

**ASSESSING ADOPTION OF OPEN SOURCE SOFTWARE FOR RUNNING CORE
ICT SYSTEMS OF A GOVERNMENT AGENCY: A CASE OF ZAMBIA REVENUE
AUTHORITY**

BY

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DECLARATION

I, Mweene Chjikwa declares that this dissertation represents my own work and that it has not been previously submitted for a degree at this or any other university.

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APPROVAL

This dissertation by Mweene Chjikwa is approved as fulfilling part of the requirements for the award of the degree of Master of Business Administration (MBA) in Management Strategy by the University of Zambia

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ABSTRACT

Zambia Revenue Authority has continued procuring expensive proprietary enterprise software solutions from big private companies like Oracle, SAP, and TATA, while there is alternative software. This problem has been compounded with inadequate funding from government of Republic of Zambia. The purpose of this research was to study how to reduce costs of running the core ICT systems of a government agency using open source software: A case of Zambia Revenue Authority. The literature was reviewed and Open Innovation model was adopted for the research. The research was carried out using the philosophy of Pragmatism. Questionnaires, interviews and document reviews were deployed to collect data. The targeted population of 67 participants were given questionnaires and in addition, some were interviewed. The findings are; the major costs incurred are on acquiring software are; training, licenses, deployment costs. Major software characteristics that are considered when acquiring software are; stability and reliability, security, functionality and customer Support. 18.44% of respondents indicated that it was stability and reliability of the software that was critical when considering the software to purchase, and then 17.19% said that it was security. It was also noted that 51.56% of respondents agreed that ICT policy guides the Authority when buying software. It was further observed that the Authority still acquire the proprietary software because of customer support, updates and patches, technical skills. The customer support had 19% of responses, Updates and patches 18%, Security 16%, Staff technical skills 13% and Functionality had 12.7%. In conclusion, the research helped in understanding the costs involved in the purchase of the software, major characteristics considered, understand the motives for not adopting alternative software. The Proprietary software bought at Zambia Revenue Authority is expensive compared to Open source software and this has been supported by the reviewed literature and statistical tests carried out. The research recommends the following; Zambia Revenue Authority must put a deliberate programme/policy in place to ensure employees with responsibility to evaluate the software to procure to evaluate all the options of software or solutions available. The Authority must conduct seminars and workshops bi-annual to sensitise the employee in decision-making positions about the benefits of open source software.

Key words: Cost, Open Source software, Proprietary software, Core systems, Zambia Revenue Authority, Adoption

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LIST OF ABBREVIATIONS AND ACRONYMS

CRM - Customer Relationship Management software

ERP - Enterprise resource planning software

EULA - End-user license agreement

ICT – Information Communication Technology

HDD - Hard Drive Disk

MTTF - Mean time to failure

OSS - Open Source Software

SAP - Systems, Applications, and Products in Data Processing. It is German Software Company

Taxpayer - a person who pays taxes

TATA - Tata Consultancy Services – Indian Software and Agriculture Company

TCO - Cost of ownership

ZESCO - Zambia Electricity Corporation

ZRA - Zambia Revenue Authority

CHAPTER ONE

INTRODUCTION

1.1 BACKGROUND TO THE STUDY

This chapter looks at how Zambia Revenue Authority was established, highlights the functions of the Authority. Then it discusses the software and hardware used by the Authority to deliver on its mandate of administering the taxes on behalf of the Government of Zambia. In addition, the chapter highlights some of the major costs incurred in relation to software procurement.

Furthermore, it looks at the problem statement under the research at Zambia Revenue Authority, research questions, research objectives and the value the research is adding to the body of research and the community.

Zambia Revenue Authority is a government agency charged with the responsibility of collecting and administering taxes on behalf of the Government of the Republic of Zambia. This agency is under the supervision of the ministry of Finance. The Authority was formed under the Zambia Revenue Authority Act, now Chapter 321 of the Laws of Zambia (National Assembly, 1993). The main responsibilities of Zambia Revenue Authority are; to properly assess and collect taxes and duties at the right time. To ensure that all monies collected are properly accounted for and banked (ZRA, 2016).

In order to discharge its responsibilities the Authority depends on information communication technology. Therefore, the Authority has invested in information communication technology to achieve its objectives. Zambia Revenue Authority depends on information communication technology to run and manage its operations. The information communication technology consists of hardware, software and networks. Computer hardware is the collection of physical elements that constitutes a computer system. Computer hardware refers to the physical parts or components of a computer such as the monitor, mouse, keyboard, computer data storage, hard drive disk (HDD), system unit (graphic cards, sound cards, memory, motherboard and chips), etc. all of which are physical objects that can be touch(Casey,2015). Computer software is

a collection or set of instructions written in a computer programming language that tells the computer how to behave or respond. The computer network is hardware and software infrastructure that is used as media to transmit the instructions from one device (computer) to another.

The information communication technology equipment are purchased using the resources from Government of Republic of Zambia through the ministry of Finance, and in some instances the donors help the Authority to procure the equipment.

The Authority is funded like any other government agency. The process of funding involves analysing different government needs and the resources available or projected to be available at the time of executing the given programme. Therefore, there are times when some programmes or activities are not allocated with funds because of competing needs. This leads to some of Zambia Revenue Authority programmes being suspended or not delivered as expected.

Therefore, it leads to the Authority not collecting enough taxes, some taxpayers incurring some extra costs that are not necessary. This is because of not having enough resources to implement all the projects and activities necessary to ensure that tax collection is affordable and efficient for both the Authority and the taxpayers. For example, if the Authority does not implement the robust and intuitive information technology system for collecting taxes, the taxpayers have to travel long distances to pay taxes, second the Authority will not collect enough taxes so that the government can implement economic and social programmes for the country.

1.2 SOFTWARE AT ZAMBIA REVENUE AUTHORITY

Zambia Revenue Authority procures software based on business and technical requirements. According to Zambia Revenue Authority ICT policy, 2015 it is very crucial to specify the business and technical requirements that are to be met, before deciding on the development or purchase of new software. Most of the software that ZRA uses is off shelf packages software. However, the core software used in the taxes management are developed by the private organisations. For example TATA of India, Bulls of South Africa, and SAP of Germany. Core system are systems that critical in the operations of the Authority's business. For example, the software used to manage domestic taxes was designed and developed by Tata of India, while the software used to

manage the import and export taxes was acquired from United Nations conference for Trade facilitation (UNCTAD).

The ZRA ICT policy, 2015 further stresses that the business case for a bespoke development must be very strong indeed to reject the selection of a suitable packaged solution. On the other hand acquiring the already developed software is a critical process especially that it is usually very expensive to correct things after making mistakes and will have to suffer consequences for years to come.

In addition to the core applications software, there is operating systems software that sits between core applications and hardware. Zambia Revenue authority uses Windows and Linux operating systems. There are two types of software when it comes to issue of ownership and these are open source software and proprietary software.

Proprietary software remains the property of the organisation, group, or individual who created it (BBC, 2019). The organisation that owns the rights to the product usually does not release the source code, and may insist that only those who have purchased a special licence key can use it (BBC, 2019). These are usually related to the core systems that the Authority uses to administer and manage taxes. For example, Oracle database, Microsoft SQL server database, Oracle Weblogic server application server.

Open source software is free and openly available to everyone, and people who create open source products publish the code and allow others to use and modify it (BBC, 2019). According to Intellectual Property Expert Group (Ipeg) (2016), Open source software does not just mean access to the source code. Some of the distribution terms of open-source software must comply with the following criteria; there must be free redistribution. The program must include source code, and must allow distribution of the source code along with the compiled form. The license must allow modifications and derived works, and must allow them to be distributed under the same terms as the license of the original software.

1.3 HARDWARE AT ZAMBIA REVENUE AUTHORITY

According to Zambia Revenue Authority information communication technology policy and Security policy, 2015 the purchase of new computers and peripherals requires careful consideration in line with the business needs. It further recognises that the rate of technological changes in this area is very high and poorly defined business requirements

would result in purchasing low specification computers which would be obsolete within a short time of usage.

The Authority purchases different types of hardware for different systems. The hardware is acquired based on the business user requirement. The Authority spends a lot of money on the hardware. The cost of the hardware does not change based on proprietary software nor open source software. However, it has been noted that the open source software like Mysql, Redhat do run on the servers with low specification compared to proprietary software. For example, Linux operating system runs efficiently on low server machine compared to Windows operating system.

