sample answered in affirmative that OSS would be more usable if it had the same icons and interfaces with Proprietary software such as Ms Office. A number of respondents felt that OSS should adopt better icons in order to make it more usable. Table 6.3-11 shows a pattern analysis on the responses.

Table 6.3-11: Summary for interview question 11 responses

Responses from 20 respondents	Frequency	Percentage %
Yes	20	100%
if the software OSS can adapt better icons	**5**	**25%**

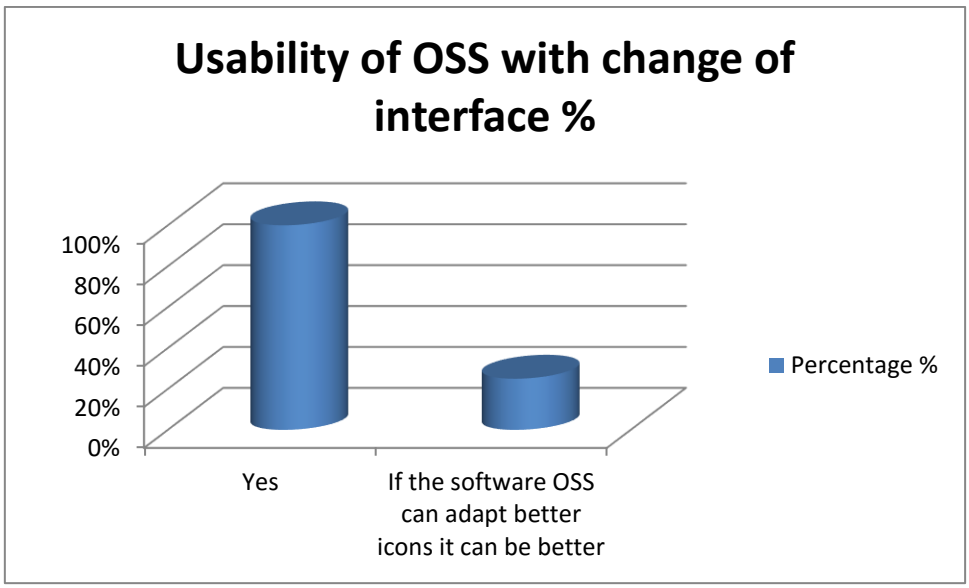

Figure 6.3-11: Summary for interview question 11 responses

12. Before you joined the university were you using Open source software and if yes where?

Majority of the users had not used OSS before they joined campus. For those who had used the software before joining campus, the study noted that they had used the software at their places of work and others at cybercafés. A few respondents had not heard about OSS before joining campus. They only heard about it from friends when they joined campus and used the software while in campus. Table 6.3-12 shows quantitative analysis on the responses.

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Table 6.3-12: Summary for interview question 12 responses

Responses from 20 respondents	Frequency	Percentage %
Yes	5	25%
No	15	75%
I used it after joining Campus	15	75%
Used it at place of work	1	5%
Used it at a cybercafé	3	15%
I had not heard about OSS before joining campus	4	20%

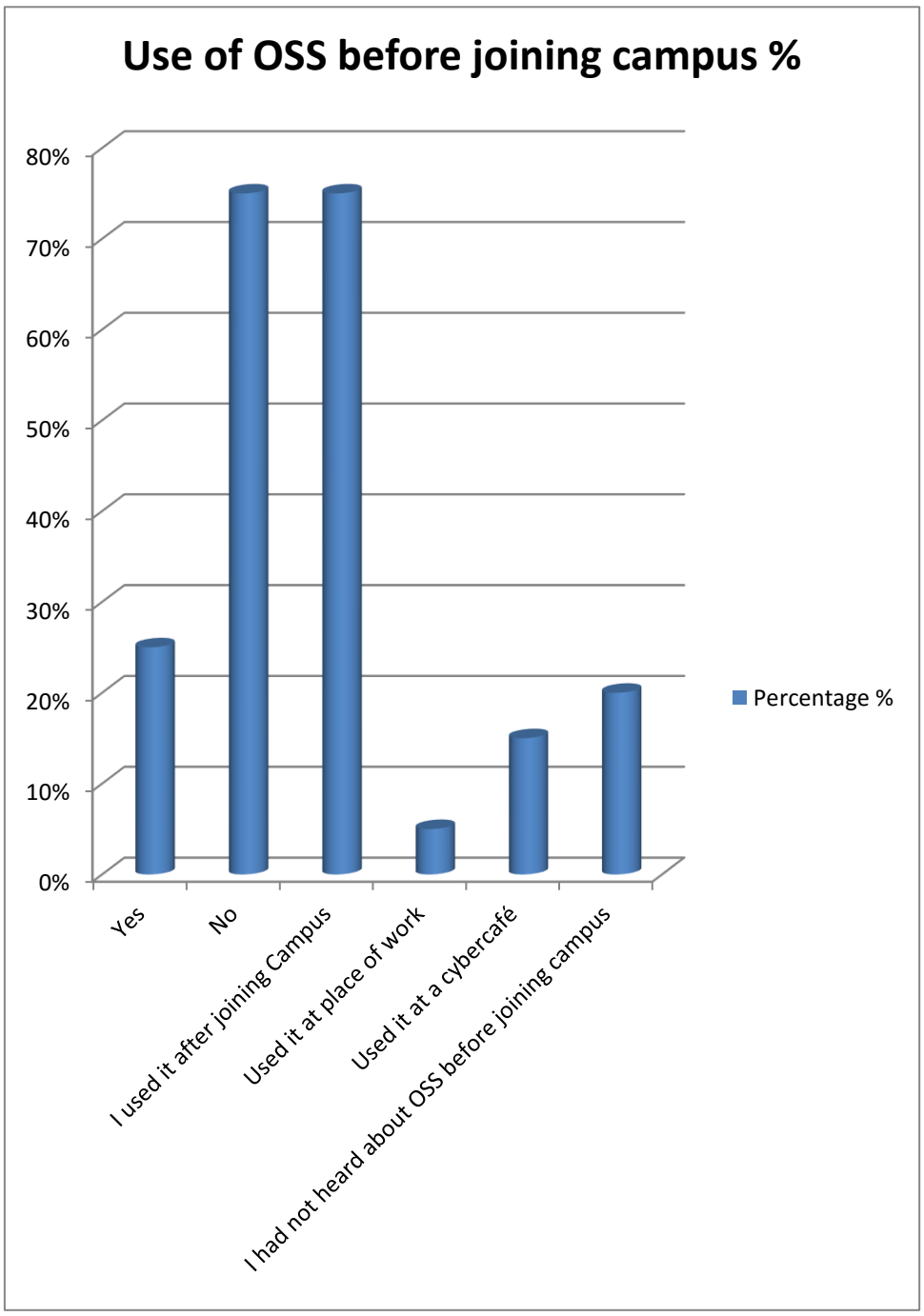


Figure 6.3-12: Summary for interview question 12 responses

13. Are students with Open source software skills more marketable than those without?

The study noted that most respondents thought that graduates with OSS knowledge are not more marketable than those without. All the respondents felt that OSS is more beneficial to computer experts and that IT students would be more marketable if they possessed OSS skills. The respondents said that the reason for preferring IT graduates who possess OSS skills is because they are required to support servers, users and other OSS platforms. A quantitative analysis on the responses is shown in Table 6.3-13.

Table 6.3-13: Summary for interview question 13 responses

Responses from 20 respondents	Frequency	Percentage %
Yes	4	20%
No	15	75%
OSS is more usable and favourable for computer experts	2	10%
Marketable for I.T. students	**2**	**10%**

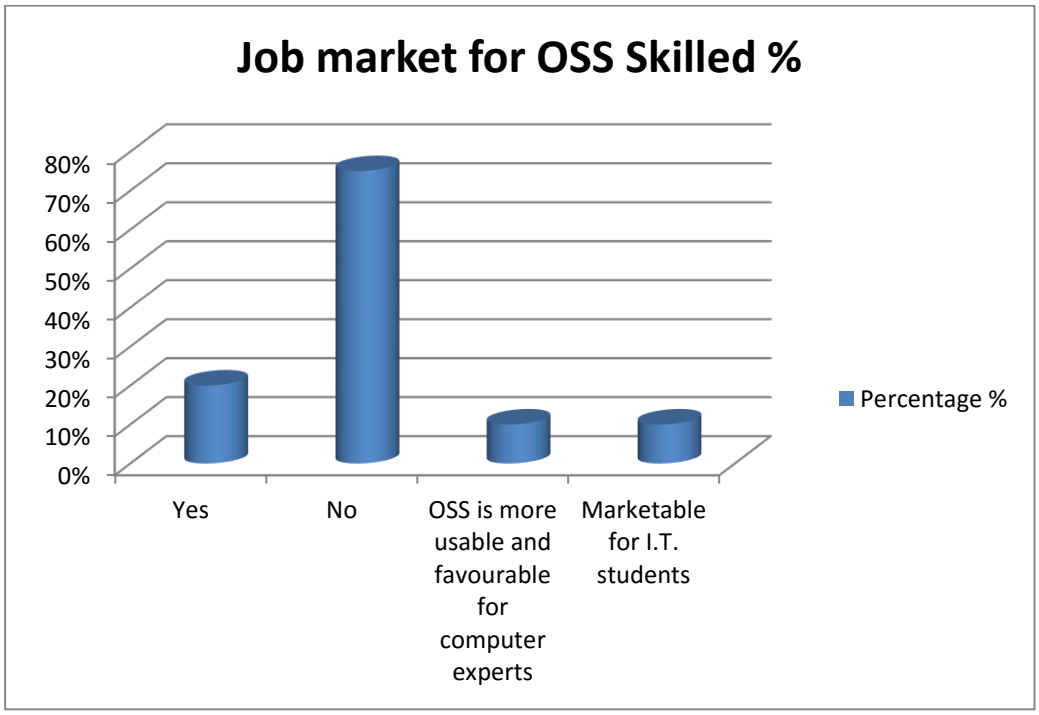


Figure 6.3-13: Summary for interview question 13 responses

Summary of interview results

The results obtained from the interviews indicate that the majority of the respondents have used OSS in cybercafés. This study notes that cybercafés do not install OSS out of choice but to avoid being apprehended by law enforcing agents. This study also noted that software license enforcement is only applied to cybercafés. The interviews further established that majority of the respondents prefer using PS. However the study noted that some respondents find OSS better than PS in some respects especially in terms of vulnerability to virus attacks.

The interviews established that training in OSS is very limited which is in agreement with the questionnaires findings. The other aspect that was confirmed in the interviews is that most users find OSS difficult in achieving tasks mainly because Desktop OSS uses a graphical user interface that is completely different from that of PS which they are used to. Further the interviews established that license fees for PS is way above what ordinary students can afford. The high fees of PS leads to software piracy in an effort to obtain the software they prefer. The further interviews confirmed that peers influence the kind of software the respondents use.

The interview results contributed to this study by confirming the results of the questionnaires and also gave an opportunity for probing the respondents in order to get more information. The results contributed in answering research questions 1, 2, 4 and 5 of this study.

The free Desktop OSS adoption model developed and tested in section 6.1.3 of this study has performed well. However it is important to validate it further in order to ascertain its suitability in the prediction of free Desktop OSS adoption among university students in Kenya. The next section (section 6.4) presents more formal validation results of the model.

6.4. Empirical validation of the OSS adoption model

The model validation exercise is important in model development because it assists the developer to ascertain that the new model is suitable in the scenario for which it has been developed. In a case where a model already exists, the validation exercise is useful in comparing the new model with the old one in order to establish whether the new one performs better. For example during the development of EUTAUT, the model was validated against UTAUT in order to verify whether EUTAUT was a better model in explaining behavioural intention and technology use than UTAUT (Venkatesh, et al., 2012). This section answers research question number 5.

In order to validate the free desktop OSS adoption model, three empirical studies were conducted. As explained below;

1. The first validation study aimed at comparing the prediction capability of the new free desktop OSS adoption model with EUTAUT. EUTAUT is an improvement of UTAUT and is arguably the latest technology adoption model which is quickly gaining popularity (Venkatesh, et al., 2012). This validation study aimed at determining whether the new Desktop OSS adoption model performs better than EUTAUT in the African scenario. The new OSS model will be termed better if the validation results indicate that the new model explains a higher level (in percentage) of the variance in free desktop OSS use than EUTAUT.
2. An OSS model validation questionnaire was developed and given to experts to give their opinion regarding the newly developed model. The individuals who were termed as experts are researchers who hold at least a master's degree and have been using technology acceptance models to conduct research.
3. Experts were interviewed in order to gather opinions regarding the newly developed model. The experts that were interviewed were selected among those that responded to the expert questionnaire.

6.4.1. Comparison of OSS adoption model with EUTAUT

A new set of data was collected using the original EUTAUT questionnaire (shown on Appendix D) and the questionnaire used to collect the original OSS adoption data (shown on Appendix A1) which was developed by the researcher for this study. The EUTAUT questionnaire was modified to capture the particularities of the OSS adoption study. The two different questionnaires (EUTAUT and OSS adoption) were given to 50 different respondents in the sampled universities as shown in the table below based on the percentages of the original study as shown in Table 6.3-1. The exercise was carried out in order to determine whether the new Desktop OSS adoption model performs better than EUTAUT in the African scenario.

Table 6.4-1 Number of participants per university

No	Name of University	Number of OSS questionnaire respondents	Number of EUTAUT questionnaire respondents	Percent
1.	MOUNT KENYA UNI	6	6	13.0
2.	KENYATTA UNI	8	8	15.9
3.	JKUAT	5	5	10.2
4.	MOI UNI	5	5	9.4
5.	NAIROBI UNI	6	6	13.0
6.	DAYSTAR	2	2	3.9
7.	BARATON	1	1	2.6
8.	CATHOLIC	3	3	5.2
9.	USIU	1	1	2.6
10.	SCOTT THEOLOL	1	1	2.6
11.	AGA KHAN	1	1	2.6
12.	STRATHMORE	2	2	3.1
13.	KABARACK	1	1	1.8
14.	KEMU	3	3	5.2
15.	KERIRI WOMEN	1	1	1.3
16.	MASENO	2	2	4.7
17.	MASINDE MULIRO	1	1	2.9
	Total		50	100

Table 6.4-2 Results comparison of OSS adoption model with EUTAUT

	OSS Adoption model		**EUTAUT**	
	D only	**D + I**	**D only**	**D + I**
R^2	0.851	0.957	0.56	0.7896
Adjusted	**0.849**	**0.944**	**0.55**	**0.7606**
SOCIALECONOMICSTATUS	0.32	89.27**		
PRIOREXPERIENCE	0.58	73.49**		
OSSCOMPATIBILITYWITHOTHERSOFTWARE	0.44	13.93**		
USERTRAINING	0.66	76.17**		
SOCIALINFLUENCE	0.84	15.35*		
OPENSOURCESOFTWAREUSABILITY	0.81	85.3		
USERTRAINING:JOBMARKETDEMANDS		96.32*		
OPENSOURCESOFTWAREUSABILITY:PROPRIETARYSOFTWAREPIRACYCULTURE		63.13		
OSSCOMPATIBILITYWITHOTHERSOFTWARE:PATENTANDCOPYRIGHT LAWS		70.3		
SOCIALINFLUENCE:AGE		32.99*		
SOCIALINFLUENCE:GENDER		65.74		
EFFORTEXPECTANCY			0.87**	1092.30**
FACILITITATINGCONDITIONS			0.39*	2000.83**
HEDONICMATIVATION			0.56*	529.32**
PERFORMANCEEXPECTANCY			0.42	5755.51
PRICEVALUE			0.45·	927.46*
SOCIALINFLUENCE			0.43·	-828.64
HABIT			0.12	228.64
GENDER				4194.03
AGE				5382.00
YEAROFSTU				-7064
GENDER:AGE				-1855.01
GENDER:YEAROFSTU				-153**
AGE:YEAROFSTU				1733.91
EFFORTEXPECTANCY:GENDER				-369.99
FACILITITATINGCONDITIONS:GENDER				-150.50
HEDONICMATIVATION:GENDER				846.45
PERFORMANCEEXPECTANCY:GENDER				-1184.19
PRICEVALUE:GENDER				-1.2722

SOCIALINFLUENCE:GENDER				-0.8139*
HABIT:GENDER				0.5262
EFFORTEXPECTANCY:AGE				-445.95
FACILITITATINGCONDITIONS:AGE				-962.98
HEDONICMATIVATION:AGE				375.84
PERFORMANCEEXPECTANCY:AGE				-1920
PRICEVALUE:AGE				170.30
SOCIALINFLUENCE:AGE				161.32
HABIT:AGE				192.76
EFFORTEXPECTANCY:YEAROFSTU				-66.08
FACILITITATINGCONDITIONS:YEAROFSTU				-25.28
HEDONICMATIVATION:YEAROFSTU				926.65
PERFORMANCEEXPECTANCY:YEAROFSTU				-637.50
PRICEVALUE:YEAROFSTU				196.39
SOCIALINFLUENCE:YEAROFSTU				276.66
HABIT:YEAROFSTU				-76.56
GENDER:AGE:YEAROFSTU				9.04
EFFORTEXPECTANCY:GENDER:AGE				91.41
FACILITITATINGCONDITIONS:GENDER:AGE				25.31
HEDONICMATIVATION:GENDER:AGE				80.48
PERFORMANCEEXPECTANCY:GENDER:AGE				73.88
PRICEVALUE:GENDER:AGE				69.3
SOCIALINFLUENCE:GENDER:AGE				10.06
HABIT:GENDER:AGE				55.78
EFFORTEXPECTANCY:GENDER:YEAROFSTU				122.7379
FACILITITATINGCONDITIONS:GENDER:YEAROFSTU				50.3062
HEDONICMATIVATION:GENDER:YEAROFSTU				-282.68
PERFORMANCEEXPECTANCY:GENDER:YEAROFSTU				394.0869
PRICEVALUE:GENDER:YEAROFSTU				5.81
SOCIALINFLUENCE:GENDER:YEAROFSTU				72.12
HABIT:GENDER:YEAROFSTU				96.81
EFFORTEXPECTANCY:AGE:YEAROFSTU				84.54
FACILITITATINGCONDITIONS:AGE:YEAROFSTU				17.58
HEDONICMATIVATION:AGE:YEAROFSTU				69.25
PERFORMANCEEXPECTANCY:AGE:YEAROFSTU				90.32
PRICEVALUE:AGE:YEAROFSTU				55.67
SOCIALINFLUENCE:AGE:YEAROFSTU				81.56

HABIT:AGE:YEAROFSTU				68.49
EFFORTEXPECTANCY:GENDER:AGE:YEAROFSTU				43.91
FACILITITATINGCONDITIONS:GENDER:AGE:YEAROFSTU				61.24
HEDONICMATIVATION:GENDER:AGE:YEAROFSTU				16.28
PERFORMANCEEXPECTANCY:GENDER:AGE:YEAROFSTU				76.21
PRICEVALUE:GENDER:AGE:YEAROFSTU				54.45
SOCIALINFLUENCE:GENDER:AGE:YEAROFSTU				41.76
HABIT:GENDER:AGE:YEAROFSTU				25.19

Analysis method used – Structural equation modelling technique (SEM)

D is Dependent variables

I is the interaction which are the moderators.

R square goodness of fit measure which lies between 0 to 1 or 0 to 100 per cent. The closer it is to 1 or 100 the better the fit.

An * implies that the statistic is significantly different from zero at 5% level of significance

A ** implies that the statistic is highly significantly different from zero at 1% level of significance

The adjusted results with the dependent variable for the OSS adoption model explained 84.4% of the variance and after introducing the moderating variable the model explained 94.4% of the variance in free desktop OSS use. On the other hand the EUTAUT model explained 55% of the variance without the moderating variables. After the introduction of moderating variables, the model explained 76 % of the variance in behavioural intention to use free desktop OSS.

From the results above, the newly developed model explains 94.4% of the variance in free desktop OSS use while EUTAUT explained 76% of the variance in behavioural intention to use free desktop OSS. This is an indication that the OSS adoption model has a better capability of predicting Desktop OSS adoption in the Kenyan setup than EUTAUT.

6.4.2. OSS model validation using experts through questionnaires

An OSS model validation questionnaire was developed and given to 20 experts to give their opinion regarding the newly developed mode (see appendix E). The individuals who were regarded as experts in this study are Masters and Ph.D. holders in the area of information systems

who have experience in conducting research using the technology adoption models. All the experts who were selected for this study are based in Kenyan universities. The questionnaire contained eleven (11) Likert scale questions.

a) Question on Open source software usability

		Strongly agree	agree	neutral	disagree	Strongly disagree
1	The usability of Open source software in terms of user friendliness, presence of help facilities, and ease of task performance etc. is likely to lead to its adoption.					

Results

The usability of Open source software in terms of user friendliness, presence of help facilities, and ease of task performance etc. is likely to lead to its adoption.	Frequency	Per cent
Strongly Agree	9	45.0
Agree	8	40.0
Neutral	3	15.0
Total	20	100.0

b) Question on social influence

		Strongly agree	agree	neutral	disagree	Strongly disagree
2	Software adoption decisions for young computer users such as university students are influenced by peers, and people that they deem important to them.					

Results

Software adoption decisions for young computer users such as university students are influenced by peers, and people that they deem important to them.	Frequency	Per cent
Strongly Agree	13	65.0
Agree	7	35.0
Total	20	100.0

c) Question on user training

		Strongly agree	agree	neutral	disagree	Strongly disagree
3	User Training improves the productivity of users while using software and enhances software adoption decisions.					

Results

User Training improves the productivity of users while using software and enhances software adoption decisions.	Frequency	Per cent
Strongly Agree	13	65.0
Agree	7	35.0
Total	20	100.0

d) Question on OSS compatibility with other software

		Strongly agree	agree	neutral	disagree	Strongly disagree
4	Software that is compatible with other common software is more likely to be adopted by users than one that is not compatible.					

Results

Software that is compatible with other common software is more likely to be adopted by users than one that is not compatible.	Frequency	Per cent
Strongly Agree	14	70.0
Agree	6	30.0
Total	20	100.0

e) Question on patent and copyright laws

		Strongly agree	agree	neutral	disagree	Strongly disagree
5	Compatibility of software and use of icons and interfaces is limited by Patent and Copyright Laws.					

Results

Compatibility of software and use of icons and interfaces is limited by Patent and Copyright Laws.	Frequency	Per cent
Strongly Agree	1	5.0
Agree	10	50.0
Neutral	9	45.0
Total	20	100.0

f) Question on social economic status

		Strongly agree	agree	neutral	disagree	Strongly disagree
6	Computer users are likely to adopt software they acquire for free or at a small fee they can afford.					

Results

Computer users are likely to adopt software they acquire for free or at a small fee they can afford.	Frequency	Per cent
Strongly Agree	9	45.0
Agree	11	55.0
Total	20	100.0

g) Question on prior experience

		Strongly agree	agree	neutral	disagree	Strongly disagree
7	Computer users are more likely to adopt software that they have used before than unfamiliar software.					

Results

Computer users are more likely to adopt software that they have used before	Frequency	Per cent
Strongly Agree	11	55.0
Agree	7	35.0
Neutral	1	5.0
Disagree	1	5.0
Total	20	100.0

h) Question on job market demands

		Strongly agree	agree	neutral	disagree	Strongly disagree
8	Job Market demands determine the kind of computer skills training institutions offer to the learners as a way of being responsive to the job market needs.					

Results

Job Market demands	Frequency	Per cent
Strongly Agree	7	35.0
Agree	12	60.0
Neutral	1	5.0
Total	20	100.0

i) Question on proprietary software piracy culture.

		Strongly agree	agree	neutral	disagree	Strongly disagree
9	Users employ any means of acquiring expensive but user friendly software including piracy and software reuse					

Results

Users employ any means of acquiring expensive but user friendly software including piracy	Frequency	Per cent
Strongly Agree	13	65.0
Agree	6	30.0
Neutral	1	5.0
Total	20	100.0

j) Question on age

		Strongly agree	agree	neutral	disagree	Strongly disagree
10	Younger software users are more likely to be influenced by peers, and people that they deem important to them while making software acquisition decisions.					

Results

Younger users are more likely to be influenced by peers in software acquisition	Frequency	Per cent
Strongly Agree	13	65.0
Agree	4	20.0

Neutral	3	15.0
Total	20	100.0

k) Question on gender

		Strongly agree	agree	neutral	disagree	Strongly disagree
11	The gender of a software user determines the level of influence by peers, and friends while making software acquisition decisions.					

Results

Gender of a software user determines the level of influence by peers in SW acquisition	Frequency	Per cent
Strongly Agree	1	5.0
Agree	10	50.0
Neutral	9	45.0
Total	20	100.0

The above results indicate that the model is generally acceptable to the experts. The experts have approved the different constructs because the majority of the respondents have either strongly agreed or agreed to the constructs. The results are in agreement with those of the first validation test that involved with the comparison of the EUTAUT and the desktop OSS adoption model.

6.4.3. OSS model validation using experts through interviews

A total of 10 experts with at least a doctorate in computing were interviewed using semi-structured interviews (see appendix F). Purposive sampling was used to identify interview respondents because the study desired to have respondents who hold doctorate degrees in computing in order to get useful feedback. The Ph. D. holders that were interviewed are those that were found to have experience in using technology adoption models in research.

Table 6.4-3 Expert interview analysis

No.	Question	General response	Additional information obtained after probing
1	What is your opinion regarding usability of open source software in relation to its adoption?	• Usability is a significant factor that determines whether a user will adopt software or not.	• In your opinion what is the level of OSS usability? The existing OSS software is not very usable compared PS. • What do you think can be done to make it more usable? OSS developers need to create appealing and easy to use interfaces. • The main problem with OSS is that the developers think they are creating the software for experts and not average users.
2	What is your opinion regarding social influence in relation to the adoption of Open Source Software among university students?	• It is common for young users to be influenced by their peers on matters relating to technology use. • Not on all occasions are users influenced by peers, others want to look different.	• In the case of OSS do you think peer influence can result to OSS adoption? Yes in some circumstances. • In what circumstances? In the case where a technology looks trendy. Most young users like being associated with trendy technologies.

3	What is your opinion regarding training in relation to adoption of Open Source Software among students in universities in Kenya?	• User training is important because it empowers users to use an application. • Some individuals are able to learn certain things on their own	• Do you think OSS training is accessible in Kenya? Not at all • In your opinion why is the training not offered? Because there is very little demand for OSS skills in the country. • Do you think if the training was to be offered, more users would adopt OSS? Yes
4	What role do you think compatibility of Open Source Software with other software play in the adoption of Open Source Software?	• Users prefer software that is compatible. • It is not a major issue, what users prefer is user friendly software	• What are the different aspects of compatibility in software? There is skills compatibility, and technology compatibility. Skills compatibility means that a user can be able to transfer the skills to a different application area, while technology means that the two software can be able to share files.
5	To what extent do you think Patent and Copyright Laws limit the usability features such as icons of OSS?	• OSS cannot use the same features due to copyright laws due to the existing copyright laws. If OSS was allowed to use the icons used in PS users might find the software better	• What do you think can be done? OSS developers should create better icons and easier interfaces than PS. • Do you think that OSS can still be user friendly without copying HCI features of PS? Yes it is possible because apple and android interfaces have been adopted and they have not used icons used by PS.

6	What is your opinion on the likelihood of students with a low income adopting free Open Source Software?	• The students are more likely to adopt free software	• Do you think that most students from developing countries are in a position to buy software? Most students generally struggle to buy PCs so the additional cost of software is too high for them to afford. Many students buy second hand computers. • Those that buy second hand computers, do the computers come with software already installed? Mainly the operating system.
7	What role do you think prior experience plays in the adoption of Open Source Software?	• Users who have used a certain software are more likely to adopt a similar technology • Experienced users are more confident to try a new technology	• Do you think students in Kenya have opportunities to use OSS? There are few opportunities unless an individual user develops interest and downloads the software. Some users are not even aware of OSS.
8	What is the effect of job market demands to training programmes in institutions of higher learning?	• Training institutions are supposed to align their programs with the job market demands.	• What skills do you think are being demanded by the current job market? Ms Windows, Ms Office as basic computing skills. Courses such as International computer driving licence is a common qualification that offers Microsoft training but there is none for OSS.
9	What role do you think piracy plays in the	• Users who like proprietary software in most cases pirate the software.	• Do you think piracy is a major issue in Kenya? Yes, many users do not buy software

	adoption of proprietary software?		because they think it is expensive • What price do you think could be affordable to students? Any amount less than 2,000 shillings
10	Do you think proprietary software is more usable than Open Source Software?	• In most cases users find proprietary software more user friendly	• Why do you think users find PS more user friendly? Mainly because they were introduced to computers using PS. Icons and interfaces used in OSS are less familiar
11	In your opinion does age matter in relation to influence of peers in making software acquisition decisions?	• In some cases age is a factor that determines influence especially for younger users	• In what cases do you think Age may not matter? If a user really needs a technology in order to perform a task age may not matter. If a user is using a technology for leisure, age many matter. • Why would age matter if the technology is being used for leisure? Because young users are likely to be influenced by their peers
12	In your opinion does gender matter in relation to influence of peers in making software acquisition decisions?	• Gender matters and is a determinant in software acquisition • For software acquisition and adoption decisions gender may not matter	• Why does gender not matter? May be because OSS technology can be used to perform tasks such as assignments and not for fashion
13	What is your opinion regarding the new OSS adoption model?	• The model is appropriate. It has captured the major constructs.	• How do you think it can be improved? The model can be improved by including more indigenous factors that are

			applicable in the Kenyan situation for example government regulation or policies

The interviews validation findings further supported the proposed model because the experts approved most of the constructs in the newly developed model. The results of the validation interviews were consistent with those of the validation questionnaires. However some of the experts who served as respondents did not agree that gender determine the extent of influence in making software acquisition decisions. A new insight gained in the interviews was in the area of usability where some experts suggested that OSS does not have to use similar icons with PS for it to be usable. The OSS developers should strive to make better interfaces than PS so that OSS can be more user friendly.

6.5. Summary

This chapter has presented descriptive and inferential statistics results which are drawn from the questionnaire and interview analysis. The respondents who participated in filling in the questionnaires were 384 while whose that participated in the interviews were 20 drawn from all the different universities in Kenya. The results of the descriptive data analysis established the following;

a) The majority of the users feel that Open source software is not user friendly

b) The students' peers, lecturers and others that influence their behaviour have also not been influencing the respondents to use OSS.

c) The majority of the respondents have not been trained in the use of OSS

d) OSS is not compatible with PS in several areas

e) The majority of the users feel that OSS uses very different icons, menus and interfaces from those used by PS.

f) The majority of the respondents cannot afford proprietary software in their current status due to their limited resources.

g) The majority of the respondents have limited opportunities to use OSS.

h) A good number of employers require employees who can use OSS

i) Software piracy is rampant among the students population

j) The majority of the respondents do not use OSS

An OSS adoption model proposed in chapter four (4) was also tested and validated. The results indicated that user training, usability, OSS compatibility, social influence, prior experience and social economic status have significant combined effect on OSS adoption. Qualitative data from the interviews was also analysed and pattern matching was done to establish the trends and the possible reasons.

The validation of the proposed OSS adoption model gave very positive results regarding the suitability of the model in the Kenyan university students' setup. Validation was carried out by comparing the capability of EUTAUT with the new OSS adoption model in predicting free desktop OSS adoption. Questionnaires were given to experts and interviews conducted in order get the opinion of experts regarding the suitability of the new free desktop OSS adoption model.

The next chapter discusses findings of the quantitative and qualitative analysis. The chapter also contains the conclusions and the recommendations drawn from the study.

Chapter 7

Discussion of research findings

7.0. Introduction

This chapter discusses the finding of the study, recommendations and the conclusions drawn from the study. The aim of the study was to investigate the adoption of OSS products in African developing countries with a focus on university students in Kenya. The study further aimed at developing a new model that is more suitable in a developing country scenario.

7.1. Adoption of desktop open source software by university students in Kenya

This study established that the majority of the students use proprietary software. The questionnaire findings in table 6-15, indicate that 84.9% only have PS such as Windows and Microsoft Office installed and have no OSS such as Open office and Ubuntu. Only 9.1% of the respondents agreed that they had installed OSS products, while 6.0% of the respondents were not sure. This is an indication that PS is entrenched among the Kenyan student population. This finding answered research question number 1 on the levels of adoption of free desktop open source software by university students in Kenya. The findings above are consistent with the study of Ellis & Belle (2009), which was conducted in South Africa. The Ellis & Belle (2009), study revealed that OSS adoption levels are very low in organisations although their study did not investigate adoption among individuals. Another study conducted by Amega-Selorm & Awotwi (2010), in Ghana revealed that PS software such as the Mcrosoft Windows OS was taking the lead at 84.7% adoption levels. The study of Mutula and Kalaote (2010), also gives similar results by noting that in Botswana OSS is not widely used.

Although there are limited studies on OSS adoption levels in the world, the above findings reveal that there is a notable disparity in terms of OSS adoption in Africa with other parts of the world. This can be confirmed by the report by Cenatic team (2010), which revealed that some South and North American countries such as Mexico and Brazil have above 50% adoption of OSS products. In developed countries such as France, America, United Kingdom, Spain and Italy OSS has been widely adopted with adoption rates above 50% in many of the mentioned countries.