There are situations where the type of software going to be installed on a specific hardware do arise, especially if the software to be purchased comes from a company that also manufactures the hardware. For example, few machines are priced according to the software that is going to be installed. i.e. Oracle Exadata Server machines from Oracle Corporation are only used to install Oracle database and are expensive, but when being used to install and host Oracle software database the Software licenses are cheaper compared to installing and configuring same software on the machines that is not from Oracle Corporation. Below are some of the costs incurred when purchasing hardware equipment for the core systems; Time to try the software .Due diligent visits done by the Authority. Study tours. Advertisements and procurement processes. Training of members of staff to manage the hardware. Transportation of the hardware. Insurances costs.

1.4 COSTS OF RUNNING THE CORE SYSTEMS

The cost of running the core systems at Zambia Revenue Authority includes; paying salaries of ICT members of staff, purchase of hardware, purchase of software, purchase of power to use in the running of the servers. However, this study will not discuss the cost of power because cost of power is treated as fixed cost, does not vary according to the software being hosted or executed. It is treated as such because the supplied power is shared with non-critical systems in the server rooms. For example, Taxonline II servers and mail exchange servers share the same power supplied by Zambia Electricity Corporation (ZESCO).

1.5 STATEMENT OF THE PROBLEM

According to Gartner 2018 report the global information technology spending is likely

to be \$3.8 trillion in 2019 from estimated \$3.7trillion in 2018. Spending on proprietary enterprise software is projected to record the highest growth, 8.3% in 2019. Similarly, Zambia Revenue Authority has continued procuring expensive proprietary enterprise software solutions from big private companies like Oracle, SAP, and TATA. This problem has been compounded with inadequate funding from the government of Republic of Zambia.

For example, Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ) GmbH, 2019 stated that Zambian government finances are in a very fragile position. Hence, government spending is significantly outpacing revenues, which is partly due to insufficient tax revenues. Moreover, budget planning and implementation are at times arbitrary. More than 85% of domestic revenues for 2019 has been firmly earmarked – nearly half to pay salaries of public servants and nearly half to service debt. As a result, the government’s financial scope for implementing development-oriented policies or sustainable debt management is severely limited.

Furthermore, International Finance Corporation et al, 2014 states that there are challenges to secure funding for the program of Implementing AsycudaWorld System in Zambia. This is because the government of Republic of Zambia cannot fund the whole program due to financial constraints.

Similarly, in 2012 the Government of Republic of Zambia just managed to fund part of the development of Taxonline system, the system for collecting and managing Domestic Taxes. The rest of the funds came from Investment Climate Facility for Africa (ICF), a donor-funded development institution based in Tanzania (World Bank Group, 2019). In addition, In 2007 Zambia Revenue Authority had to get financial support from Millennium Challenge Corporation of United States to streamline the Value Added Tax (VAT) registration process, which has reduced the time required to register for the VAT from between 2 to 3 weeks to just 6 days (Millennium Challenge Corporation, 2007). This would have not be done by just using grants from the government of Zambia.

It is from this background that sometimes information technology department in conjunction with other departments/divisions in the Authority suspend, reduce, postponed, discard, compromise in execution of some of its activities. As result, planned objectives and tasks are not delivery as scheduled. As stated earlier, the Authority has continued spending a lot of money on software .For example, every year Zambia

Revenue Authority (ZRA) pays for annual subscriptions and support fees to the suppliers of proprietary software like Oracle Corporation and Microsoft Corporation.

The money spent on proprietary software can be used for other things if an alternative software was found and adopted. For example, motivating ICT employees to come up with innovations that meet the new challenges that are facing the Authority.

However, this study will mainly cover the software part because it is decided or considered based on the Zambia Revenue Authority business needs, then infrastructure (Hardware and Network) is considered based on the software to be installed and configured. Infrastructure component will be only covered where software can only run on the specific hardware (Infrastructure).

In the review of literature, there is no study on reducing costs of running the Core ICT systems of a government agency using Open Source software in a case of Zambia Revenue Authority. The solutions or alternatives to the proprietary software problem can be found by carrying out a comprehensive research.

1.6 RESEARCH GENERAL OBJECTIVE

The main objective of this research was to study how to reduce costs of running the core ICT systems of a government agency using open source software: A case of Zambia Revenue Authority.

1.7 Research questions

This study is seeking answers to the following research questions;

- a. What are the costs pertaining to the acquiring, licensing and maintenance of the existing ICT systems?
- b. What are the major characteristics considered when acquiring software in Zambia Revenue Authority?
- c. Why Zambia Revenue Authority does not adopt or use open source software despite huge licensing and maintenance costs that come with proprietary software?

1.8 RESEARCH OBJECTIVES

- a. To find out the various costs incurred when purchasing, licensing and carrying out maintenance of the exiting ICT systems at ZRA
- b. To find out the major characteristics considered when acquiring software for Zambia Revenue Authority ICT systems.
- c. To understand the motives for not adopting or using open source software despite huge licensing and maintenance costs that come with proprietary software.

1.9 VALUE OF THE STUDY

This research will add value to the body of knowledge as follows; it will help the authority to find alternative software and hence reduce cost of running ICT core systems, It will help people in various decision-making positions on how to take advantage of open source software. It will help people to evaluate their beliefs about the open source use in the enterprise systems. It will help the society to know the value or importance of open source in the delivery of services in the government agencies. Society will realise how open source can be used to change the competition.

1.10 SCOPE OF RESEARCH

This study will mainly cover software part of Zambia Revenue Authority ICT systems and part of the infrastructure where the software runs only on the proprietary hardware. It will not cover infrastructure; including connectivity and computer hardware where the software is installed and configured. This is because the software to use or install is determined after assessing or evaluating the business user requirements, then hardware is determined after choosing the software to solve or meet the business requirements.

1.11 ROAD MAP

The research paper reviews the literature in chapter two (2). Explains the theoretical and conceptual framework in chapter three (3). Then discusses methodology, philosophy, research methods in chapter four (4) and proceeds to present the findings in chapter five (5). It discusses the findings in chapter six (6) and chapter seven (7) summaries the research and gives recommendations.

1.12SUMMARY

The chapter gave the introduction of the research. It outlined the background of Zambia Revenue Authority and its mandate of managing the taxes on behalf of the Government of Zambia. It discussed the software and hardware acquired at the Authority and the procedures followed when buying. The different costs incurred when acquiring the software at the Authority. Furthermore, the chapter has outlined the statement of the problem being the procurement of expensive proprietary software despite not receiving adequate funds from Government, while there is an alternative cheaper software.

In addition, it has highlighted the main objective of the research, specific research objectives and research questions. The significance of the study and road map have been explained.

CHAPTER TWO

LITERATURE REVIEW

2.1 DIFFERENT GOVERNMENTS AND THEIR AGENCIES VIEWS ON OPEN SOURCE SOFTWARE

According to Gartner,2019 Enterprise Software includes different types of software content, communication, and collaboration software; Customer Relationship Management (CRM) software; digital and content creation software, Enterprise resource planning (ERP) software; office suites; project and portfolio management; and SCM software. This review will concentrate on core systems. When it comes to acquiring of software for an enterprise or organisation there are two types of software namely proprietary software and open source software. These are not only different because of licensing models but even the concepts used to design, develop and share or distributed it among the developers, users and consumers/clients.

This literature review will cover; different governments and their agencies views on open source software, Open source software in Zambia , open source software versus proprietary software, then look at the reliability, security and interoperability /openness of software, models of adopting technology, models used when acquiring enterprise software, innovations in Open source software verses Proprietary software cost. In addition, skills required to manage software.

Many countries especially from the developed world have recognised the importance and role that open source software plays in different sectors. The same countries have gone further to draft policies and regulations to support the use of open source in different government agencies and departments. This sections looks at the countries that have come up with policies and regulations in support of use of open source software.

Ejiaku Samuel, 2014 states that governments are to provide strategic policy framework for the acquisition and use of information technology for social and economic growth. The development of information technology infrastructure and software in emerging economies has been lagging behind those in developed countries because of poor policies and insufficient investments in the Information technology. It has been observed that most developing countries have ineffective information technology policies and this has created problems in the growth and application of information technology.