7.2. Factors affecting adoption of desktop open source software by university students in Kenya

This study investigated the contribution of some perceived factors thought to be significant in the adoption of OSS in Developing countries. The factors as hypothesised in the study are;

usability, user training, OSS compatibility, social influence, prior experience, social economic status, job market demands, proprietary software piracy culture and patent and copyright laws. The findings discussed below answer the research question 2, which seeks to investigate the factors affecting adoption of free desktop open source software by university students in Kenya.

7.2.1. Usability

This study established that the majority of the users feel that OSS is not user friendly compared to PS as presented in Table 6-6. The specific areas the questionnaire covered are; ease of recognising icons, availability of good help facilities, and ease of navigation and performance of tasks in OSS. The respondents felt that PS is better than OSS in all the above aspects. The interview responses on OSS usability established that performing tasks in OSS is perceived to be difficult. Some respondents in the interviews said the difficulty was as a result of having different icons from those used in PS and the way the programs are presented.

The above findings are consistent with those of a study by Sen (2007 a) who concluded that one of the main competitive advantages of PS over OSS is usability. He further argues that if OSS has to compete with PS, the OSS developers need to benchmark with PS. Raza & Capretz (2012) argues that although user centred designs are gaining popularity within OSS, usability is not being considered as one of their primary goals.

This study has established that OSS is perceived as being less user friendly compared to PS. In order to improve on its usability, the human computer interface needs to be improved in order to be at par with PS. The icons need to be improved and made easier to recognise by designing them to look closer to the ones that are used in PS as the users are used to them. Likewise the navigation needs to be redesigned to be similar to that of PS.

The study noted that all the computer users are introduced to PS when starting to use computers. By the time the users encounter OSS they are used to PS and it therefore becomes challenging to convert to OSS because of the difference in human computer interface (HCI) features in the two. The author suggests that if they had been introduced to OSS before PS the same conversion challenge would have been experienced due to the difference in the two types of software.

7.2.2. User training

The results of user training in this study as presented in table 6-8 reveal that the majority of the respondents have not been trained in the use of OSS. The study further noted that the general computer training offered as a common course in the university generally covers PS products. Most of the respondents also said that they did not have adequate skills relating to use of OSS

and further said that it is not easy to find OSS training. This situation is alarming as user training is key in the adoption of technologies such as software as noted by Bedard et al., (2003). End-user training results in end-user ability to use information systems which consequently contributes to acceptance of Information Systems (IS) technologies (Hung, et al., 2012).

This study notes that due to the limited OSS training opportunities in universities, adoption of OSS products is likely to continue being low unless there is a change of policy by the training institutions. As noted in the usability study in section 7.2.1, if students are introduced first to PS products, it becomes difficult to convert to OSS users due to the difference in the HCI features in the two types of software. The OSS adoption situation is made worse by the fact that non computing students are not trained at all on using OSS products so they have to learn using it on their own, from friends, and using help facilities on the Internet as noted from the interviews in table 6-37.

7.2.3. OSS Compatibility

The majority of the respondents in this study as presented in Table 6-9, felt that OSS is not compatible with PS in a number of ways. The different areas of incompatibility as noted by the respondents are; transfer of knowledge from PS to OSS, compatibility of documents across the two types of software, ability to install application software across the OSS and PS platforms. Generally above 70% of the respondents in this study felt that OSS is not compatible with PS in all the above aspects.

Compatibility is a desirable characteristic in software as it gives users flexibility and freedom to use any preferred software. With such flexibility users do not have to worry about compatibility in cases where users wish to open a document created in a software by a competitor company. In some cases users create documents in a particular software and they send it to another individual who does not have the software they used to create the document.

Apart from the document portability, users prefer having similar icons and HCI features so that it becomes easy to transfer PS skills to OSS. This can be confirmed by the interview responses presented in Table 6-44 and Figure 6-13. The findings of this study are consistent with those of a study by Dedrick and West (2004), who noted that the decision to implement an OSS platform is greatly influenced by the compatibility of the new technology with current technologies, skills and tasks. This finding is further supported by Morgan & Finnegan (2007), who noted that compatibility is one of the drawbacks of OSS. According to them incompatibility with current technology, skills and tasks is a weakness of OSS.

In order to have higher adoption levels among the university students, it is important for OSS software developers to have compatibility in mind. This does not only apply to the Kenyan university student population but also applies to other populations including users in developing countries at large. One of the major inhibitors of compatibility is the PS companies who do their best to ensure PS is not compatible with OSS in all aspects (Appelbe, 2003). Appelbe (2003), also note that companies such as Microsoft deliberately make sharing of documents difficult and inconveniencing.

7.2.4. Patent and copyright laws

The results of this study established that the majority of the respondents felt that OSS uses very different icons from those of PS. More than 90% of the respondents felt that if OSS used the same icons as those of PS, OSS would be more user friendly. This study notes that, icons, images are copyrighted by popular companies such as Microsoft and they restrict their use either in software, television programs, movies or in videos (Microsoft, 1999). It is for this reason that the OSS developers avoid using similar icons to those of well established companies such as Microsoft.

The author opines that it is possible to use similar HCI concepts without using the exact icons in order to achieve better usability acceptance and compatibility.

7.2.5. Social influence

This study established that software adoption decisions of the users in the studied population are influenced by their peers. The questionnaire findings revealed the studied population is highly influenced by peers, lecturers and other people they respect with more than 90% of the sample acknowledging this influence. One of the reasons given for this influence is that they can easily get help if they get stuck. They also prefer using software that their peers are using because it becomes easy to share files, while others do not want to be different from their peers and people they respect.

The above findings are consistent with other related studies such as that of Vannoy & Palvia (2010), which concluded that social influence is a factor that contributes to technology adoption in general. Another study conducted by Gwebu and Wang (2011), also indicated that social influence has a significant role in adoption of OSS technologies.

7.2.6. Social economic status

The findings of this study indicated that the majority of respondents are not in a position to acquire licenced software because it is expensive. However over 97% of the respondents felt that if they were earning a good salary, they would buy PS. This means that the respondents prefer PS to OSS and they can only adopt OSS in situations where they are unable to acquire PS.

The finding above is a clear indication that PS is generally not affordable to ordinary users in developing countries. OSS products could take advantage of this situation to push OSS among this population.

7.2.7. Prior experience

The majority of respondents of this study felt that they had limited opportunities to use OSS. The respondents had not come across OSS before joining university although the study noted that some cybercafés have OSS. The reason why cybercafés install OSS as noted in the interviews is to comply with the law and not by choice or demand from their customers.

This study noted that the limited opportunities to use OSS deny the respondents an opportunity to gain experience which is essential in adopting OSS products. These findings are consistent with those of Fazio & Zanna (1978), and similarly to those of Ajzen (1991), who established that prior experience of a technology is more likely to result in use of it because experience makes knowledge more accessible in memory. In order to achieve higher adoption levels, it is important to give users opportunities to use OSS.

7.2.8. Job market demands

This study established that students perceive that a number of employers require employees who can use OSS. During the interviews it emerged that not all professions require OSS knowledge but only applies to computing graduates as some companies' servers run on OSS platforms. This was confirmed during the interviews as the respondents felt that computing students would be more marketable if they possessed OSS skills.

This study concludes that job market demands influence the training needs of students. The fact that most career professionals do not require OSS skills may be the main reason why institutions do not find it necessary to offer the training.

7.2.9. Piracy culture

This study noted that a software piracy culture among the studied population is an ordinary thing and they do not find anything wrong with it. The majority of the studied population do not

purchase licensed software but they install the software from friends at a small fee or none at all. Although the respondents are aware of the challenges that come with pirated software, they seem to find acquiring legal PS too expensive so they resort to piracy. The findings above are consistent with other studies such as the one conducted by Business Software Alliance (2010), which indicated that PS piracy is rampant and is on the increase in emerging economies such as Kenya. The Business Software Alliance (2010), also noted that software licence reuse was found to be the most common form of piracy. This is similar to the findings of this study as the students also normally copy software from their friends as indicated in the interview findings.

The study noted that the high piracy rates can be attributed to the high cost of PS. If the respondents were to adopt OSS they would not need to pirate PS. The study also noted that law enforcement agencies are not able to enforce licence compliance on individuals but only do so in public places such as in cybercafé's.

7.2.10. Open source software adoption

OSS adoption among the Kenyan students population is very low as noted in this study. The questionnaire responses indicate that more than 80% of the sampled population do not have any form of OSS software in their computers. On the same theme it is important to note that more than 75% of the respondents bought their computers with Windows already installed as can be seen in table 6-15. The findings are consistent with other similar studies conducted in the area such as the finding of Bridges.org (2005), who noted that there is very limited use of OSS in most African countries.

7.3. The applicability of the existing technology acceptance models to OSS desktop applications among university students in Kenya

Chapter 3 reviewed common technology adoption models namely the TRA, TAM, MM, TPB, Combined TAM and TBP, MPCU, DOI, SCT, UTAUT and EUTAUT. This study established that the above models lack in a number of aspects which are important in predicting OSS adoption in developing countries and specifically in the case of desktop OSS adoption by university students in Kenya. The majority of the theories such as TAM, MM, Combined TAM and TBP, MPCU lack important constructs that are significant in predicting OSS adoption in a Developing country context. The findings are consistent with the findings of Brown and Irwin (2002), who concluded that TAM does not apply in the same way in a developing country as it was developed with a developed country in mind. The TPB was found inappropriate because some of its items require an explicit behavioural alternative in order to make them as specific as possible.

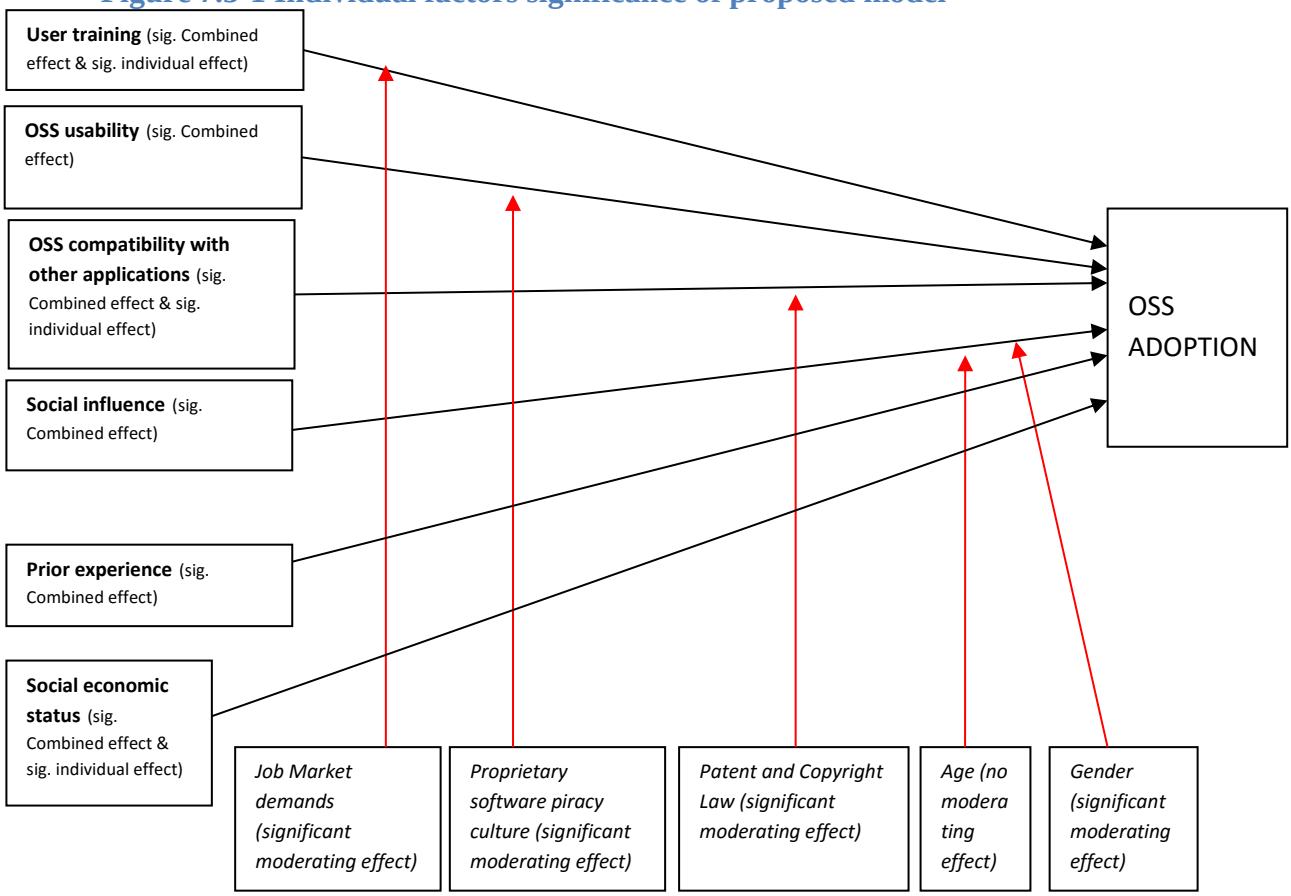
This study concluded that combined TAM and PBT on the other hand do not include some important factors of adoption such as prior experience. MPCU ignores the cost factor which is important in the adoption of OSS products. In DOI, experience which is an important factor has been ignored as a factor that contributes to the adoption of a technology apart from the fact that it was developed purposely for new technological innovations as presented in the model by Rogers (1995).

This study further noted that SCT model does not have constructs relating to attributes of the IS product being investigated as detailed in Table 3-1. The SCT model was also not originally developed to study technology adoption. The UTAUT model was also considered and the study established that the cost factor as a determinant in the adoption of a technology has been ignored in the model this fact was confirmed by some of its own authors Venkatesh et al., (2012). This is a major omission because the amount of money to be spent in relation to the perceived benefits is an important factor to be considered when adopting a technology.

This study finally examined the EUTAUT model which is relatively new and is an extension of UTAUT. This study noted that the model was developed and tested in a developed country and tested in one cultural setup. The study further noted that the model bundles some important constructs into one construct making it impossible to measure the impact of the individual factors influencing the uptake of OSS adoption in Africa. Facilitating conditions include too many items in one and in this case user training, usability and compatibility with other competing applications can be termed as facilitating conditions. The author opines that it is important to measure the impact of these individual factors/constructs in the adoption of OSS products and even determine their moderating variables.

In conclusion all the above models were generally developed and tested in developing countries and lack some important aspects that are significant in predicting technology adoption in developing countries. In addition as stated before, the majority of the theories such as TAM, MM, Combined TAM and TBP, MPCU lack important constructs that are significant in predicting OSS adoption in a Developing country context. The findings discussed above answer research question number 3 on the applicability the existing technology acceptance models in measuring adoption of free desktop open source software applications by university students in Kenya.

Figure 7.3-1 Individual factors significance of proposed model



Source: researcher

7.4. The proposed OSS adoption model

The proposed model has user training, OSS usability, OSS compatibility with other applications, social influence, prior experience, and social economic status as the independent variables. This study aimed at confirming or rejecting the role of these factors in the adoption of desktop OSS in a developing country setup. The ANOVA test results revealed that user training, usability, OSS compatibility, social influence, prior experience and social economic status have a significant combined effect on OSS adoption. Further regression tests revealed that user training, OSS compatibility and social economic status have significant individual influence on OSS adoption at 10% level of significance.

The proposed model has usability as one of the variables that contribute to OSS adoption. This can be compared to one of the main constructs in TAM which is perceived ease of use which was found to be significant in predicting the level of systems use (Davis, 1989). In TAM, perceived

ease of use is defined as the level to which an individual believes that using a technology is free from effort and therefore can be equated to usability in the case of software. Ease of use also features prominently in the combined TAM and TBP developed by Taylor and Todd (1995). In the model of PC utilisation developed by Thompson et al., (1991), complexity is one of the main constructs which in their study is defined as "the degree to which an innovation is perceived as relatively difficult to understand and use" (Thompson et al., 1991). Complexity has an element of usability because if a system is not user friendly, it can be termed as complex (Thompson, et al., 1991). Complexity also features prominently in the DOI developed by Rogers (1995). In both UTAUT and EUTAUT, usability is presented in the form of effort expectancy which Venkatesh et al., (2012), define as "the degree of ease associated with the use of the system" (Venkatesh et al., 2012 pg. 450). Effort expectancy was found to play a significant role in the adoption of a technology in both UTAUT and EUTAUT. Therefore the findings of this study are consistent with those of TAM, combined TAM and TBP, DOI, UTAUT and EUTAUT.