For example, Australian Tax office has formulated Tax Office Free and Open Source Software Policy. This policy has many statements that guides how the authority should use the open source software. Some of the content in this policy are (Australian Tax office, 2008) are as follows;

- a. The Tax Office endorses the use of freeware and FOSS. Staff involved in the selection and acquisition of ICT products and services will consider alternatives alongside commercial and proprietary solutions and assess them based on fitness for purpose, total cost of ownership risk and supportability.
- b. A position will be reserved on all ICT-related tender evaluation teams for a nominee appointed by the Chief Technology Officer (CTO). Advanced notification will be given and arrangements made to put this into effect. The CTO may decide to withdraw this representative as the evaluation proceeds.
- c. Before granting final approval for the procurement of a FOSS-based solution, the relevant financial delegate, authorised under the financial management Act, will seek timely advice from the Chief Technology Officer and the ATO General Counsel.
- d. Unless a FOSS-based ICT solution has specific relevance to Tax Office operations, the Tax Office will engage software support from major suppliers rather than assume the added burden of technical support.
- e. It is a minimum requirement that all freeware and FOSS software be assessed for its suitability to operate in the Tax Office's computing environment. Software will be submitted for evaluation through the ICT's software acquisition process.
- f. The Chief Technology Officer may issue an ICT technical ruling governing the use of a particular piece of freeware or FOSS even if the software acquisition does not involve an industry tender. Staff are bound to comply with this ruling, which will specify the conditions of use of the product in the Tax Office's computing environment.

According to Hong Kong government,2003, the Government had formulated policies and issued guidelines to encourage and assist government departments in adopting open source software (OSS). This would also set an example for the private sector to follow to promote the adoption of Open source software in Hong Kong. This was done to help the government departments adopt and start using Open source software.

According to Cnet,2004 Indian President A.P.J. Abdul Kalam called for his country's military to use such non-proprietary technology to ward off cybersecurity threats. The president said that Software maintenance and software upgrade is an important issue for defence.

Without naming any proprietary software products, the president asked defence engineers to develop and implement on open platforms. He said even though the required software for the equipment could be developed by the private industry, it is essential that the technical know-how and the architecture is fully available with these services for ensuring provision of lifetime support for the software which may or may not be forthcoming from the trade.

According to Ejiaku Samuel, 2014 most developing countries do not have the resource to develop Information Technology in their respective countries. Rather, they depend on substantial foreign aid to ensure the development of Information Technology. Developed countries have also not done much to assist emerging nations to develop their information technology infrastructure. Therefore, open source software can play a big role in the helping the developing countries to develop or enhance performance without looking for resources from the developed countries.

For example, with Open source software operating system Linux or Ubuntu allows the organisations or individuals to install without any major costs. In addition, Linux operating system comes with firewalls, server management tools. This empowers individuals and organisations to be innovative of which cannot happen if the organisations are using proprietary software.

Therefore, it is clear that various countries have recognised Open source software contribution to the development and delivery of government services. It is from this background they have started coming with policies and legislation to help their respective agencies and departments to start using the open source software.

2.2 OPEN SOURCE SOFTWARE IN ZAMBIA

The use of software in Zambia is evident everywhere, however, there is not much literature talking about Open source software use in Zambia. In March 2007, the Zambian government launched its national ICT policy, and at the launch, then President Mwanawasa reportedly emphasised the creation of an innovative, market responsive,

highly competitive, co-ordinated, and well-regulated ICT industry (Zambia National ICT Policy, 2007). It was hoped that the use of software and in particular open source will increase especially that it is free and a lot of Zambians and institutions do not have money to spend on software.

According to Dobрева-McPherson et al, 2019 institutions , individuals and countries are migrating from commercial software (CS) to open source software mostly because of two reasons; the increase of costs of purchase and maintenance of commercial software against the backdrop of global economic meltdown. However, African countries are still using commercial software and Zambia has National ICT policy but it does not cover or talk about open source software usage.

However, there are open source software movements or groups in Zambia that try to advocate for the use of the Open source software in Zambia. These groups organise events to promote open source. For example, Living Open Source Foundation organised an event at University of Zambia, Lusaka, Zambia, in 2018 under the theme stimulates the growth of local economies by enabling people to develop themselves as experts in the area of Open Source Software (Living Open Source Foundation, 2018). This event was a success but the organiser do not have statistics about the use of open Source software in Zambia.

2.3 OPEN SOURCE SOFTWARE VERSUS PROPRIETARY SOFTWARE

Open source software has source code available to everyone for use as is or with modifications. The two main categories of open source licenses are copyleft and permissive.

Unlike Copyright law or license that restricts the right to use, modify, and share creative works without the permission of the copyright holder, copyleft license says that people have the right to use, modify, and share the work as long as the reciprocity of the obligation is maintained. In other words, if they are using a component with this kind of open source license, then they too must make their code open for use by others as well (Goldstein Ayala, 2019). Example of the copyleft is The GNU's General Public License is the most popular open source license around. Richard Stallman created the GPL to protect the GNU software from becoming proprietary.

A permissive open source license is a non-copyleft open source license that guarantees

the freedom to use, modify, and redistribute, while also permitting proprietary derivative works (Goldstein Ayala, 2019).

However, it should be noted that open source software under these licenses do not attract any fee. There are open source software applications/systems for different uses such as database servers, application server, integration, communication. Examples of open source software are Mysql as database, Apache as application server, Pentaho for business intelligence

Proprietary software is licensed under exclusive legal right of the copyright holder, and the user of a proprietary piece of software is granted use under certain conditions. Typically, the user must accept an end-user license agreement (EULA), a contract between user and publisher, in order for an application to be installed on a hard-drive. By accepting the EULA, the user agrees not to e.g. modify the software, derive the source code, by-pass protection mechanisms, and redistribute the software, in addition to various other restrictions (Gramstad, 2012).

Open source and proprietary software will be discussed in the following areas; security, reliability, customizability, custom applications, auditability, support options, interoperability. Total cost of ownership. These are very important because most of these areas or categories considered when procuring the software.

2.3.1 Security

It involves ensuring that the computer, data, and other associated equipment are not tempered with and integrity are maintained, and systems are not accessed by unauthorised people or programmes. Both open source and proprietary software provide security, however, the design and implementation are different. Open source software code can be accessed patched, changed by anyone with access to the code while proprietary software can be patched, upgraded by the owner or supplier of the software. This means that it may take longer to improve the security of the proprietary software compared to open source. Some critics of open source software say that someone may introduce a bug then distribute which may cause open source software venerable.

However, Open source software is more secure than proprietary software in many respects. For example, when Linux Redhat or Debain operating systems which are open

source are compared with Microsoft Windows operating system proprietary. Microsoft Windows operating system is more prone to virus, worm and other electronic attacks than Linux Redhat operating systems. For example on Friday 12th May 2017, the virus 'WannaCry' hit the world, affecting over 200,000 machines in more than 150 countries. The ongoing attack continued to spread across systems that have not been updated with recent security updates (The Telegraph, 2018). It was discovered that many of these machines were running Microsoft Windows that did not get software patches from Microsoft Corporation. In case of open source software, there are a lot of developers to fix bugs and other errors unlike the proprietary software that depends on the owners of software to fix bugs and errors.

It is from such incidents, events, arrangements and evidence that it is concluded that open source software is more secure than proprietary software in many respects. Security has an impact on the cost of software. For example, if the organisation wants database software to manage its data, it will go for the secure database. Therefore, to have a secure proprietary database requires many information technology specialists to implement the controls while under open source software database is not the case.

2.3.2 Reliability

Software reliability is considered in terms of probability of failure-free operation over a specified time interval, Mean time to failure (MTTF), the predicted elapsed time between inherent failures of a system during operation and expected number of failures per unit time interval (failure intensity) (Susan, 2011).

Open-source software is considered to be more reliable than proprietary software because of various reasons which include ; it is peer-reviewed software reasons being that the source code is free and open, therefore, other developers can fix bugs unlike , proprietary software, mature open-source code is as reliable because there a lot of developers (Tiwari, 2011). The core idea of open-source development is very simple: open-source programmers have learned that secrecy is the enemy of quality (Tiwari, 2011). However, the opponents of open source software claim that open source software is unreliable as the source code of OSS is available and the potential threats can easily be incorporated.

On other hand, organizations or individuals who are perhaps professional teams (Singh et al, 2015) develop proprietary software, exclusively accomplished products are likely

to be given at the channels. Since there will be no un-validated alteration, the result is consistently trustworthy. It is from this perspective that some organisations and individuals believe that the proprietary software is reliable than open source software.

When the arguments from both sides are analysed objectively, it can be concluded that open source is reliable because of serious scrutiny that takes place when developing and peer reviews that are done before users start using software. Proprietary software is not reviewed and validated as open source because private organisations or individuals may not have adequate number of staff or time.

2.3.3 Customizability

It involves the changing or extending the source of the existing software so that it can meet the business user requirements. Open source software can be customized to meet the unique needs of an organization at a minimum cost and time. This is because the source code is developed using open standards, frameworks and accessible as open source licenses allow individuals and organisations to modify the source code. In addition, the modification may incur costs related to the work being done but not because of accessing or acquiring source code.

The same cannot be said about the proprietary software because the source code is not accessible to the public or client, as the proprietary licenses do not allow modification. All the modifications have to be done by the supplier/developer. It is good for the supplier but not for the client because the client has to depend on the supplier and it attracts additional costs, hence, it slows down the innovation and adaption in case of modifications requirements. In addition, the code modification or customisation comes may take longer because modifications have to be done by the supplier/developer.

2.3.4 Support

Open source programming and solutions depend on the online group system(s) to convey help by means of discussions, forums and blogs. While there is huge, steadfast and captivated online groups that clients can turn to, time-poor customers of today are acquainted with the prompt administration and help that empowers issues to be determined in an auspicious way. In addition, these groups can't promise the abnormal state of responsive (Singh et al, 2015). The support provided by the open source community may not be always adequate, but there are many options that a client or

developers may look at. In addition, an organisation or individual may seek help from private individuals or organisations that are specialised in the open source systems or source code.

While proprietary software suppliers offer support in different ways, which include; backup solutions, resolving challenges, providing software patches, helping installation, configuration of the software and management. The support rendered under this arrangement costs more many than open source, and there are few options compared to open source community. This is because the source code and systems configurations are not available to everyone but remains with the suppliers or developers.

2.3.5 Interoperability

The ability of software and hardware on different machines from different vendors to share data or work together. The proprietary software owners do not divulged specifications that would allow other companies to duplicate the product or come up with the similar software that may work with other software (Emmott, 2014). This makes it difficult to find proprietary software that is widely interoperable. Therefore, Open source software is more interoperable than proprietary software. Open source software enhances trust in interoperability through transparency. This is achieved when source code and compiler are accessible, users are able to verify that the software interoperates as it should and organizations have a solution whose security, privacy and transparency is not dependent on actions of and are continued support by their suppliers (Almeida et al, 2011). The Interoperability /Openness software is very important because it helps the organisation to plan for future expansions through using interfaces or application interfaces. The interoperability is also important when it comes to interfacing or integrating systems in the organisation. This is because the organisation will always have more than one core system to integrate, as the business needs change and many more in an organisation. Furthermore, interoperability should has a bearing on the cost.

2.3.6 Total cost of ownership

Gartner (2019) defines total cost of ownership (TCO) of information technology assets as comprehensive assessment of information technology (IT) or other costs across

enterprise boundaries over time. Information technology includes hardware and software acquisition, management and support, communications, end-user expenses and the opportunity cost of downtime, training and other productivity losses.

Similarly, Maha and Tony (2011) defines Total Cost Ownership(TCO) as a measure of all the costs of identifying and acquiring software, installing it and operating it, and finally the exit costs found in migrating away from the software. TCO reflects not just the balance of the direct qualities of competing software products (price, functionality, reliability etc.) but also the relationship of the software to the organization's broader set of technology platforms, installed systems, culture and skills base, and strategic goals, as well as the ability to access market and community based services and support. Last but not the least, it also looks at the implications of the software not being available or not accessible.

Open source software code is free, however, service charges may be incurred in the process of hiring experts to develop, modify, install, configure and manage solution powered by Open source software, and sometimes it requires a certain level of specialized skill to oversee the content. It is important to take interest into the expenses acquired once the product is gotten. Remarkably, open source software vendors are increasingly charging for add-ons, additional administrations and joining, however, these will not be equivalent to the proprietary software costs (Singh et al, 2015). The total cost of ownership for open source software may generally equivalent to some jagged source alternatives consequently (Singh et al, 2015).

The proprietary software expenses consist of a base charge for programming, combination administrations and yearly annual subscription. These expenses may be restrictive for some; however, what the client is paying for being a more tweaked item from a trusted brand that incorporates larger amounts of security and usefulness, nonstop advancement, a more prominent capacity to scale, progressing preparing and packing and a lower prerequisite for specialized abilities (Singh et al, 2015).

Total cost of ownership (TCO) is a useful and indeed operational concept, but it does not give the full picture of how useful or effective any given software. According to Maha and Tony (2011) its primary role is to allow comparisons between various software products and services through like-termed costs. TCO is, in its purest form,

mute as to relative benefits. For this reason, Return on Investment (ROI) is often used in conjunction with TCO studies to provide the benefit versus costs perspective.

For example, in 2011, British government commissioned a team to write a report on Total Cost of Ownership of Open Source Software and below are the tables showing the Cost Drivers for software acquisition and TCO of software in government departments and agencies, and the second table shows the factors of influence for open source software adoption.

2-1 Cost Drivers for software acquisition and TCO

Cost Category	
Search	Cost of up-front evaluation study
	Cost of up-front proof of concept implementation
Acquisition	Cost of Software
	Cost of Customisation for business needs
	Cost of Integration (to current platform)
Integration	Cost of Migration (data and users)
	Cost of Training
	Cost of Process and Best Practice change
Use	Cost of Support services - in house
	Cost of Support services – contracted
	Cost of Maintenance and Upgrades
	Software scaling (for change in user or transaction volumes)
Retire	Exit costs (in relation to hardware and software)
	Exit costs (in relation to changeover, re-training)

(Source: Maha and Tony ,2011)

2-2 Factors of influence for open source software adoption

Factor of Influence
Reducing Vendor Lock-In
Ability to Experiment or Innovate
Value for Money
Access to Knowledge and Skills
Building Business Agility
Support for Incremental Development of Solutions
Ability to build and work with a peer community to re-use and share code
Ability to work with Local/SME Service Providers
Access to a wider choice of Support Service Providers
Ability to work with Sector Peers on Common Areas of Interest
Better adoption of Open Standards
Access to Code (e.g. for worst case)
Ability to Modify Code (e.g. for customization and solving critical defects)
Ability to change Support Service Providers

(Source: Maha and Tony 2011)

Zambia Revenue Authority may not consider all the factors that were identified in the tables above. However, the organisation and its information communication technology department have similar issues like cost of support services - in house, cost of support services – contracted , Cost of Maintenance and Upgrades. This may not be conclusive.

Cost of Support services - in house

Under this arrangement, the Authority incurs costs related to in-house design, development and deployment of software or system(s). These costs come as salaries to the employees involved in the given project, buying hardware and other software to support the local or in-house development. It should be noted that not all the costs can be identified or quantified because it very difficult and too many to itemised. For example, the costs incurred due to unavailability of the system.

Cost of Support services – contracted and Maintenance and Upgrades

Zambia Revenue Authority has many contracts with number of organisations that have supplied software and support the delivered software. Some of these organisations are SAP, Oracle, Microsoft, Teammate. The costs incurred range from annual subscription fees, training, and consultancy. Furthermore, there are costs for patches and other upgrade. Some of these upgrades demands that new hardware is in place which increases the costs.

2.4 MODELS USED WHEN ACQUIRING ENTERPRISE SOFTWARE

There are different models used to assess the suitability and good attributes of the software to be acquired or developed. This review focuses on three models namely McCall, Deutsch and Willis, and Evans and Marciniak. These are very important because they cover critical components of software acquisition and help the users of software by ensuring that they have comprehensively defined the user requirements of the software. These include usability, reusability, maintainability and other things.