OSS compatibility with other applications is the other construct in this study which was found to contribute to the adoption of OSS adoption. Compatibility features in combined TAM and TBP as a factor and is defined as the degree to which an "innovation fits with potential adopters' existing values, previous experiences and current needs" (Taylor & Todd, 1995 pg. 152). In other models such as the model of PC utilisation, UTAUT and EUTAUT compatibility does not feature anywhere as a factor. These models have facilitating conditions as a construct where compatibility can fit as discussed in section 2.11.

Social influence was found to be a significant factor contributing to OSS adoption in this study. This is consistent with the model of PC utilisation which has social factors as a construct. In the model, social factors are defined as "individual's internalization of the reference group's subjective culture, and specific interpersonal agreements that the individual has made with others, in specific social situations" (Thompson et al., pg. 126). The UTAUT and EUTAUT models equally have social influence as a significant construct which in their studies was established as being moderated by individual characteristics such as age gender and experience (Venkatesh, et al., 2012).

Prior experience is another variable that was found to contribute to OSS adoption in this study. This is a departure from other technology adoption models as they do not explicitly have this construct apart from the UTAUT and EUTAUT models where it was taken as a moderating variable of facilitating conditions in both models. In other models such as the model of PC

utilisation and combined TAM and TBP prior experience can be classified as a facilitating condition.

In this study social economic status of the individual was found to have significant individual influence on OSS adoption at 10% level of significance. This is a departure from other technology adoption models as they do not explicitly have this construct apart from the EUTAUT model which has price value as a construct. According to Venkatesh et al., (2012) hypothesis, the cost and pricing structure was hypothesised to have a significant impact on consumers' adoption of a technology although in their study price value is moderated by age and gender. The Venkatesh et al., (2012) study established that the price value had a contribution to the adoption of a technology and noted that it was more important to older women. In other technology adoption models, social economic status can be categorised under facilitating conditions. This is not appropriate in the case of OSS adoption in an African setup because the construct is playing a key role as a determinant of adoption.

In the proposed OSS adoption model, the study hypothesised that gender has a moderating effect on the relationship between social influence and OSS adoption which was found to be correct after performing the ANOVA test. This hypothesis is consistent with that of Venkatesh et al., (2003) and Venkatesh et al., (2012) which had gender as a moderating variable for social influence although in their study gender was also moderating performance and effort expectancy which are absent in the proposed OSS adoption model.

The other hypothesised moderating variable is age as a moderator for social influence. This study established that age was not significant (P-value > 0.05) implying that age did not have a significant moderating effect on the relationship between Social Influence and OSS adoption. This is a departure from the study of Venkatesh et al., (2003) which hypothesised that age is a moderator for social influence, effort expectancy, performance expectancy, and facilitating conditions. Their study established that age is a moderator of social influence, effort expectancy, performance expectancy, and facilitating conditions. This departure can only be explained by the fact that this OSS adoption study dealt with respondents (university students) who were generally from the same age group as they were aged between 18 – 26 years of age. If the same study was to be repeated with a population that has varying age groups, it is likely to give different results from the ones obtained in this study.

The other moderating variable in this study was copyright and patent laws which was found to have a moderating effect on the relationship between OSS compatibility with other applications

and OSS adoption. The fourth moderating variable was proprietary software culture which was found to have a significant moderating effect on the relationship between OSS usability and OSS adoption. The fifth moderating variable was job market demands which was found to have a significant moderating effect on the relationship between user training and OSS adoption. Copyright and patent laws, proprietary software culture and job market demands are new as they have not been hypothesised and tested in other studies. The findings discussed above answer research question number 4 which demonstrated the applicability of the developed OSS adoption model which is applicable to the situation in Kenya.

7.5. Chapter summary

This chapter has presented a discussion of the results of this study and compared them with the results of similar studies that have been conducted in the past. This study has established that OSS adoption is very low among university students. The factors that were found to contribute to OSS adoption are usability, user training, OSS compatibility, social influence, prior experience, social economic status, job market demands, proprietary software piracy culture and patent and copyright laws.

The existing technology adoption models such as TAM, MM, Combined TAM and TBP, MPCU lack important constructs that are significant in predicting OSS adoption in a developing country context. This study proposed a model for OSS adoption for a developing country which was found to be appropriate in such a setup. The next chapter will conclude the study and suggest areas of future research.

Chapter 8

Conclusion

8.0. Introduction

This chapter concludes the findings of the study of OSS adoption among university students in a developing country which further assessed the appropriateness of the existing technology adoption models in this scenario. The study developed and validated an appropriate model that is more suitable in predicting the adoption of OSS in a developing country scenario. This chapter contains pointers to key areas of knowledge contribution made by this study. The chapter further discusses potential areas which can be studied in the future which this study was not able to adequately address.

8.1. Key findings

This study had five research objectives as presented in Section 1.2. The first objective sought to investigate the level of adoption of desktop open source software by university students in Kenya. This study established through an empirical study that OSS adoption is very low among university students. Only 15.1% of the population under study had adopted OSS products while the rest were exclusively using PS products.

The second objective in this study was to investigate the factors affecting adoption of desktop open source software by university students in Kenya. An empirical study was conducted which established that the factors affecting adoption of desktop OSS are usability, user training, OSS compatibility, social influence, prior experience, social economic status, job market demands, proprietary software piracy culture and patent and copyright laws.

The third objective was to investigate the applicability of the existing technology acceptance models to OSS desktop applications in the Kenyan situation and in particular to the Kenyan university students. A review of all the current common technology acceptance models was conducted as presented in Chapter 3 of this report which established that the popular models were lacking in some aspects that are useful in predicting OSS adoption in the Kenyan scenario.

The fourth objective was to develop an OSS adoption model which is applicable to the situation in Kenya and may be applicable more broadly in Africa. The model was developed as presented in chapter 4 of this report. The model has user training, OSS usability, OSS compatibility with other applications, social influence, prior experience, social economic status as the independent

variables. The moderating variables in this model are job market demands, proprietary software piracy culture, patent and copyright laws, age and gender as presented in Figure 6-2.

The fifth and the last objective in this study was to validate the OSS adoption model developed in four (4) above. This was done using statistical tests such as R-square goodness of fit and ANOVA test which is conducted in order to analyse the systematic factors that are statistically contributing to the data set's variability. The proposed model was found appropriate in predicting adoption of OSS products among university students. The statistical validation results of the proposed model are presented and discussed in Sections 6.1.2 and 6.1.3 of this report.

8.2. Theoretical academic contributions

The study concluded that the factors affecting adoption of desktop OSS are usability, user training, OSS compatibility, social influence, prior experience, social economic status, job market demands, proprietary software piracy culture and patent and copyright laws. These factors are likely to be the same in other populations in Kenya although it is worth investigating to see whether they are applicable locally in other populations and in other developing countries.

This study noted that the popular technology adoption models were developed and tested in developed countries. These models are not the most ideal in a developing country setup as the countries have their own dynamics that need to be taken into account by a more suitable model.

This study further noted that the existing models lack important constructs that are important in the prediction of technology adoption in a developing country. In this study the proposed model introduced OSS compatibility with other applications, prior experience, and social economic status as the independent variables which are new technology determinants as they have not been used in other studies. This study established that these new constructs are significant in the prediction of OSS adoption.

The study further introduced new moderators that have not been used in other studies which are; job market demands, proprietary software piracy culture, patent and copyright laws. This study was able to prove that the above are moderators of user training, OSS usability and OSS compatibility with other applications respectively.

8.3. Methodological contributions

The methodological approach undertaken in this research provides a guideline to other researches who wish to undertake a similar study. Such researchers will be able to get guidance on the design of the questionnaire, interview schedule as research instruments. They will also be able to get

pointers on sampling procedures, validity and reliability of the research instruments and the overall methodological approach undertaken in this study.

This study also provides guidance on statistical quantitative and qualitative data analysis to other researchers who wish to conduct a similar study.

8.4. Practical implications of the study

This study established that the adoption of OSS products in Kenya is very low and existing literature revealed that it is also the case in other developing countries. If OSS was to be made more usable than PS, users would find it easier to use and prefer to use it as opposed to PS. This would promote OSS products in developing countries and in turn reduce software piracy culture.

This study established that PS piracy culture is rampant in developing countries such as in Kenya. There is very little that the government does to stop this culture especially among individual users. The piracy culture has been a major hindrance to the adoption of OSS products in developing countries.

Training institutions in Kenya do not offer OSS training as basic computing skills but they offer PS training. This makes it difficult to convert from PS to OSS because they have not received any formal training. The conversion is also made more difficult due to the significant difference between the two types of software in terms of the graphical user interface.

This study further established that most PS and OSS products are not compatible including document format compatibility. This makes it difficult for users to move documents from PS to OSS. This discourages the population under study to use OSS as they can share the files with their friends and colleagues.

The study also established that students are influenced by their peers on areas of software adoption. It was noted that the university students like using the software their peers use because they don’t want to be different from them.

8.5. Recommendations

In order to make OSS products popular in developing countries it is important for the OSS movement to develop marketing strategies and programmes. The developers also need to pay close attention to the usability of the software in order to make it at par with their PS counterparts. Currently OSS uses icons and GUI that varies from PS which makes OSS products complicated to use. The OSS developers need to use icons and GUI features that are close to those of PS or

even try to lead with better designs without infringing copyright laws. OSS should also be made compatible with PS in order to make sharing of documents easier across the software.

Training institutions have a big role to play as they can be able to promote the use of OSS by offering basic training in these products and make it the natural choice of software for the learners. The institutions will able benefit by doing this as they will also cut licence costs. The learners will be able to make their own choice on whether to adopt OSS since they will be having the knowledge to use it.

The governments of developing countries such as Kenya need to make deliberate efforts to promote adoption of OSS products. This will save money in terms of licence fees which can be channelled to other areas of the economy. This can be done by passing legislation that supports the use of OSS products. The government also needs to take more measures to stop software piracy as it also hinders the adoption of OSS products.

8.6. Limitations of the study

This is a comprehensive study that sampled students from all the universities that had been established at the time of the study. The study covered university students in Kenya as a developing country. The generalizability of these results to other populations in Kenya and other developing countries in African cannot be ascertained.

8.7. Recommendations for further study

This study has focused on the adoption of Desktop OSS products among university students in Kenya. University students fall in the category of individual users. It would be important to conduct a study using the newly developed OSS model in organisations in developing countries in order to establish if it is applicable in these organisations. Organisations also use server software apart from the desktop software. It would be important to establish the adoption levels of the server, and desktop software in organisations in developing countries such as Kenya.

In the future it would also be important to undertake similar studies in other populations which have different age groups in order to establish whether the results would be similar to those of this study.

8.8. Conclusion

This chapter presents the conclusion of the study by highlighting the findings based on each research objective and research question. The theoretical and methodological contributions as well as the practical implications of the study are also presented. The chapter further presents the

recommendations to OSS developers, training institutions and the government of Kenya and other developing countries.

This study established that OSS adoption among university students is very limited and may be the case in other populations in Kenya and in other developing countries. The study further noted that the factors affecting OSS adoption are: usability, user training, OSS compatibility, social influence, prior experience, social economic status, job market demands, proprietary software piracy culture and patent and copyright laws.

The study also established that the existing technology models are not appropriate in predicting adoption of OSS in this population. This improved model which is more suitable in this scenario was developed and validated.

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Appendix A

Informed consent form

Questionnaire on the adoption of desktop open source software by university students in Kenya

This study is being conducted by John Wachira Kamau who is undertaking a Doctor of Philosophy in Information Systems at the University of South Africa (UNISA). The researcher seeks to identify the factors affecting the adoption of desktop open source software by university students in Kenya. The researcher hopes that the information that will be obtained from this study will be very useful in increasing the level of OSS adoption in the country and consequently lowering the software acquisition costs.

Informed consent

1. Voluntary participation: You are under no obligation to participate: You may skip any questions you are not comfortable answering. You may also withdraw your participation at any time.

2. Confidentiality: The information produced by this study will be confidential and private. While reporting the results of the study in the thesis, presentations, reports, or publication, we will not use your name or University name.

3. Benefits: We do not anticipate a direct benefit to you for completing the study, however, you will be providing valuable information that will enable the researcher complete a Doctorate degree thesis.

Name and contact details of the researcher

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Kiambu Kenya

Tel: +254733388505

Name and contact details of the supervisor

Prof. Ian Sanders

University of South Africa

Tel: 011 471 2858

I have read and understood this consent form, and I agree to participate in this study.

_____ _____

Signature Date

Name of the participant _____

Appendix A1

The questionnaire below is meant to collect Open Source adoption data

Bio data
Respondent Number _____

5. Name of University _____
6. Year of study
   □ Year 1 □ year 2 □ Year 3 □Year 4 □Year 5
7. Age
   □ 18-20yrs □ 21-23yrs □ 24-26yrs □ 27-30 yrs □ 31 and above

8. Gender
   □ Male □ Female
9. Area of study (i.e Business) _____

		Strongly agree	agree	neutral	disagree	Strongly disagree
1	Open source software such as Linux and Open Office is more user friendly than proprietary software such as Microsoft office and Windows.					
2	Open source software such as Linux and Open Office has familiar icons that are more easily recognizable than proprietary software such as Microsoft office and Windows.					
3	Open source software such as Linux and Open Office has better help facilities, tutorials and wizards than proprietary software such as Microsoft office and Windows.					
4	Navigation while performing tasks in Open source software such as Linux and Open Office is easier than in proprietary software such as Microsoft office and Windows.					
5	I find it easier to format a document using Open office writer than Ms Office Word					
6	People who influence my behavior think that I should use Open source software.					
7	People who are important to me think that I should use Open source software.					
8	Most of my university lecturers use Open source software					
9	Most of my friends use Open source software					
10	Most of my class and college mates use Open source software					
11	I have been trained to use Open source software such as Linux and Open Office					
12	Training on Open source software could increase my productivity while using the software					
13	The general computer training offered as a common course in the university covers open source software as an area of training					

14	I have the knowledge necessary to use Open source software					
15	I can easily find training on the use of Open source software					
16	The knowledge I have in using proprietary software can be transferred to Open Source software without requiring further training					
17	I can easily open an Microsoft word document in Open office Writer without losing any format properties					
18	I can easily open an Open office writer document in Microsoft Word without losing any format properties					
19	I can easily install any software on Ubuntu or Linux platform					
20	An Ms Excel document can easily open in Open Office calc without reporting any conversion errors					
21	I would find Open office easier to use if it used the same icons as Microsoft Office for in its interface					
22	I would find Open office easier to use if it used similar menus as Microsoft Office in its interface					
23	I would find Ubuntu easier to use if it used a similar desktop and start menu as the Microsoft Windows 7					
24	I would find Ubuntu easier to use if tasks were performed in a similar way as they are performed in Microsoft Windows 7					
25	I would prefer the Windows 8 start button to be used in Ubuntu					
26	Open source software is more affordable than proprietary software					
27	If I earned a good salary then I would buy Proprietary Software rather than Open Source Software					
28	Students like me generally have limited resources					
29	Proprietary software is exorbitantly expensive to students					
30	I would easily raise Kshs. 15,000 to buy an Ms Office 2010 licence					
31	I was using Open source software before I joined the university					
32	Computer training in the school I attended was conducted using open source software					
33	I have limited opportunities to use Open source software					
34	Learning institutions I attended before joining the university supported the use of Open source software					
35	I have used OSS in cybercafés and other places before I joined the university					
36	Majority of the potential employers require employees who can use Open source software					
37	The job adverts I have seen require candidates who can use Open source software as a mandatory requirement					
38	The jobs my friends do require candidates who can use Open source software as a mandatory requirement					
39	I could miss employment opportunities if I did not have Opens source software skills					
40	The career guidance I have received indicates that I need OSS skills in order to easily secure a job					

41	All the proprietary software I have in my computer has a licence that is not shared with other users					
42	There is no need to purchase proprietary software such as Microsoft office and Windows from software stores such as PC world because I can easily get it from my friends.					
43	I can spend large amounts of money to buy licensed proprietary software such as Microsoft Office 2010 which costs about 15,000 Kshs in my current financial status.					
44	I get the same value from the unlicensed software as a computer owner who has licensed software					
45	Most of My friends buy genuine software for their computers					
46	Using Open source software makes my work more interesting					
47	I like using open source software					
48	The Windows I use was already pre-installed in the computer when I bought the computer					
49	My computer only has Proprietary software such as windows and Microsoft Office installed and has no Open source software such as Open office and Ubuntu					
50	Many students at campus prefer open source software					

Appendix B

Informed consent form

Interview on the adoption of desktop open source software by university students in Kenya

This study is being conducted by John Wachira Kamau who is undertaking a Doctor of Philosophy in Information Systems at the University of South Africa (UNISA). The researcher seeks to identify the factors affecting the adoption of desktop open source software by university students in Kenya. The researcher hopes that the information that will be obtained from this study will be very useful in increasing the level of OSS adoption in the country and consequently lowering the software acquisition costs.