2.4.1 McCall factor model

The McCall quality model looks at three(3) qualities of software product: product transition (adaptability to new environment), product revision (ability to undergo changes), and product operations (its operation characteristics)(Lee,2014). The software product includes maintainability, flexibility, and testability. Product Transition includes Portability, Reusability, and interoperability. This model contains eleven (11) quality factors and twenty-three (23) quality criteria. The quality factors describe different types of system characteristics and quality criteria are attributes to one or more of the quality factors(Lee,2014).

Product transition is very important because it shows if the software solution can run on different platforms and environments. For example, in an event of migrating the system from one environment to another. Similarly, product revision is important because it is critical factor that covers upgrades or modifications to enhance or accommodate the new requirements that may be raised. The software should accommodate the changes because the system(s) operates in environment that is dynamic and changes cannot be avoided. Last but not the least, product operations states the characteristics of the software when it is operational or in use. Operational

can vary from one organisation to another but what is important is that the system is serving its purpose.

The developers or suppliers of the software are required to meet the user requirements. There are different formats and ways of submitting the user requirements. Therefore, when it comes to the testability of software the following factors should be considered;

Correctness – when the software system satisfies all the functional requirements specified the system is said to be correct. A correct software system may still be unacceptable to customer if the system fails to meet unstated requirements such as stability performance and scalability (Kleppmann, 2012). These are called non-functional requirements. They are important because they ensure that the users are using the systems without any problem. Therefore, it is important that both functional and non-functional requirements are met before the system is acquired and deployed.

Reliability- the extent to which the software performs as required, i.e. the absence of defects. It can also be defined as ability of software product or component to continue to perform its intended role over a period to pre-defined conditions (Naik and Tripathy,2008). Some of the issues that are associated with measurement of system's reliability are ; measured in terms of the mean time between failures, the mean time to repair, the mean time to recover, the probability of failure and the general availability of the system. This is very critical because if the system is not reliable the organisation incurs unnecessary costs of always repairing or fixing. This leads users and other stakeholders not being satisfied.

The mean time between failures - under pre-defined conditions, the average time between consecutive failures over a given period in the life of a system. The mean time to repair - the average time to repair or maintain equipment.

The mean time to recover - the average time to return a system to operation after a failure. The time involved should include periods taken to re-instate from previous checkpoints.

The probability of failure - the use of formal methods to predict the likelihood that a system will behave in an expected way under certain circumstances. Probability of

failure is most appropriate to safety-critical systems and "continuous running" systems.

However, the software may have defects but may still be acceptable to customers because the execution scenarios causing the system to fail may not frequently occur when the system is deployed. Reliability is a customer perception.

Zambia Revenue Authority (ZRA) information communication technology has incorporated some concepts highlighted above. Some have been highlighted in the ICT and security policy, and measurements of The mean time between failures, The mean time to repair, The mean time to recover and The probability of failure in its Disaster Recovery systems document. These guide the members of staff responsible for managing the information technology systems, which includes software.

Efficiency- covers what extent a software system utilizes resources such as computing power, memory disk space, communication bandwidth and energy. This is important for the organisation because users should know the bandwidth, power, memory resources and storage required to execute the software. For example, for a taxpayer or ZRA officer's computer to run ASYCUDAWorld application software used to manage import and export taxes, it requires minimum of 1 Mbyte bandwidth and at least 4GB RAM of client computer to run properly.

Integrity- refers to application/system ability to withstand attacks to its security, it may also cover the extent to which access to software or data by unauthorized persons or programs can be controlled. Integrity has assumed a prominent role in today's network based application (Padmakar et al, 2017). This is a very important factor because the system must provide proper integrity mechanism to give confidence to the users and other interested parties. For example, the software being used by the Authority must have measures in place so that the integrity of systems and data is not compromised or tempered with.

Usability- a software system is considered to be usable if human users find it easy to use. User input must stress on the user interface of software systems. It should also be intuitive and consistent to the user(s) so that it is easy to use or learn how to use. For example, the icons for saving, opening and deleting the document should be consistent in the all modules of the system.

Maintainability - refers to the upkeep of products in response to deterioration of their components due to continued use of the products. Maintainability known to how easily and inexpensively should be or executed (Naik and Tripathy, 2008). This is important because the business user requirements and some business procedures change, Hence, the maintenance of the software will always be there as the organisation is to operate and improve the operation of the organisation.

Testability- the ability to verify user requirements. At every stage of software development, it is necessary to consider the testability aspect of a product. This helps the customer to know that he/she has bought a software that will meet user requirements and supplier of the software that he/she supplied the correct software.

Flexibility - reflected in the cost of modifying an operational system. As many changes are effected in a system throughout its operational phase subsequent changes may cost more and more(Padmakar et al, 2017). If the initial design is not flexible it is highly likely that subsequent changes are every expensive in order to measure the flexibility of a system (Kleppmann, 2012), and easily one can add a new feature to a system.

Portability of a software system refers to how easily it can be adapted to run in a different execution environment. For example, Java application that can run on both windows and Linux operating system. This gives an organisation many options when it comes to deploying software. In allows the organisations to be agile when responding to different business user requirements and changes in the environment. It is also important for developers because a major adaptation of a system can increase its market potential.

Reusability means if a significant portion of one product can be reused may be with minor modification in another product economically it may not be viable to reuse small components. It saves the cost and time to develop and test the component being reused (Naik and Tripathy, 2008).

Interoperability is the ability or feature that can binds different type of environments to work together in terms of the data exchange, data validations, authentication and other many more things. This makes it easy for an organisation to use different computer systems that share data/information and achieve its objectives in coordinated manner.

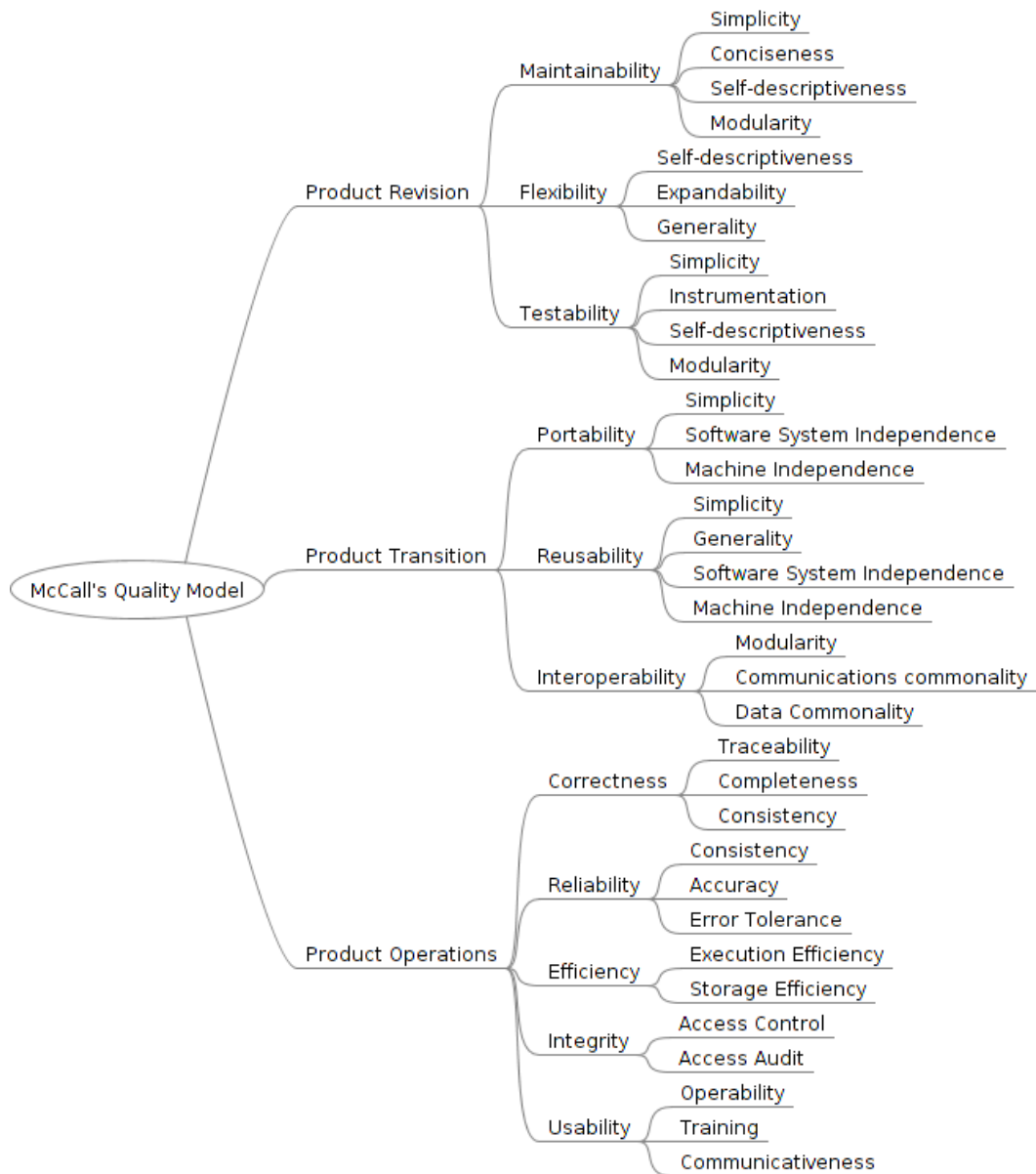


Figure 2-1 McCall Model

Source: (Shabbir Sundas, 2017)