Informed consent

1. Voluntary participation: You are under no obligation to participate: You may skip any questions you are not comfortable answering. You may also withdraw your participation at any time.

2. Confidentiality: The information produced by this study will be confidential and private. While reporting the results of the study in the thesis, presentations, reports, or publication, we will not use your name or University name.

3. Benefits: We do not anticipate a direct benefit to you for completing the study, however, you will be providing valuable information that will enable the researcher complete a Doctorate degree thesis.

Name and contact details of the researcher

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Name and contact details of the supervisor

Prof. Ian Sanders

University of South Africa

Tel: 011 471 2858

I have read and understood this consent form, and I agree to participate in this study.

_____ _____

Signature Date

Name of the participant _____

Appendix B1

Interview Schedule for Open Source usability and adoption data

1. Have you ever used Open source software such as Ubuntu, Linux, Open Office etc?
2. How was the experience compared to using proprietary products such as Ms Windows, Ms Office?
3. Have you ever been trained to use Proprietary software and was it formal training?
4. Have you ever been trained to use Open source software and was it formal training?
5. How easy is it to achieve a task using open source software compared to proprietary software
6. What is your view concerning the licence fees of proprietary software?
7. Can you easily obtain a copy of proprietary software from friends and other informal sources to install in your computer?
8. Has a government enforcing agent ever challenged you to produce a licence for software installed in your computer and if so how frequent is it?
9. Do your friends and age mates influence the kind of software that you mostly use?
10. How different are OSS applications from PS applications in terms of appearance and user interface?
11. Do you think OSS would be more usable if it had the same icons and interfaces with Proprietary software such as Ms Office?
12. Before you joined the university, were you using Open source software and if yes where?
13. Are students with Open source software skills more marketable than those without?

Appendix B2

Interview Transcriptions

Respondent Number 1. University. JKUAT

Interview Schedule for Open Source usability and adoption data

1. **Interviewer** Have you ever used Open source software such as Ubuntu, Linux, Open Office etc?

   Interviewee.Yes. I have used Ubuntu, Linux and Open office.

   Interviewer. Do you know of any other OSS apart from the three above? Yes I know about Mozilla and MySql. Have you used them?

   Interviewee. Yes I have used both of them.

   Interviewer. Are they installed in your computer?

   Interviewee. Yes a friend installed the software for me.

2. **Interviewer.** How was the experience compared to using proprietary products such as Ms Windows, Ms Office?

   Interviewee. It was great but I was challenged in maneuvering. Performing simple tasks is a bit complex compared to Ms Windows and office products.

   Interviewer. So, would you say that PS has a better user experience?

   Interviewee. Yes it does.

3. **Interviewer.** Have you ever been trained to use Proprietary software and was it formal training?

   Interviewee. Yes. It was formal training.
   Interviewer. Where did you learn?

   Interviewee. At university as a unit, although the training was not thorough but I have also learnt a lot from my class mates and friends.

4. **Interviewer.** Have you ever been trained to use Open source software and was it formal training?

   Interviewee. No training I learnt from a friend and the Internet.

   Interviewer. How useful was the Internet in the learning process?

   Interviewee. It was helpful but time consuming, it took a lot of time to learn how to perform a simple task.

5. **Interviewer.** How easy is it to achieve a task using open source software compared to proprietary software.

   Interviewee. It is relatively difficult.

   Interviewer. Did you not transfer the knowledge that you have in PS while using OSS?
   Interviewee. The operations, the icons and the interaction is relatively difficult.

6. **Interviewer.** What is your view concerning the licence fees of proprietary software?

   Interviewee. It is costly.

   Interviewer. Do you buy software for your computer? No I don't I always get from friends. When install pirated software I get some nagging reminders which appear on the screen "you may be victim of software counterfeit software".

   Interviewer. What action do you take?

   Interviewee. I just ignore.

7. **Interviewer.** Can you easily obtain a copy of proprietary software from friends and other informal sources to install in your computer?

   Interviewee. Yes. But is risky to the computer.

8. **Interviewer.** Has a government enforcing agent ever challenged you to produce a licence for software installed in your computer and if so how frequent is it?
   Interviewee. If you are using it at home or installed in your computer, nobody can challenge you. But for cybercafés government agents normally check. When I was running a cybercafé before I joined campus the government agents used to visit about twice a year, they found that the computers were not having licensed software and I was fined.

9. **Interviewer.** Do your friends and age mates influence the kind of software that you mostly use?

   Interviewee. Yes.

   Interviewer. How do you know which software your friends prefer?

   Interviewee. Through conversations and sometimes social media.

   Interviewer. Why do you adopt the software your friends prefer?

   Interviewee. Because I can easily get help.

10. **Interviewer.** How different are OSS applications from PS applications in terms of appearance and user interface?

    Interviewee. More or less appear the same; the interface in OSS is a bit complex especially Minimize and maximize buttons look different. This makes it quite different while using the OSS.

11. **Interviewer.** Do you think OSS would be more usable if it had the same icons and interfaces with Proprietary software such as Ms Office?

    Interviewee. Yes, especially if the software OSS can adapt better icons.

12. **Interviewer.** Before you joined the university, were you using Open source software and if yes where?

    Interviewee. No. I only used OSS when I joined campus.

13. **Interviewer.** Are students with Open source software skills more marketable than those without?

    Interviewee. Yes currently open source is said to be more secure and favourable in advance database and high profile interconnected envelopment like network.

Respondent Number 2. University. MKU

Interview Schedule for Open Source usability and adoption data

1. **Interviewer.** Have you ever used Open source software such as Ubuntu, Linux, Open Office etc?

   Interviewee. Yes.

   Interviewer. Have you used any other apart from what I have mentioned?

   Interviewee I have used Mysql

   Interviewer. Where did you use Mysql?

   Interviewee. I used it at the university

2. **Interviewer.** How was the experience compared to using proprietary products such as Ms Windows, Ms Office?

   Interviewee. Not bad but windows is better.

   Interviewer. What in particular were you uncomfortable with?

   Interviewee. Performing tasks was difficult

Interviewer. What exactly did you find difficult?

Interviewee. Finding some basic functions like the start button, starting a program was difficult because OSS does not use familiar icons.

3. **Interviewer.** Have you ever been trained to use Proprietary software and was it formal training?

   Interviewee. Yes I did a certificate.

   Interviewer. When and where?

   Interviewee. At a small college before joining campus

4. **Interviewer.** Have you ever been trained to use Open source software and was it formal training?

   Interviewee. No.

   Interviewer. Was the small college where you did a certificate offering OSS training?

   Interviewee. No, it wasn't in their brochure

5. **Interviewer.** How easy is it to achieve a task using open source software compared to proprietary software.

   Interviewee. Not as easy as in windows. It is also time wasting especially if you are in a hurry. You would rather use PS.

6. **Interviewer.** What is your view concerning the licence fees of proprietary software?

   Interviewee. Very expensive not affordable.

   Interviewer. How much would you afford?

   Interviewee. If the price was Kshs 3,000

7. **Interviewer.** Can you easily obtain a copy of proprietary software from friends and other informal sources to install in your computer?

   Interviewee. Yes.

   Interviewer. What is your source of such software?

   Interviewee. From friends and from trial versions which I download from the Internet.

8. **Interviewer.** Has a government enforcing agent ever challenged you to produce a licence for software installed in your computer and if so how frequent is it?

   Interviewee. I have never been challenged.

Interviewer. But do you know that it is illegal to have pirated software?
Interviewee. Not quite

9. **Interviewer.** Do your friends and age mates influence the kind of software that you mostly use?

   Interviewee. Yes.

   Interviewer. How do you know which software your friends prefer?

   Interviewee. Through social media.

   Interviewer. Why do you adopt the software your friends prefer?

   Interviewee. Because I don't want to be different.

10. **Interviewer.** How different are OSS applications from PS applications in terms of appearance and user interface?

    Interviewee. Not very different. It only requires some effort to learn which is time taking.

11. **Interviewer.** Do you think OSS would be more usable if it had the same icons and interfaces with Proprietary software such as Ms Office?

    Interviewee. Much better.

    Interviewer. What aspects do you think they should share?

    Interviewee. The icons, and the window features.

12. **Interviewer.** Before you joined the university, were you using Open source software and if yes where?

    Interviewee. Yes. At place of work.

    Interviewer. Which OSS in particular?

    Interviewee. Mysql

13. **Interviewer.** Are students with Open source software skills more marketable than those without?

    Interviewee. Yes more marketable for I.T. careers.

Respondent Number 3. University. KU

Interview Schedule for Open Source usability and adoption data

1. **Interviewer.** Have you ever used Open source software such as Ubuntu, Linux, Open Office etc.?

   Interviewee. Yes I used Ubuntu and Linux In a cyber . I haven't used open office.

   Interviewer. Have you used any other apart from what I have mentioned?

   Interviewee. Only Mozilla

   Interviewer. Where did you use Mozilla?

   Interviewee. It is installed in my computer

2. **Interviewer.** How was the experience compared to using proprietary products such as Ms Windows, Ms Office?

   Interviewee A few challenges while trying to use the software. Locating programs was difficult.

3. **Interviewer.** Have you ever been trained to use Proprietary software and was it formal training?

   Interviewee Yes. I was formally trained before I joined the university.

   Interviewer. Where were you trained.

   Interviewee At a college where I did ICDL

4. **Interviewer.** Have you ever been trained to use Open source software and was it formal training?

   Interviewee . No. I trained on my own.

   Interviewer. What was the motivation?

   Interviewee . It was out of curiosity

5. **Interviewer.** How easy is it to achieve a task using open source software compared to proprietary software.

   Interviewee . Not easy even starting a program is challenging. The start button and going to programs is quite different.

6. **Interviewer.** What is your view concerning the licence fees of proprietary software?

   Interviewee . Very expensive especially for students.

   Interviewer. How much would you afford?

Interviewee . If the price was Kshs 2,000

7. **Interviewer.** Can you easily obtain a copy of proprietary software from friends and other informal sources to install in your computer?

   Interviewee . It is easy mostly from friends.

   Interviewer. What is your source of such software?

   Interviewee . From friends

8. **Interviewer.** Has a government enforcing agent ever challenged you to produce a licence for software installed in your computer and if so how frequent is it?

   Interviewee. There is no enforcement.

   Interviewer. Have you ever heard of it?

   Interviewee. Never

9. **Interviewer.** Do your friends and age mates influence the kind of software that you mostly use?

   Interviewee . Friends influence me.

   Interviewer. How do you know which software your friends prefer?

   Interviewee. Through conversations and sometimes social media.

   Interviewer. Why do you adopt the software your friends prefer?

   Interviewee. Because I can easily get help.

10. **Interviewer.** How different are OSS applications from PS applications in terms of appearance and user interface?

    Interviewee . Quite different.

    Interviewer. What is different?

    Interviewee . The icons and interfaces

11. **Interviewer.** Do you think OSS would be more usable if it had the same icons and interfaces with Proprietary software such as Ms Office?

    Interviewee . It would be more usable.

12. **Interviewer.** Before you joined the university, were you using Open source software and if yes where?

    Interviewee . Yes in a cyber café.

    Interviewer. Where was the cybercafé?

    Interviewee. In Nairobi

    Interviewer. Do all the cybercafés you have visited have OSS?

    Interviewee. No, very few

13. **Interviewer.** Are students with Open source software skills more marketable than those without?

    Interviewee. More marketable.

Respondent Number 4. MKU

Interview Schedule for Open Source usability and adoption data

1. **Interviewer.** Have you ever used Open source software such as Ubuntu, Linux, Open Office etc.?

   Interviewee. Yes.

   Interviewer. Where did you use the software?

   Interviewee. In a cybercafé

2. **Interviewer.** How was the experience compared to using proprietary products such as Ms Windows, Ms Office?

   Interviewee. I prefer open source as it is more stable for technical applications although is Windows more user friendly.

   Interviewer. Explain what you mean by stable for technical applications

   Interviewee. When you want to run applications like Apache server, Linux is better.

3. **Interviewer.** Have you ever been trained to use Proprietary software and was it formal training?

   Interviewee. yes.

4. **Interviewer.** Have you ever been trained to use Open source software and was it formal training?

Interviewee. Not formal

5. **Interviewer.** How easy is it to achieve a task using open source software compared to proprietary software

   Interviewee. Windows is faster in accomplishing tasks.

6. **Interviewer.** What is your view concerning the licence fees of proprietary software?

   Interviewee. The price is exorbitant.

7. **Interviewer.** Can you easily obtain a copy of proprietary software from friends and other informal sources to install in your computer?

   Interviewee. It is easily obtainable from fellow students or from Internet.

8. **Interviewer.** Has a government enforcing agent ever challenged you to produce a licence for software installed in your computer and if so how frequent is it?

   Interviewee. No. I wonder whether there are such laws.

9. **Interviewer.** Do your friends and age mates influence the kind of software that you mostly use?

   Interviewee. My friends and age mates influence.

   Interviewer. How do you know which software your friends prefer?

   Interviewee. Through conversations.

   Interviewer. Why do you adopt the software your friends prefer?

   Interviewee. Because I can easily get help from them.

10. **Interviewer.** How different are OSS applications from PS applications in terms of appearance and user interface?

    Interviewee. Looks quite different compared to PS.

11. **Interviewer.** Do you think OSS would be more usable if it had the same icons and interfaces with Proprietary software such as Ms Office?

    Interviewee. Yes.

12. **Interviewer.** Before you joined the university, were you using Open source software and if yes where?

Interviewee. Yes at cyber café.

13. **Interviewer.** Are students with Open source software skills more marketable than those without?

    Interviewee. Yes. For experts OSS is useful for shooting and recovery of data.

Respondent Number 5. University. JKUAT

Interview Schedule for Open Source usability and adoption data

1. **Interviewer.** Have you ever used Open source software such as Ubuntu, Linux, Open Office etc.?

   Interviewee. Yes I have used Linux but I have installed Ubuntu.

   Interviewer. Where did you use Linux?

   Interviewee. In a cybercafé

   Interviewer. Are you the one who installed Ubuntu in your computer?

   Interviewee. I installed the software.

2. **Interviewer.** How was the experience compared to using proprietary products such as Ms Windows, Ms Office?

   Interviewee. For expert and experienced users OSS is better.

   Interviewer. Why would the expert user find OSS easier to use?

   Interviewee. If one is used to using OSS, then it becomes easier

3. **Interviewer.** Have you ever been trained to use Proprietary software and was it formal training?

   Interviewee. Yes. It is offered as a unit at the university.

4. **Interviewer.** Have you ever been trained to use Open source software and was it formal training?

   Interviewee. No.

5. **Interviewer.** How easy is it to achieve a task using open source software compared to proprietary software.

   Interviewee. To achieve a simple task a user needs experience.

6. **Interviewer.** What is your view concerning the licence fees of proprietary software?

Interviewee. Proprietary software is too expensive.

7. **Interviewer.** Can you easily obtain a copy of proprietary software from friends and other informal sources to install in your computer?

   Interviewee. Yes. From fellow students at a small fee about Khs. 500.

8. **Interviewer.** Has a government enforcing agent ever challenged you to produce a licence for software installed in your computer and if so how frequent is it?

   Interviewee. No.

9. **Interviewer.** Do your friends and age mates influence the kind of software that you mostly use?

   Interviewee. Yes.

   Interviewer. How do you know which software your friends prefer?

   Interviewee. Through conversations and sometimes social media.

   Interviewer. Why do you adopt the software your friends prefer?

   Interviewee. Because I can easily get help.

10. **Interviewer.** How different are OSS applications from PS applications in terms of appearance and user interface?

    Interviewee. The two are quite different.

11. **Interviewer.** Do you think OSS would be more usable if it had the same icons and interfaces with Proprietary software such as Ms Office?

    Interviewee. It would be more friendly.

12. **Interviewer.** Before you joined the university, were you using Open source software and if yes where?

    Interviewee. I have not used OSS before joining university I used it after joining.

13. **Interviewer.** Are students with Open source software skills more marketable than those without?

    Interviewee. Yes. I.T. students could be more marketable.

Respondent Number 6. University. MOI

Interview Schedule for Open Source usability and adoption data

1. **Interviewer.** Have you ever used Open source software such as Ubuntu, Linux, Open Office etc.?

   Interviewee. I have used Linux.

   Interviewer. Where did you use Linux?

   Interviewee. In a cybercafé

2. **Interviewer.** How was the experience compared to using proprietary products such as Ms Windows, Ms Office?

   Interviewee. It is only better because it is not affected by viruses otherwise it is not easer.

   Interviewer. So what do you think about OSS user interface?