2.4.2 Deutsch and Willis model

This model uses same criteria or factors as McCall' factor model. This includes; expandability, maintainability, efficiency, reliability, integrity, interoperability, flexibility, reusability, portability (Jawawi, 2005).

Expandability deals with increasing the software's functionality or performance to meet new needs. This is in case of the business requirements changing. For example, if there is need to change the software to meet the user requirements

Maintainability it is about how ease it is of finding and fixing errors and bugs. This includes the issues of ensuring that the source code is well documented so that the developers or new person can understand the logic and the reasons behind every code.

Efficiency deals with the initial effort required to learn, and the recurring effort to use the functionality of the software and Reliability deals with security against either overt or covert access to the programs or data.

Integrity Deals with how easy it is to couple the software in other systems or applications. Interoperability it deals with the extent to which the software design and implementation conform to the stated requirements (Jawawi, 2005)

Flexibility deals with modifying the software to work in different environments. Reusability deals with transporting the software to execute on a host processor or operating system different from the one for which it was designed .Portability it deals with how easy it is to verify that the software is working correctly (Jawawi, 2005)

In addition, it looks at the verification, expandability, safety, manageability and survivability. However, it does not consider testability factor. The Deutsch and Willis model is an alternative model has emerged after the McCall model. It has fifteen factors grouped into four categories: operating, performance, change and management (Younes et al, 2013)

Safety requirements address conditions that could bring the equipment or application down especially for controlling software, as in setting alarms or sounding warnings. Especially important to process control / real time software such as that running conveyor belts or instrumentation for ordinance (Galin, 2004). This meant to eliminate conditions hazardous to operators of equipment because of errors in process control software.

Manageability requirements refer to tools primarily administrative to control versions, configurations and change management / tracking. Organisations must have tools to manage versions and various configurations that may vary from customer to customer (Galin, 2004). This speaks to the administrative tools that support software modification during the software design, development and maintenance periods, such as configuration management, software change procedures, and the like.

Survivability requirements refer to MTBF, or continuity of service, as well as MTTR (mean time to recover). This appears to be quite similar to Reliability in McCall's model

2.4.3 Evans and Marciniak Model

This model is similar to Deutsch and Willis model. It considers all the factors as McCall' factor model, and like other models, there is functionality, which takes care of suitability, accuracy, interoperability, security, functionality and compliance

Reliability consist of the maturity, fault tolerance, recoverability and reliability while factor of usability has the following issues of understand ability, learnability operability and attractiveness usability.

Efficiency factor takes of the time, behaviour, resources, utilization, maintainability factor covers analysability, changeability, stability, and maintainability. Portability factor has adaptability, install ability, co-existence, replace ability and portability.

In addition, it looks at verifiability and expandability of requirements. Verifiability requirements addresses design and programming features that allow for efficient verification of design and programming.

This does not refer to outputs; rather, structure of code, design elements and their dependencies, coupling, cohesion; pattern applies to modularity, simplicity, adherence to documentation and programming guidelines, etc. It looks at the universal modelling language (UML) for dependencies, cohesion, coupling (Saba et al, 2015).

Expandability requirements really refers to scalability and extensibility to provide more usability. This is the capabilities and efforts required to support adaptive maintenance activities. These include the resources required to adapt a software package to a variety of customers of the same trade, of various extents of activities, of different ranges of products, and soon. This is same as McCall's flexibility. Future efforts that will be needed to serve larger populations, improve service, or add new applications in order to improve usability. The majority of these requirements are covered by McCall's flexibility factor.

After reviewing models and Zambia Revenue Authority ICT policies, and procedures, it was established that some of these factors are considered and used in the process of acquiring the software at Zambia Revenue Authority, while other factors are not considered. However, further analysis will be done after collecting data from the

targeted sample population responding to questionnaires. Some of the factors considered are; portability, efficiency, correctness and usability.

2.5 TECHNOLOGY ADOPTION LIFE CYCLE

In this section, the literature review identifies overarching factors affecting technology adoption in organisations and by individuals. Technology adoption at each level or stage involves analysing pros and cons. There are different stages or groups in this life cycle that may also affect the adoption of proprietary software or open source software in organisation or as an individual. It provides insight into the current market conditions for a technology and a glimpse into the future.

However, this discussion will cover proprietary software and open source software adoption. There are five (5) different stages or groups namely innovators, early adopters, early majority, late majority adopters and Laggards.

2.5.1 Innovators

These are technology enthusiasts. These are risk-oriented, leading-edge minded individuals who are extremely interested in technological developments. They pursue new technology aggressively, learning about and evaluating new products in an effort to be first (Wohler's Report, 2002).

They are likely to try anything new. They also have a higher risk tolerance and are prepared for the innovation to fail their expectations and relatively few in number, so for marketers; they represent a beachhead, an important source of references and referrals. Innovators will often have some connection to the scientific discipline in which a new product or service is generated from and will tend to socialize with other innovators in their chosen product categories. Even some organisation fall in this category as they are looking out for the new things. Especially those that value research and development. Furthermore, even organisation with individuals that want to help the organisation to reduce on costs, outshine the competitors, and bring efficiency to the organisation.

Zambia Revenue Authority has some of members of staff who fall in this category. They may try to influence the organisations to start using the new technologies to solve some of the business challenges that come with tax collections.

2.5.2 Early adopters

They are visionaries, not technologists. These tend to be the most influential people within any market space and they will often have a degree of “thought leadership” for other potential adopters. They find it easy to imagine, understand, and appreciate the benefits of new technology. These end-users see value for the new technology within their industry and want to capitalize on the savings or new capabilities before their competitors or colleagues (Kotler and Armstrong, 2014).

They are willing to risk technical immaturity, recognizing that not all aspects of the new technology have yet been worked out. However, they do not take as many risks as innovators and tend to make reasoned decisions as to whether or not to become involved in a particular product. They will try to obtain more information than an innovator in this decision making process.

Zambia Revenue Authority has individuals that fall in the category as well, and some of these are key decision makers or influencers.

2.5.3 Early majority

They are people who are pragmatists. They are ready to buy when someone else has taken the risk and worked out the bugs. This class of adopter is reasonably risk averse and wants to be sure that their, often more limited, resources are spent wisely on products.

They help organisation get traction, means making a product or service appealing to the early majority. Indeed, the early majority is made of conscious consumers that look for useful solutions, and beware of possibility of an intense and widely shared enthusiasm for something (Cuofano, 2019). They see a technology decision as something they are going to have to live with for a long time, so service is important. They are however, generally, people with better than average social status and while not thought leaders in their own right – they will often be in contact with thought leaders and use the opinions of these thought leaders when making their adoption decisions. Once you win them, they are extremely loyal.

2.5.4 Late majority

They are conservative and content to be followers, and often are not comfortable in their ability to handle new technology. They tend to put their resources towards tried and tested solutions only and are risk-averse. They are conservative pragmatists who

hate risk and are uncomfortable with new ideas. Practically their only driver is the fear of not fitting in, hence, they will follow mainstream fashions and established standards. For example, they are not going to buy many products until what they are using is finished (Kotler and Armstrong, 2014). As you might expect, in general terms, this category of adopter has less money, lower social status, and less interaction with thought leaders and innovators than the other groups of adopters.

2.5.5 Laggards

They are skeptics, they are very late adopters, all things being equal, never adopt. They are people who see a high risk in adopting a particular product or behaviour. Some of them are so worried that they stay awake all night, tossing and turning, thinking up arguments against it (Cuofano, 2019). Typically, laggards will have low socio-economic status and rarely seek opinions outside of their own limited social set. However, it is worth noting that in many cases laggards are older people who are less familiar with technology than younger generations and in these cases, they may still have a mid-level of socio-economic status.

It is important to review Technology Adoption Life Cycle because it helps in understanding what happens in organisation such as Zambia Revenue Authority. After having reviewing Zambia Revenue Authority and interviewing some of its ICT members of staff, it was established that there are these five groups in the Authority. At the individual level , it was ease to relate how and know which group or category individuals belong. However, strategy and policies are the documents that guide in the adoption of the technology in the Authority. Therefore, it can be deduced that Zambia Revenue Authority are early majority adopters when it comes to buying the core system software or technologies. This is because the organisation is cautious about the risks that come with new technology. This has impact on choosing the type of software to buy and in this case open source software or proprietary software. However, in some cases it can be deduced that the Authority is an innovator especially when it comes to reducing the costs of collecting and managing taxes. For example, Zambia Revenue Authority ICT department in conjunction with other departments in the Authority partnered with commercial banks in 2009 to introduce e-payment facility. At that time, many of Zambian government agencies were not in position to adopt the concept of e-payment.

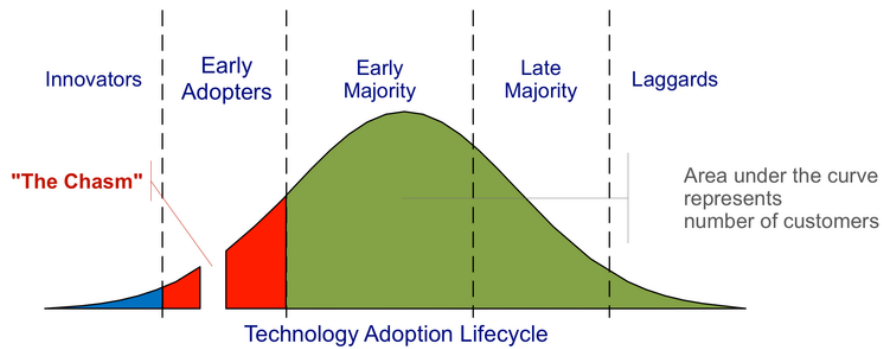


Figure 2-2 Technology Adoption Lifecycle Source: (Kumbar,2017)

2.6

2.7 THEORIES OF ADOPTING TECHNOLOGY (SOFTWARE).

There are different theories used to adopt technologies. This section will discuss Theory of Reasoned Action (TRA), Theory of Planned Behaviour (TPB) and Technology Acceptance Model (TAM). These theories help organisations and individuals in adopting or start using technologies including software.

2.7.1 Theory of Reasoned Action (TRA)

It suggests that a person's behaviour is determined by their intention to perform the behaviour and that this intention is, in turn, a function of their attitude towards the behaviour and subjective norms (Fishbein & Ajzen, 1980). The theory suggests that attitude and subjective norms are important for persuasive communication and showing what an individual wants or intend to do. The attitude and behaviour of the users, information technology staff and management in the department or organisation influence or affect the choice of the technology being used or to be adopted.

That is how and why people's beliefs change the way they act and make decisions. Behaviour can either be verbal or non-verbal such as body language, signals, signs, or vocally expressed (Otieno et al, 2016). In this regard, the actual use of an innovation is determined by the individual's behavioural intention to use it. This theory may not work well for the organisations because they are guided by the strategy or policy and not the attitude of the individual(s). However, scholar may urge or claim that it is individuals who come up with strategy for the organisation but the individuals will not have the same attitude nor beliefs.

This concept may apply or not among Zambia Revenue Authority Information technology members of staff, because members of staff have different beliefs and behaviours. In addition, some employees have worked for different organisations and have different exposure to different technologies, different ages, different cultures and gone to different universities and colleges. The diagram below shows the pictorial view of Theory of Reasoned Action.

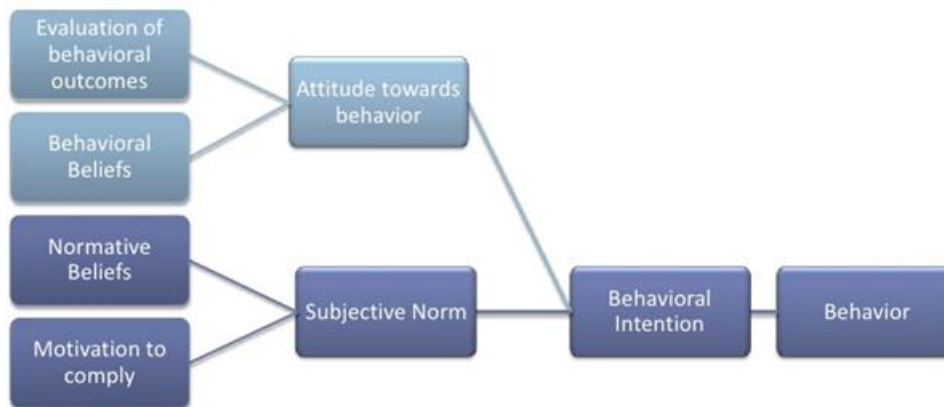


Figure 2-3 Theory of Reasoned Action Source: (Khalil Md Nor et al, 2014)

2.7.2 Theory of Planned Behaviour (TPB)

The Theory of Planned Behaviour (TPB) started as the Theory of Reasoned Action in 1980 to predict an individual's intention to engage in behaviour at a specific time and place, this theory was intended to explain all behaviours over which people have and the ability to exert self-control (Wayne LaMorte,2019). This is an extension of Theory of Reasoned Action (TRA) discussed above.

Instead of relying on the overall evaluation or utility of a product, this theory concentrates on the specific consumer behaviour of target group. For example, buying cheap open source software in a given specific period. The goal of the theory of planned behaviour (TPB) is to provide a comprehensive framework for understanding the determinants of such behaviours.

This theory brings in the aspect of studying a specific product or services in given period. This is good because it removes unnecessary attributes and characterises. However, it does not change the fact that it uses the behaviour and beliefs of individuals in the organisation or targeted group.

This applies in Zambia Revenue Authority when it comes to looking at the specific units. For example, Domestic Taxes Business Intelligent unit may have specific attributes different from other units. The diagram below shows the pictorial view of Theory of Planned behaviour.

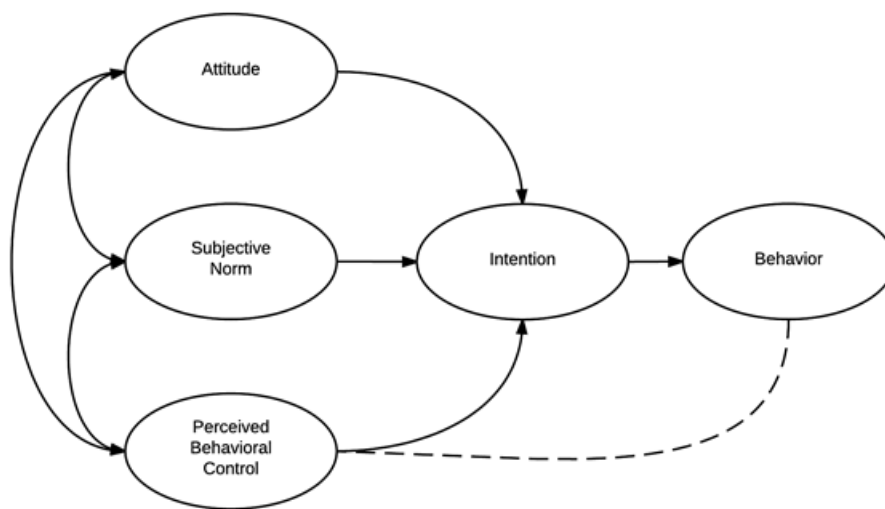


Figure 2-4 Theory of Planned behaviour Source: (Icek Ajzen,2019)

2.7.3 Technology Acceptance Model (TAM).

This is Davis's (1989) model of technology acceptance is one of the utmost widely used models for studying and interpreting user behaviour towards information technology in different areas through two beliefs: the conviction of usefulness and ease of use, the validity of using this model has been demonstrated in different environments(Davis,1989).