   Interviewee. It is less familiar and difficult to use.

3. **Interviewer.** Have you ever been trained to use Proprietary software and was it formal training?

   Interviewee. Yes at a computer college before joining the university.

4. **Interviewer.** Have you ever been trained to use Open source software and was it formal training?

   Interviewee. I have not been trained.

5. **Interviewer.** How easy is it to achieve a task using open source software compared to proprietary software.

   Interviewee. If a user is very conversant it is easier.

6. **Interviewer.** What is your view concerning the licence fees of proprietary software?

   Interviewee. Too expensive.

   Interviewer. How much would you afford?

   Interviewee . If the price was Kshs 2,500

7. **Interviewer.** Can you easily obtain a copy of proprietary software from friends and other informal sources to install in your computer?

   Interviewee. Yes. From friends at no or little fee.

8. **Interviewer.** Has a government enforcing agent ever challenged you to produce a licence for software installed in your computer and if so how frequent is it?

   Interviewee. No.

9. **Interviewer.** Do your friends and age mates influence the kind of software that you mostly use?

   Interviewee. Yes.

   Interviewer. Why do you adopt the software your friends prefer?

   Interviewee. Because I can easily get help.

10. **Interviewer.** How different are OSS applications from PS applications in terms of appearance and user interface?

    Interviewee. They are quite different, the icons and the interaction is different.

11. **Interviewer.** Do you think OSS would be more usable if it had the same icons and interfaces with Proprietary software such as Ms Office?

    Interviewee. Yes.

12. **Interviewer.** Before you joined the university, were you using Open source software and if yes where?

    Interviewee. I have not used it before I used it after joining Campus.

13. **Interviewer.** Are students with Open source software skills more marketable than those without?

    Interviewee. Yes.

Respondent Number 7. University. JKUAT

Interview Schedule for Open Source usability and adoption data

1. **Interviewer**. Have you ever used Open source software such as Ubuntu, Linux, Open Office etc.?

   Interviewee. Yes. I have used Linux and Ubuntu.

   Interviewer. Where did you use the two?

Interviewee. In a cybercafé

2. **Interviewer.** How was the experience compared to using proprietary products such as Ms Windows, Ms Office?

   Interviewee. Good for expert user.

   Interviewer. Why would the expert user find OSS easier to use?

   Interviewee. If one is used to using OSS, then it becomes easier

3. **Interviewer.** Have you ever been trained to use Proprietary software and was it formal training?

   Interviewee. Yes in high school.

4. **Interviewer.** Have you ever been trained to use Open source software and was it formal training?

   Interviewee. No.

5. **Interviewer.** How easy is it to achieve a task using open source software compared to proprietary software.

   Interviewee. If experienced it is easier.

6. **Interviewer.** What is your view concerning the licence fees of proprietary software?

   Interviewee. Proprietary software it too expensive.

7. **Interviewer.** Can you easily obtain a copy of proprietary software from friends and other informal sources to install in your computer?

   Interviewee. It is easy to get from friends.

8. **Interviewer.** Has a government enforcing agent ever challenged you to produce a licence for software installed in your computer and if so how frequent is it?

   Interviewee. No.

9. **Interviewer.** Do your friends and age mates influence the kind of software that you mostly use?

   Interviewee. Yes.

   Interviewer. Why do you adopt the software your friends prefer?

   Interviewee. Because I can easily get help.

10. **Interviewer.** How different are OSS applications from PS applications in terms of appearance and user interface?

    Interviewee. Linux is more attractive than windows.

11. **Interviewer.** Do you think OSS would be more usable if it had the same icons and interfaces with Proprietary software such as Ms Office?

    Interviewee. Yes.

12. **Interviewer.** Before you joined the university, were you using Open source software and if yes where?

    Interviewee. In high school I used proprietary software.

13. **Interviewer.** Are students with Open source software skills more marketable than those without?

    Interviewee. Yes.

Respondent Number 8. University. MKU

Interview Schedule for Open Source usability and adoption data

1. **Interviewer.** Have you ever used Open source software such as Ubuntu, Linux, Open Office etc.?

   Interviewee. I have used Linux and Ubuntu.

   Interviewer. Where did you use the two?

   Interviewee. In a cybercafé

2. **Interviewer.** How was the experience compared to using proprietary products such as Ms Windows, Ms Office?

   Interviewee. Not easy to apply the proprietary software skills to OSS.

   Interviewer. What exactly do you think made it difficult?

   Interviewee. They use different interfaces such as the icons.

3. **Interviewer.** Have you ever been trained to use Proprietary software and was it formal training?

   Interviewee. Yes.

4. **Interviewer.** Have you ever been trained to use Open source software and was it formal training?

   Interviewee. Yes I covered unix as part of the practical's in the operating system unit.

5. **Interviewer.** How easy is it to achieve a task using open source software compared to proprietary software

   Interviewee. Not easy.

6. **Interviewer.** What is your view concerning the licence fees of proprietary software?

   Interviewee. Proprietary software is too expensive.

7. **Interviewer.** Can you easily obtain a copy of proprietary software from friends and other informal sources to install in your computer?

   Interviewee. Can obtain easily from friends.

8. **Interviewer.** Has a government enforcing agent ever challenged you to produce a licence for software installed in your computer and if so how frequent is it?

   Interviewee. No

9. **Interviewer.** Do your friends and age mates influence the kind of software that you mostly use?

   Interviewee. Yes.

   Interviewer. Why do you adopt the software your friends prefer?

   Interviewee. It is easy to share files.

10. **Interviewer.** How different are OSS applications from PS applications in terms of appearance and user interface?

    Interviewee. Quite different

11. **Interviewer.** Do you think OSS would be more usable if it had the same icons and interfaces with Proprietary software such as Ms Office?

    Interviewee. Yes.

12. **Interviewer.** Before you joined the university, were you using Open source software and if yes where?

    Interviewee. No. Not even heard of Open source software before joining the universtity.

13. **Interviewer.** Are students with Open source software skills more marketable than those without?

    Interviewee. Yes.

Respondent Number 9. University. KU

Interview Schedule for Open Source usability and adoption data

1. **Interviewer.** Have you ever used Open source software such as Ubuntu, Linux, Open Office etc.?

   Interviewee. I have used Linux.

   Interviewer. Where did you use Linux?

   Interviewee. In a cybercafé.

2. **Interviewer.** How was the experience compared to using proprietary products such as Ms Windows, Ms Office?

   Interviewee. OSS is good for data recovery.

3. **Interviewer.** Have you ever been trained to use Proprietary software and was it formal training?

   Interviewee. Yes.

   Interviewer. Where were you trained.

   Interviewee At a college after secondary school

4. **Interviewer.** Have you ever been trained to use Open source software and was it formal training?

   Interviewee. No.

5. **Interviewer.** How easy is it to achieve a task using open source software compared to proprietary software

   Interviewee. If you have used it before it is easy.

6. **Interviewer.** What is your view concerning the licence fees of proprietary software?

   Interviewee. It is expensive.

   Interviewer. How much would you afford?

   Interviewee . If the price was Kshs 2,000

7. **Interviewer.** Can you easily obtain a copy of proprietary software from friends and other informal sources to install in your computer?

   Interviewee. Yes, friends.

8. **Interviewer.** Has a government enforcing agent ever challenged you to produce a licence for software installed in your computer and if so how frequent is it?

   Interviewee. No.

9. **Interviewer.** Do your friends and age mates influence the kind of software that you mostly use?

   Interviewee. Yes.

   Interviewer. Why do you adopt the software your friends prefer?

   Interviewee. Because I can easily get help.

10. **Interviewer.** How different are OSS applications from PS applications in terms of appearance and user interface?

    Interviewee. The two are quite different

11. **Interviewer.** Do you think OSS would be more usable if it had the same icons and interfaces with Proprietary software such as Ms Office?

    Interviewee. Yes.

12. **Interviewer.** Before you joined the university, were you using Open source software and if yes where?

    Interviewee. Yes. In a cybercafé.

13. **Interviewer.** Are students with Open source software skills more marketable than those without?

    Interviewee. No.

Respondent Number 10. University. MKU

Interview Schedule for Open Source usability and adoption data

1. **Interviewer.** Have you ever used Open source software such as Ubuntu, Linux, Open Office etc.?

   Interviewee. I have used Linux and Ubuntu

Interviewer. Where did you use the two?

Interviewee. In a friend's computer.

2. **Interviewer.** How was the experience compared to using proprietary products such as Ms. Windows, Ms. Office?

   Interviewee. Ubuntu is complex.

   Interviewer. What exactly is difficult?

   Interviewee. They use different interfaces from Ms. Windows, Ms. Office.

3. **Interviewer.** Have you ever been trained to use Proprietary software and was it formal training?

   Interviewee. Yes in high school.

4. **Interviewer.** Have you ever been trained to use Open source software and was it formal training?

   Interviewee. Not formal.

5. **Interviewer.** How easy is it to achieve a task using open source software compared to proprietary software

   Interviewee. It is difficult.

6. **Interviewer.** What is your view concerning the licence fees of proprietary software?

   Interviewee. Expensive although not aware how much it cost.

7. **Interviewer.** Can you easily obtain a copy of proprietary software from friends and other informal sources to install in your computer?

   Interviewee. Yes, from friends.

8. **Interviewer.** Has a government enforcing agent ever challenged you to produce a licence for software installed in your computer and if so how frequent is it?

   Interviewee. No.

9. **Interviewer.** Do your friends and age mates influence the kind of software that you mostly use?

   Interviewee. Yes.

   Interviewer. Why do you adopt the software your friends prefer?

   Interviewee. Because I can easily get help.

10. **Interviewer.** How different are OSS applications from PS applications in terms of appearance and user interface?

    Interviewee. Very different.

11. **Interviewer.** Do you think OSS would be more usable if it had the same icons and interfaces with Proprietary software such as Ms Office?

    Interviewee. Yes.

12. **Interviewer.** Before you joined the university, were you using Open source software and if yes where?

    Interviewee. No. Used after joining universtity.

13. **Interviewer.** Are students with Open source software skills more marketable than those without?

    Interviewee. No

Respondent Number 11. University. MKU

Interview Schedule for Open Source usability and adoption data

1. **Interviewer.** Have you ever used Open source software such as Ubuntu, Linux, Open Office etc.?

   Interviewee. I have used Linux.

   Interviewer. Where did you use Linux?

   Interviewee. In a cybercafé.

2. **Interviewer.** How was the experience compared to using proprietary products such as Ms Windows, Ms Office?

   Interviewee. OSS is good for data recovery.

3. **Interviewer.** Have you ever been trained to use Proprietary software and was it formal training?

   Interviewee. Yes.

4. **Interviewer.** Have you ever been trained to use Open source software and was it formal training?

   Interviewee. No.

5. **Interviewer.** How easy is it to achieve a task using open source software compared to proprietary software

   Interviewee. If you have used it before it is easy.

6. **Interviewer.** What is your view concerning the licence fees of proprietary software?

   Interviewee. It is expensive.

   Interviewer. How much would you afford?

   Interviewee . If the price was Kshs 2,000

7. **Interviewer.** Can you easily obtain a copy of proprietary software from friends and other informal sources to install in your computer?

   Interviewee. Yes, friends.

8. **Interviewer.** Has a government enforcing agent ever challenged you to produce a licence for software installed in your computer and if so how frequent is it?

   Interviewee. No.

9. **Interviewer.** Do your friends and age mates influence the kind of software that you mostly use?

   Interviewee. Yes.

   Interviewer. Why do you adopt the software your friends prefer?

   Interviewee. It is easier to share documents.

10. **Interviewer.** How different are OSS applications from PS applications in terms of appearance and user interface?

    Interviewee. The two are quite different

11. **Interviewer.** Do you think OSS would be more usable if it had the same icons and interfaces with Proprietary software such as Ms Office?

    Interviewee. Yes. It would be more usable.

12. **Interviewer.** Before you joined the university, were you using Open source software and if yes where?

    Interviewee. Yes. In a cybercafé.

13. **Interviewer.** Are students with Open source software skills more marketable than those without?

    Interviewee. No.

Respondent Number 12. University. KU

Interview Schedule for Open Source usability and adoption data

1. **Interviewer.** Have you ever used Open source software such as Ubuntu, Linux, Open Office etc.?

   Interviewee. Yes.

   Interviewer. Which one of them have you used?

   Interviewee. All the above.

   Interviewer. Where did you use the software?

   Interviewee. The software is installed in my computer.

   Interviewer. How did you acquire the software?

   Interviewee. I downloaded it from the Internet.

2. **Interviewer.** How was the experience compared to using proprietary products such as Ms Windows, Ms Office?

   Interviewee. I prefer open source as it is more stable for technical applications although Windows more user friendly.

3. **Interviewer.** Have you ever been trained to use Proprietary software and was it formal training?

   Interviewee. yes.

4. **Interviewer.** Have you ever been trained to use Open source software and was it formal training?

   Interviewee. Not formal

5. **Interviewer.** How easy is it to achieve a task using open source software compared to proprietary software

   Interviewee. Windows is faster in accomplishing tasks.

6. **Interviewer.** What is your view concerning the licence fees of proprietary software?

Interviewee. The price is exorbitant.

Interviewer. How much would you afford?

Interviewee . If the price was Kshs 1,500

7. **Interviewer.** Can you easily obtain a copy of proprietary software from friends and other informal sources to install in your computer?

   Interviewee. It is easily obtainable from fellow students or from Internet.

8. **Interviewer.** Has a government enforcing agent ever challenged you to produce a licence for software installed in your computer and if so how frequent is it?

   Interviewee. No. I wonder whether there are such laws.

9. **Interviewer.** Do your friends and age mates influence the kind of software that you mostly use?

   Interviewee. My friends and age mates influence.

   Interviewer. Why do you adopt the software your friends prefer?

   Interviewee. Because I don't want to be different.

10. **Interviewer.** How different are OSS applications from PS applications in terms of appearance and user interface?

    Interviewee. Looks quite different compared to PS.

11. **Interviewer.** Do you think OSS would be more usable if it had the same icons and interfaces with Proprietary software such as Ms Office?

    Interviewee. Yes.

12. **Interviewer.** Before you joined the university, were you using Open source software and if yes where?

    Interviewee. Yes at cyber café.

13. **Interviewer.** Are students with Open source software skills more marketable than those without?

    Interviewee. Yes. For experts OSS is useful for trouble shooting and recovery of data.

Respondent Number 13. University. MKU

Interview Schedule for Open Source usability and adoption data

1. **Interviewer.** Have you ever used Open source software such as Ubuntu, Linux, Open Office etc.?

   Interviewee. Yes I have used Linux but I have installed Ubuntu.

   Interviewer. Why did you install Ubuntu?

   Interviewee. Out of interest in order to learn.

   Interviewer. Where did you use Linux?

   Interviewee. In a cybercafé.

2. **Interviewer.** How was the experience compared to using proprietary products such as Ms Windows, Ms Office?

   Interviewee. For expert and experienced users OSS is better.

   Interviewer. Why do you think it is better for an experienced user?

   Interviewee. Such a user would not have issues of viruses compared to proprietary software.

3. **Interviewer.** Have you ever been trained to use Proprietary software and was it formal training?

   Interviewee. Yes. It is offered as a unit at the university.

4. **Interviewer.** Have you ever been trained to use Open source software and was it formal training?

   Interviewee. No.

5. **Interviewer.** How easy is it to achieve a task using open source software compared to proprietary software?

   Interviewee. To achieve a simple task a user needs experience.

6. **Interviewer.** What is your view concerning the licence fees of proprietary software?

   Interviewee. Proprietary software is too expensive.

   Interviewer. How much would you afford?

   Interviewee . If the price was Kshs 2,000

7. **Interviewer.** Can you easily obtain a copy of proprietary software from friends and other informal sources to install in your computer?

   Interviewee. Yes. From fellow students at a small fee about Khs. 1000.

8. **Interviewer.** Has a government enforcing agent ever challenged you to produce a licence for software installed in your computer and if so how frequent is it?

   Interviewee. No.

9. **Interviewer.** Do your friends and age mates influence the kind of software that you mostly use?

   Interviewee. Yes.

   Interviewer. Why do you adopt the software your friends prefer?

   Interviewee. Because I can easily get help.

10. **Interviewer.** How different are OSS applications from PS applications in terms of appearance and user interface?

    Interviewee. The two are quite different.

11. **Interviewer.** Do you think OSS would be more usable if it had the same icons and interfaces with Proprietary software such as Ms Office?

    Interviewee. OSS Would be more friendly.

12. **Interviewer.** Before you joined the university, were you using Open source software and if yes where?

    Interviewee. I have not used OSS before joining university.

13. **Interviewer.** Are students with Open source software skills more marketable than those without?

    Interviewee. Yes. I.T. students could be more marketable.

Respondent Number 14. University. JKUAT

Interview Schedule for Open Source usability and adoption data

1. **Interviewer**. Have you ever used Open source software such as Ubuntu, Linux, Open Office etc.?

   Interviewee. Yes I have used Linux.

Interviewer. Where did you use Linux?

Interviewee. In a cybercafé.

2. **Interviewer**. How was the experience compared to using proprietary products such as Ms Windows, Ms Office?

   Interviewee. It is only better because it is not affected by viruses otherwise it is not easer.

3. **Interviewer**. Have you ever been trained to use Proprietary software and was it formal training?

   Interviewee. Yes at a computer college before joining the university.

4. **Interviewer**. Have you ever been trained to use Open source software and was it formal training?

   Interviewee. No

5. **Interviewer**. How easy is it to achieve a task using open source software compared to proprietary software.

   Interviewee. If a user is used to using it is easier.

6. **Interviewer**. What is your view concerning the licence fees of proprietary software?

   Interviewee. Too expensive.

   Interviewer. How much would you afford?

   Interviewee . If the price was Kshs 2,000

7. **Interviewer** . Can you easily obtain a copy of proprietary software from friends and other informal sources to install in your computer?

   Interviewee. Yes. From friends at no or little fee of Kshs 500.

8. **Interviewer** . Has a government enforcing agent ever challenged you to produce a licence for software installed in your computer and if so how frequent is it?

   Interviewee. No.

9. **Interviewer** . Do your friends and age mates influence the kind of software that you mostly use?

   Interviewee. Yes.

Interviewer. Why do you adopt the software your friends prefer?

Interviewee. Because I can easily get help.

10. **Interviewer** . How different are OSS applications from PS applications in terms of appearance and user interface?

    Interviewee. They are quite different, the icons and the interface is different.

11. **Interviewer** . Do you think OSS would be more usable if it had the same icons and interfaces with Proprietary software such as Ms Office?

    Interviewee. Yes. It would be more user friendly.

12. **Interviewer** . Before you joined the university, were you using Open source software and if yes where?

    Interviewee. I have not used it before I used it after joining Campus.

13. **Interviewer** . Are students with Open source software skills more marketable than those without?

    Interviewee. Yes.

Respondent Number 15. University. MOI

Interview Schedule for Open Source usability and adoption data

1. **Interviewer**. Have you ever used Open source software such as Ubuntu, Linux, Open Office etc.?

   Interviewee. I have used Linux and Ubuntu

   Interviewer. Where did you use the two?

   Interviewee. At campus.

2. **Interviewer**. How was the experience compared to using proprietary products such as Ms Windows, Ms Office?

   Interviewee. Ubuntu is complex.

   Interviewer. What exactly did you find complex?

   Interviewee. The way the programs are presented.

3. **Interviewer**. Have you ever been trained to use Proprietary software and was it formal training?

Interviewee. Yes in high school.

4. **Interviewer**. Have you ever been trained to use Open source software and was it formal training?

   Interviewee. Not formal.

5. **Interviewer**. How easy is it to achieve a task using open source software compared to proprietary software

   Interviewee. It is difficult.

6. **Interviewer**. What is your view concerning the licence fees of proprietary software?

   Interviewee. Expensive although not aware how much it cost.

7. **Interviewer**. Can you easily obtain a copy of proprietary software from friends and other informal sources to install in your computer?

   Interviewee. Yes, from friends.

8. **Interviewer**. Has a government enforcing agent ever challenged you to produce a licence for software installed in your computer and if so how frequent is it?

   Interviewee. No.

9. **Interviewer**. Do your friends and age mates influence the kind of software that you mostly use?

   Interviewee. Yes.

   Interviewer. Why do you adopt the software your friends prefer?

   Interviewee. Because I can easily get help.

10. **Interviewer**. How different are OSS applications from PS applications in terms of appearance and user interface?

    Interviewee. Very different.

11. **Interviewer**. Do you think OSS would be more usable if it had the same icons and interfaces with Proprietary software such as Ms Office?

    Interviewee. Yes.

12. **Interviewer**. Before you joined the university, were you using Open source software and if yes where?

    Interviewee. No. Used after joining university.

13. **Interviewer**. Are students with Open source software skills more marketable than those without? (H)

    Interviewee. No

Respondent Number 16. University. JKUAT

Interview Schedule for Open Source usability and adoption data

1. **Interviewer**. Have you ever used Open source software such as Ubuntu, Linux, Open Office etc.?

   Interviewee. I have used Linux and Ubuntu.

   Interviewer. Where did you use the two?

   Interviewee. In a cybercafé.

2. **Interviewer**. How was the experience compared to using proprietary products such as Ms Windows, Ms Office?

   Interviewee. Not easy to apply the proprietary software skills to OSS.

   Interviewer. Why is this?

   Interviewee. Because they use totally different interfaces and icons.

3. **Interviewer**. Have you ever been trained to use Proprietary software and was it formal training?

   Interviewee. Yes.

4. **Interviewer**. Have you ever been trained to use Open source software and was it formal training?

   Interviewee. Yes I covered unix as part of the practical's in the operating system unit.

5. **Interviewer**. How easy is it to achieve a task using open source software compared to proprietary software

   Interviewee. It is difficult.

6. **Interviewer**. What is your view concerning the licence fees of proprietary software?

   Interviewee. Proprietary software is too expensive.

   Interviewer. How much would you afford?

   Interviewee . If the price was Kshs 3,000

7. **Interviewer**. Can you easily obtain a copy of proprietary software from friends and other informal sources to install in your computer?

   Interviewee. Can obtain easily from friends.

8. **Interviewer**. Has a government enforcing agent ever challenged you to produce a licence for software installed in your computer and if so how frequent is it?

   Interviewee. No

9. **Interviewer**. Do your friends and age mates influence the kind of software that you mostly use?

   Interviewee. Yes.

   Interviewer. Why do you adopt the software your friends prefer?

   Interviewee. Because I can easily get help.

10. **Interviewer**. How different are OSS applications from PS applications in terms of appearance and user interface?

    Interviewee. Quite different

11. **Interviewer**. Do you think OSS would be more usable if it had the same icons and interfaces with Proprietary software such as Ms Office?

    Interviewee. Yes.

12. **Interviewer**. Before you joined the university, were you using Open source software and if yes where?

    Interviewee. No. Not even heard of Open source software before joining the university.

13. **Interviewer**. Are students with Open source software skills more marketable than those without?

    Interviewee. No. Only computing students would be marketable if they have the skills.

Respondent Number 17. University. JKUAT

Interview Schedule for Open Source usability and adoption data

1. **Interviewer**. Have you ever used Open source software such as Ubuntu, Linux, Open Office etc?

   Interviewee. Yes. Ubuntu, Linux and Open office

Interviewer. Where did you use the software?

Interviewee. They are installed in my computer.

Interviewer. What was the motivation of installing them in your computer?

Interviewee. It was out of interest because I wanted to learn how to use them.

2. **Interviewer**. How was the experience compared to using proprietary products such as Ms Windows, Ms Office?

Interviewee. It was good but I was challenged in maneuvering.

Interviewer. What did you find difficult?

Interviewee. The different interfaces and icons.

3. **Interviewer**. Have you ever been trained to use Proprietary software and was it formal training?

Interviewee. Yes. It was formal training at a local college before joining the university.

4. **Interviewer**. Have you ever been trained to use Open source software and was it formal training?

Interviewee. No training I learnt from a friend.

5. **Interviewer**. How easy is it to achieve a task using open source software compared to proprietary software.

Interviewee. It is relatively difficult.

6. **Interviewer**. What is your view concerning the licence fees of proprietary software?

Interviewee. It is costly.

Interviewer. How much would you afford?

Interviewee . If the price was Kshs 2,000

7. **Interviewer**. Can you easily obtain a copy of proprietary software from friends and other informal sources to install in your computer?

Interviewee. Yes.

8. **Interviewer**. Has a government enforcing agent ever challenged you to produce a licence for software installed in your computer and if so how frequent is it?

Interviewee. They used to check in cybercafés

9. **Interviewer**. Do your friends and age mates influence the kind of software that you mostly use?

   Interviewee. Yes.

   Interviewer. Why do you adopt the software your friends prefer?

   Interviewee. Because I can easily get help.

10. **Interviewer**. How different are OSS applications from PS applications in terms of appearance and user interface?

    Interviewee. More or less appear the same.

11. **Interviewer**. Do you think OSS would be more usable if it had the same icons and interfaces with Proprietary software such as Ms Office?

    Interviewee. Yes, especially if the software OSS can adapt better icons.

12. **Interviewer**. Before you joined the university, were you using Open source software and if yes where?

    Interviewee. No.

13. **Interviewer**. Are students with Open source software skills more marketable than those without?

    Interviewee. Yes.

Respondent Number 18. University. JKUAT

Interview Schedule for Open Source usability and adoption data

1. **Interviewer.** Have you ever used Open source software such as Ubuntu, Linux, Open Office etc.?

   Interviewee. Yes. Linux and Ubuntu.

   Interviewer. Where did you use the software?

   Interviewee. In a cybercafé.

2. **Interviewer.** How was the experience compared to using proprietary products such as Ms Windows, Ms Office?

   Interviewee. Good for expert user.

3. **Interviewer.** Have you ever been trained to use Proprietary software and was it formal training?

   Interviewee. Yes in high school.

4. **Interviewer.** Have you ever been trained to use Open source software and was it formal training?

   Interviewee. No.

5. **Interviewer.** How easy is it to achieve a task using open source software compared to proprietary software.

   Interviewee. If experienced it is easier.

6. **Interviewer.** What is your view concerning the licence fees of proprietary software?

   Interviewee. Proprietary software it too expensive.

   Interviewer. How much would you afford?

   Interviewee . If the price was Kshs 1,000

7. **Interviewer.** Can you easily obtain a copy of proprietary software from friends and other informal sources to install in your computer?

   Interviewee. It is easy to get from friends.

8. **Interviewer.** Has a government enforcing agent ever challenged you to produce a licence for software installed in your computer and if so how frequent is it?

   Interviewee. No.

9. **Interviewer.** Do your friends and age mates influence the kind of software that you mostly use?

   Interviewee. Yes.

   Interviewer. Why do you adopt the software your friends prefer?

   Interviewee. Because I can easily get help.

10. **Interviewer.** How different are OSS applications from PS applications in terms of appearance and user interface?

    Interviewee. Linux is more attractive than windows.

11. **Interviewer.** Do you think OSS would be more usable if it had the same icons and interfaces with Proprietary software such as Ms Office?

    Interviewee. Yes.

12. **Interviewer.** Before you joined the university, were you using Open source software and if yes where?

    Interviewee. In high school I used proprietary software.

13. **Interviewer.** Are students with Open source software skills more marketable than those without?

    Interviewee. Yes. Computing and engineering students are more marketable if they have the skills.

Respondent Number 19. University. MOI

Interview Schedule for Open Source usability and adoption data

1. **Interviewer.** Have you ever used Open source software such as Ubuntu, Linux, Open Office etc?

   Interviewee. Yes.

   Interviewer. Which one of them have you used?

   Interviewee. All the above.

   Interviewer. Where did you use the software?

   Interviewee. The software is installed in my computer.

   Interviewer. How did you acquire the software?

   Interviewee. I downloaded it from the Internet.

2. **Interviewer.** How was the experience compared to using proprietary products such as Ms Windows, Ms Office?

   Interviewee. Not bad but windows is better.

   Interviewer. What do you think can make OSS better?

   Interviewee. If it used the same icons as PS.

3. **Interviewer.** Have you ever been trained to use Proprietary software and was it formal training?

   Interviewee. Yes I did a certificate course in computer applications.

4. **Interviewer.** Have you ever been trained to use Open source software and was it formal training?

   Interviewee. No.

5. **Interviewer.** How easy is it to achieve a task using open source software compared to proprietary software.

   Interviewee. Not as easy as in windows.

6. **Interviewer** What is your view concerning the licence fees of proprietary software?

   Interviewee. Not affordable.

   Interviewer. How much would you afford?

   Interviewee . If the price was less than Kshs 2,000

7. **Interviewer** . Can you easily obtain a copy of proprietary software from friends and other informal sources to install in your computer?

   From friends and from trial versions obtained from the Internet.

8. **Interviewer.** Has a government enforcing agent ever challenged you to produce a licence for software installed in your computer and if so how frequent is it?

   Interviewee. Never been challenged.

9. **Interviewer.** Do your friends and age mates influence the kind of software that you mostly use?

   Interviewee. Yes.

   Interviewer. Why do you adopt the software your friends prefer?

   Interviewee. Because I can easily get help.

10. **Interviewer.** How different are OSS applications from PS applications in terms of appearance and user interface?

    Interviewee. Not very different

11. **Interviewer.** Do you think OSS would be more usable if it had the same icons and interfaces with Proprietary software such as Ms Office?

    Interviewee. Much better.

12. **Interviewer.** Before you joined the university, were you using Open source software and if yes where?

    Interviewee. Yes. At place of work.

13. **Interviewer.** Are students with Open source software skills more marketable than those without?

    Interviewee. Yes more marketable for I.T. careers.

Respondent Number 18. University. KCA

Interview Schedule for Open Source usability and adoption data

1. **Interviewer**. Have you ever used Open source software such as Ubuntu, Linux, Open Office etc.?

   Interviewee. Yes I used Ubuntu and Linux In a cyber, haven't used open office.

2. **Interviewer**. How was the experience compared to using proprietary products such as Ms Windows, Ms Office?

   Interviewee. A few challenges while trying to use the software.

   Interviewer. What exactly was difficult?

   Interviewee. Locating programs was difficult.

3. **Interviewer**. Have you ever been trained to use Proprietary software and was it formal training?

   Interviewee. Yes. I was formally trained before I joined the university.

4. **Interviewer**. Have you ever been trained to use Open source software and was it formal training?

   Interviewee. No. I trained on my own.

5. **Interviewer**. How easy is it to achieve a task using open source software compared to proprietary software.

   Interviewee. Not easy even starting a program is challenging.

6. **Interviewer**. What is your view concerning the licence fees of proprietary software?

   Interviewee. Very expensive especially for students.

   Interviewer. How much would you afford?

Interviewee . If the price was Kshs 1,000

7. **Interviewer**. Can you easily obtain a copy of proprietary software from friends and other informal sources to install in your computer?

   Interviewee. It is easy mostly from friends.

8. **Interviewer**. Has a government enforcing agent ever challenged you to produce a licence for software installed in your computer and if so how frequent is it?

   Interviewee. There is no enforcement.

9. **Interviewer**. Do your friends and age mates influence the kind of software that you mostly use?

   Interviewee. Friends influence me.

   Interviewer. Why do you adopt the software your friends prefer?

   Interviewee. Because I can easily get help.

10. **Interviewer**. How different are OSS applications from PS applications in terms of appearance and user interface?

    Interviewee. Quite different.

11. **Interviewer**. Do you think OSS would be more usable if it had the same icons and interfaces with Proprietary software such as Ms Office?

    Interviewee. It would be more unable.

12. **Interviewer**. Before you joined the university, were you using Open source software and if yes where?

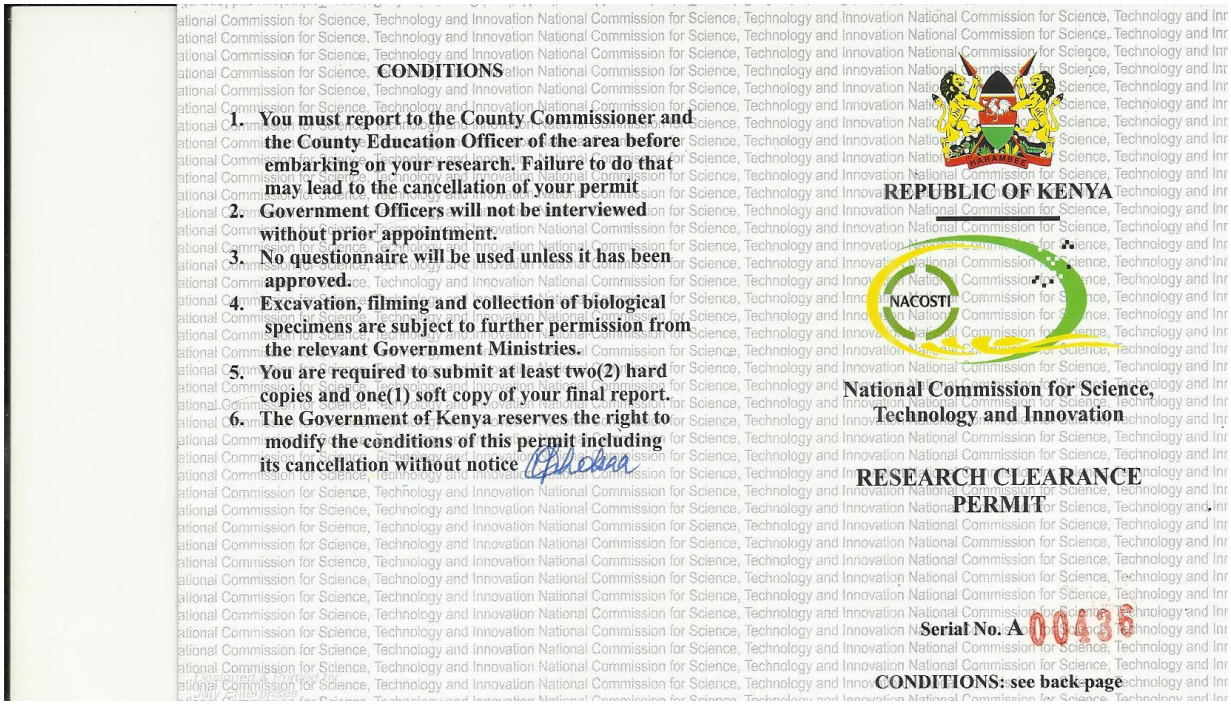
    Interviewee. Yes in a cyber café.

13. **Interviewer**. Are students with Open source software skills more marketable than those without?

    Interviewee. More marketable.

Appendix C

Ethical clearance by NACOSTI



CONDITIONS

1. You must report to the County Commissioner and the County Education Officer of the area before embarking on your research. Failure to do that may lead to the cancellation of your permit
2. Government Officers will not be interviewed without prior appointment.
3. No questionnaire will be used unless it has been approved.
4. Excavation, filming and collection of biological specimens are subject to further permission from the relevant Government Ministries.
5. You are required to submit at least two(2) hard copies and one(1) soft copy of your final report.
6. The Government of Kenya reserves the right to modify the conditions of this permit including its cancellation without notice

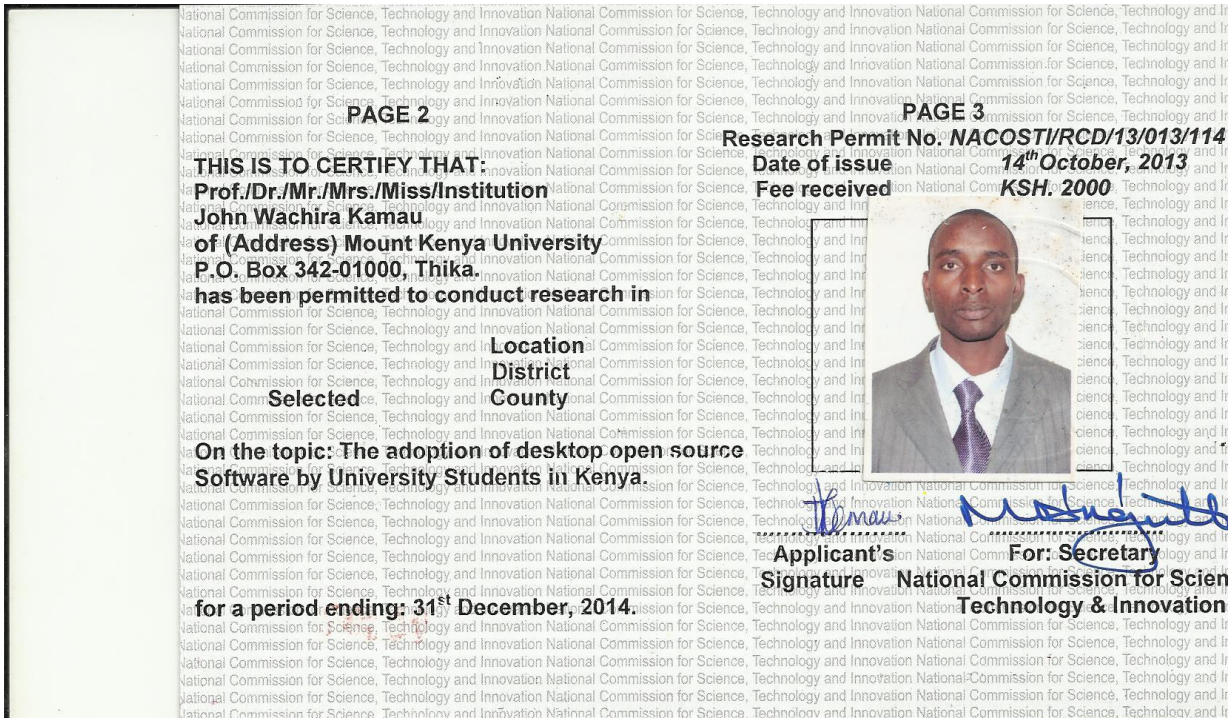
REPUBLIC OF KENYA

National Commission for Science, Technology and Innovation

RESEARCH CLEARANCE PERMIT

Serial No. A 00436

CONDITIONS: see back page



PAGE 2

THIS IS TO CERTIFY THAT:
Prof./Dr./Mr./Mrs./Miss/Institution
John Wachira Kamau
of (Address) Mount Kenya University
P.O. Box 342-01000, Thika.
has been permitted to conduct research in
Location
District
Selected County
On the topic: The adoption of desktop open source Software by University Students in Kenya.
for a period ending: 31st December, 2014.

PAGE 3

Research Permit No. NACOSTI/RCD/13/013/114
Date of issue 14th October, 2013
Fee received KSH. 2000

Applicant's Signature

For: Secretary
National Commission for Scien
Technology & Innovation

Appendix D

Informed consent form

Questionnaire on the adoption of desktop open source software by university students in Kenya

This study is being conducted by John Wachira Kamau who is undertaking a Doctor of Philosophy in Information Systems at the University of South Africa (UNISA). The researcher seeks to identify the factors affecting the adoption of desktop open source software by university students in Kenya. The researcher hopes that the information that will be obtained from this study will be very useful in increasing the level of OSS adoption in the country and consequently lowering the software acquisition costs.

Informed consent

1. Voluntary participation: You are under no obligation to participate: You may skip any questions you are not comfortable answering. You may also withdraw your participation at any time.

2. Confidentiality: The information produced by this study will be confidential and private. While reporting the results of the study in the thesis, presentations, reports, or publication, we will not use your name or University name.

3. Benefits: We do not anticipate a direct benefit to you for completing the study, however, you will be providing valuable information that will enable the researcher complete a Doctorate degree thesis.

Name and contact details of the researcher

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Kiambu Kenya

Tel: +254733388505

Name and contact details of the supervisor

Prof. Ian Sanders

University of South Africa

Tel: 011 471 2858

EUTAUT Questionnaire with Desktop OSS adoption questions

The questionnaire below is meant to collect Open Source adoption data

Bio data
Respondent Number _____

10. Name of University _____
11. Year of study
□ Year 1 □ year 2 □ Year 3 □Year 4 □Year 5
12. Age
□ 18-20yrs □ 21-23yrs □ 24-26yrs □ 27-30 yrs □ 31 and above

13. Gender
□ Male □ Female
14. Area of study (i.e Business) _____

	Performance Expectancy (Not shown to the respondent)	Strongly agree	agree	neutral	disagree	Strongly disagree
1	PE1. I find Open Source Software such as Linux, Ubuntu and Open Office useful in my daily life.					
2	PE2. Using Open Source Software such as Linux, Ubuntu and Open Office helps me accomplish things more quickly.					
3	PE3. Using Open Source Software such as Linux, Ubuntu and Open Office increases my productivity.					
	Effort Expectancy (Not shown to the respondent)					
4	EE1. Learning how to use Open Source Software such as Linux, Ubuntu and Open Office is easy for me.					
5	EE2. My interaction with Open Source Software such as Linux, Ubuntu and Open Office is clear and understandable.					
6	EE3. I find Open Source Software such as Linux, Ubuntu and Open Office easy to use.					
7	EE4. It is easy for me to become skilful at using Open Source Software such as Linux, Ubuntu and Open Office.					
	Social Influence (Not shown to the respondent)					
8	SI1. People who are important to me think that I should use mobile Internet.					
9	SI2. People who influence my behaviour think that I should use Open Source Software such as Linux, Ubuntu and Open Office.					
10	SI3. People whose opinions that I value prefer that I use mobile Internet.					

	Facilitating Conditions(Not shown to the respondent)					
11	FC1. I have the resources necessary to use Open Source Software such as Linux, Ubuntu and Open Office.					
12	FC2. I have the knowledge necessary to use Open Source Software such as Linux, Ubuntu and Open Office.					
13	FC3. Open Source Software such as Linux, Ubuntu and Open Office is compatible with other technologies I use.					
14	FC4. I can get help from others when I have difficulties using Open Source Software such as Linux, Ubuntu and Open Office.					
	Hedonic Motivation(Not shown to the respondent)					
15	HM1. Using Open Source Software such as Linux, Ubuntu and Open Office is fun.					
16	HM2. Using Open Source Software such as Linux, Ubuntu and Open Office is enjoyable.					
17	HM3. Using Open Source Software such as Linux, Ubuntu and Open Office is very entertaining.					
	Price Value (Not shown to the respondent)					
18	PV1. Open Source Software such as Linux, Ubuntu and Open Office is reasonably priced.					
19	PV2. Open Source Software such as Linux, Ubuntu and Open Office is a good value for the money.					
20	PV3. At the current price, Open Source Software such as Linux, Ubuntu and Open Office provides a good value.					
	Habit (Not shown to the respondent)					
21	HT1. The use of Open Source Software such as Linux, Ubuntu and Open Office has become a habit for me.					
22	HT2. I am addicted to using Open Source Software such as Linux, Ubuntu and Open Office.					
23	HT3. I must use Open Source Software such as Linux, Ubuntu and Open Office.					
	Behavioral Intention (Not shown to the respondent)					
24	BI1. I intend to continue using Open Source Software such as Linux, Ubuntu and Open Office in the future.					
25	BI2. I will always try to use Open Source Software such as Linux, Ubuntu and Open Office in my daily life.					
26	BI3. I plan to continue to use Open Source Software such as Linux, Ubuntu and Open Office frequently.					

	Use (Please choose your usage frequency for each of the following)	Very frequent	frequent	neutral	I don't use	I have never used
27	a) Ubuntu					
28	b) Linux					
29	c) Open Office Writer					
30	d) Open Office Calc					
31	e) Open Office Impress					
32	f) Open Office Base					

Appendix E

Informed consent form

Experts' questionnaire on the adoption of desktop open source software by university students in Kenya

This study is being conducted by John Wachira Kamau who is undertaking a Doctor of Philosophy in Information Systems at the University of South Africa (UNISA). The researcher seeks to identify the factors affecting the adoption of desktop open source software by university students in Kenya. The researcher hopes that the information that will be obtained from this study will be very useful in increasing the level of OSS adoption in the country and consequently lowering the software acquisition costs.

Informed consent

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2. Confidentiality: The information produced by this study will be confidential and private. While reporting the results of the study in the thesis, presentations, reports, or publication, we will not use your name or University name.

3. Benefits: We do not anticipate a direct benefit to you for completing the study, however, you will be providing valuable information that will enable the researcher complete a Doctorate degree thesis.

Name and contact details of the researcher

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Name and contact details of the supervisor

Prof. Ian Sanders

University of South Africa

Tel: 011 471 2858

Validation of the OSS Adoption model in developing countries

Expert questionnaire

The table below comprises of the proposed Open source software (OSS) Adoption model in developing countries components (metrics), which shall be used to validate the model. The components of the model are OSS usability, social influence, user training, OSS compatibility with other software, patent and copyright laws, social economic status, prior experience, job market demands, proprietary software piracy culture, age and gender.

The model is to be used to predict OSS adoption in developing countries.

Respondent Number _____

Level of qualification. Masters □ Phd □

Job Position _____

Years of experience _____

		Strongly agree	agree	neutral	disagree	Strongly disagree
1	The usability of Open source software in terms of user friendliness, presence of help facilities, and ease of task performance etc. is likely to lead to its adoption.					
2	Software adoption decisions for young computer users such as university students are influenced by peers, and people that they deem important to them.					
3	User Training improves the productivity of users while using software and enhances software adoption decisions.					
4	Software that is compatible with other common software is more likely to be adopted by users than one that is not compatible.					
5	Compatibility of software and use of icons and interfaces is limited by Patent and Copyright Laws.					
6	Computer users are likely to adopt software they acquire for free or at a small fee they can afford.					
7	Computer users are more likely to adopt software that they have used before than unfamiliar software.					
8	Job Market demands determine the kind of computer skills training institutions					

	offer to the learners as a way of being responsive to the job market needs.					
9	Users employ any means of acquiring expensive but user friendly software including piracy and software reuse.					
10	Younger software users are more likely to be influenced by peers, and people that they deem important to them while making software acquisition decisions.					
11	The gender of a software user determines the level of influence by peers, and friends while making software acquisition decisions.					

Appendix F

Informed consent form

Expert interview on the adoption of desktop open source software by university students in Kenya

This study is being conducted by John Wachira Kamau who is undertaking a Doctor of Philosophy in Information Systems at the University of South Africa (UNISA). The researcher seeks to identify the factors affecting the adoption of desktop open source software by university students in Kenya. The researcher hopes that the information that will be obtained from this study will be very useful in increasing the level of OSS adoption in the country and consequently lowering the software acquisition costs.

Informed consent

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Name and contact details of the researcher

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Tel: +254733388505

Name and contact details of the supervisor

Prof. Ian Sanders

University of South Africa

Tel: 011 471 2858

Validation of the OSS Adoption model in developing countries

Expert Interview schedule

Respondent Number _____

Level of qualification. Phd □

Job Position _____

Years of experience _____

1. What is your opinion regarding usability of open source software in relation to its adoption?

2. What is your opinion regarding social influence in relation to the adoption of Open Source Software among university students?
3. What is your opinion regarding training in relation to adoption of Open Source Software among students in tertiary institutions in Kenya?
4. What role do you think compatibility of Open Source Software with other software play in the adoption of Open Source Software?
5. To what extent do you think Patent and Copyright Laws limit the usability features such as icons of OSS?

6. What is your opinion on the likelihood of students with a low income adopting free Open Source Software?

7. What role do you think prior experience plays in the adoption of Open Source Software?
8. What is the effect of job market demands to training programmes in institutions of higher learning?

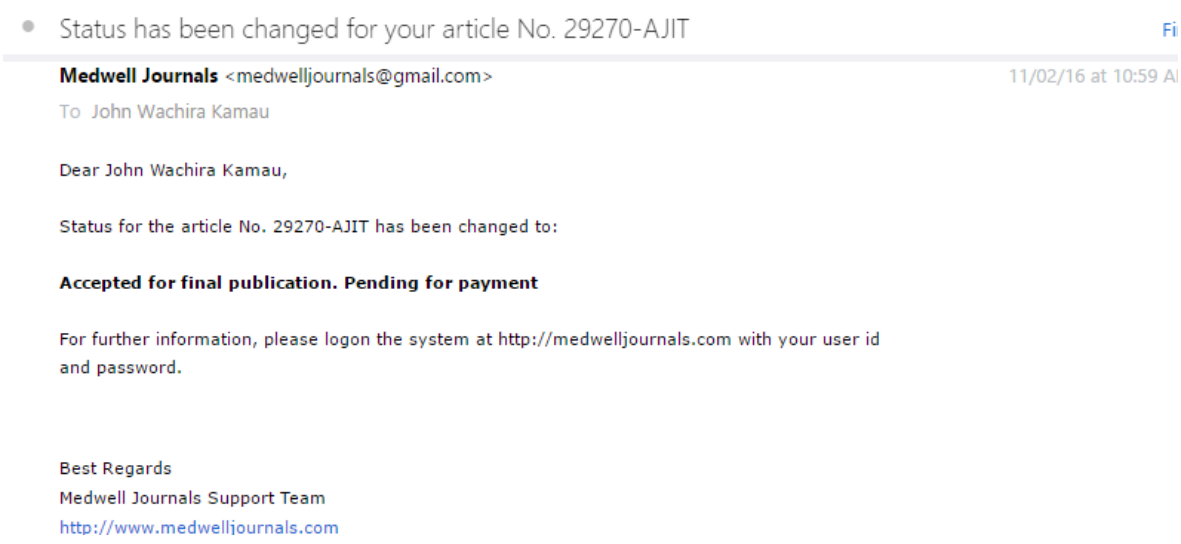
9. What role do you think piracy plays in the adoption of proprietary software?
10. Do you think proprietary software is more usable than Open Source Software?

11. In your opinion does age matter in relation to influence of peers in making software acquisition decisions?

12. In your opinion does gender matter in relation to influence of peers in making software acquisition decisions

Appendix G

Email acceptance



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