This model has been used in assessing the adoption of the technologies in different organisations. In this model, accepting new technology through intermediate factors of perceived usefulness and perceived ease of use to affect users' behavioural intention (William et al, 2009). The perceived usefulness refers to the degree to

which a person believes that using a particular system would enhance his or her job performance . The perceived ease of use refers to the level to which a person believes that using a particular system would help that person.

This model is easy to use, however; it has the weaknesses of being subjective and it is for an individual. This may not work well for an organisation like Zambia Revenue Authority because strategy and policies are used in determining the technologies to adopt. The two beliefs of the conviction of usefulness and ease of use are well understood and real. The conviction of usefulness is appreciated by the in the organisation while ease to use is both understood and appreciated by the managers and functional members of staff in the department. It is important to for decision makers and organisation to understand these beliefs.

It is easy for the organisation to buy software that it thinks it will help the organisation to deliver the objectives but it may not be easy to use. There could be different reasons why it is not ease to use. Some of these reasons include; lack of skills, lack of management support, poorly adopted, not well documented. However, it is important that both beliefs are giving positive results.

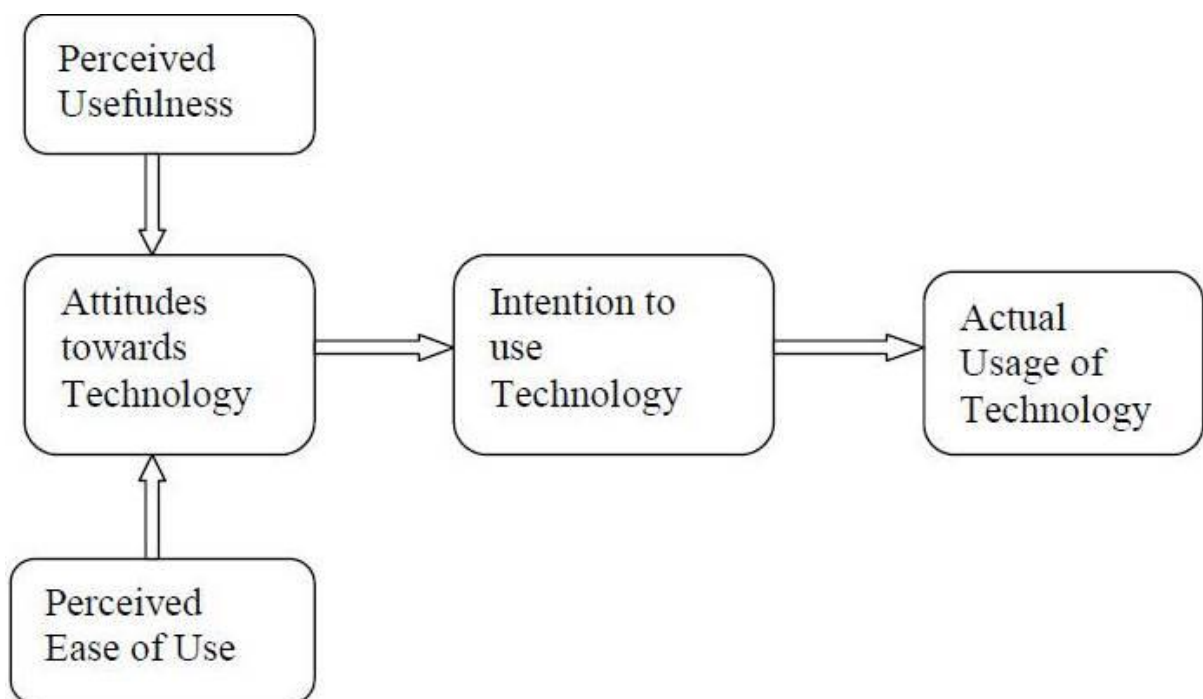


Figure 2-5 Technology Acceptance Model Source: (Jeff Sauro, 2019)

2.8 INNOVATIONS IN OPEN SOURCE SOFTWARE VERSES PROPRIETARY SOFTWARE

Oxford dictionary, 2015 states that innovation is the action or process of innovating. However, the business world has various definitions and understanding on what innovation is. For example, Nick Skillicorn (2019) defines innovation as turning an idea into a solution that adds value from a customer's perspective while David Burkus, 2019 defines innovation as the application of ideas that are novel and useful. Creativity, the ability to generate novel and useful ideas, is the seed of innovation but unless it's applied and scaled it's still just an idea. This section discusses Open innovation theory in open source software verses proprietary software.

Chesbrough, 2003 defines open innovation as the use of purposive inflows and outflows of knowledge to accelerate internal innovation, and expand the markets for external use of innovation, respectively. Open innovation is a paradigm that assumes that firms can and should use external ideas as well as internal ideas, and internal and external paths to market, as they look to advance their technology. According to Brant and Lohse (2014) Open innovation enables firms to integrate external knowledge and expertise into their innovative process, improving their offerings while cutting costs and more effectively managing risks.

Open Innovation models stress the importance of using a broad range of sources for a firm's innovation and invention activities, including customers, rivals, academics, and firms in unrelated industries while simultaneously using creative methods to exploit a firm's resulting IP (Chesbrough, et al, 2006). This model emphasizes the fact that external opportunities have to be better explored, allowing the development of innovation through the exploration of technologies and resources (Chesbrough, 2007).

According to Chesbrough, et al, 2006 Open source software emerged as a reaction to the proprietary software model, with two direct antecedents. One was the open systems movement—centered around Unix and its variants—reflecting an attempt by customers to reduce their dependence on proprietary software vendors. Another antecedent was the creation of university research software during the 1980s, including the BSD variant of Unix from UC Berkeley.

Closed Innovation is a paradigm shift taking place in commercialised companies and a view is that successful innovation needs control, and that firms need to be strongly self-

reliant because of uncertainty with quality, availability and capability of others' ideas (Chesbrough, 2004). Unlike closed Innovation, open innovation proposes that paradigm, (i) firms can, and should, use external as well as internal ideas and (ii) that internal ideas can be taken to market through external channels, outside a firm's current business, to generate value. According to Chesbrough (2006), ideal businesses resist the 'not invented here' and 'not sold here' syndromes in favour of open innovation reasons, their own offerings and stay ahead of competitors (Chesbrough & Growther 2006; Van de Vrande et al. 2009).

Proprietary software comes from the private companies that use closed innovation model. This means that individual private companies do the software development. This means that the innovations should come from the same company, source code is available to the customer nor competitors, hence the same company fixes bugs and errors. This means that it is expensive because the company many to have free human resource to patch the software, it takes long to fix the errors. In addition, the company or developer has to cover all the costs incurred. This contributes to the high cost of software.

While open source software development is using open source software. There are a lot of companies and individuals around the world who take part in software development and management of the software. Furthermore, the software is accessed by anyone who wish to have a look at the software. The open source software development model is open and takes advantage of the many developers, utilizing the knowledge of the developers from different parts of the world, it is free hence the open source software is cheaper compared to proprietary software.

The rise of open source software has enabled different organisations in private and public sectors to carry out a lot of experimentation in software business that is ongoing almost every day, because of these experimentations and trails the organisation have come with different innovations. There are many reasons why this is achieved and these are ; Open source software is cheaper, source code is available to anyone willing to work with it, developers use open standard methods , there are a lot of developers in different parts of the world. This concept has led to many innovations that has benefitted a lot of individuals and organisations.

The diagram below shows the closed innovation and open innovation models. The open innovation model is showing how it enables that organisations to cut on development costs and present other opportunities compared to the Closed innovation model. The development costs of innovation are reduced by the greater use of external technology in a firm's own R&D process. This saves time as well as money. In addition, the firm no longer restricts itself to the markets it serves directly. Now it participates in other segments through licensing fees, joint ventures and spinoffs, among other means. These different streams of income create more overall revenue from the innovation. The result is that innovation becomes economically attractive again, even in a world of shorter product life cycles (Chesbrough,2007).

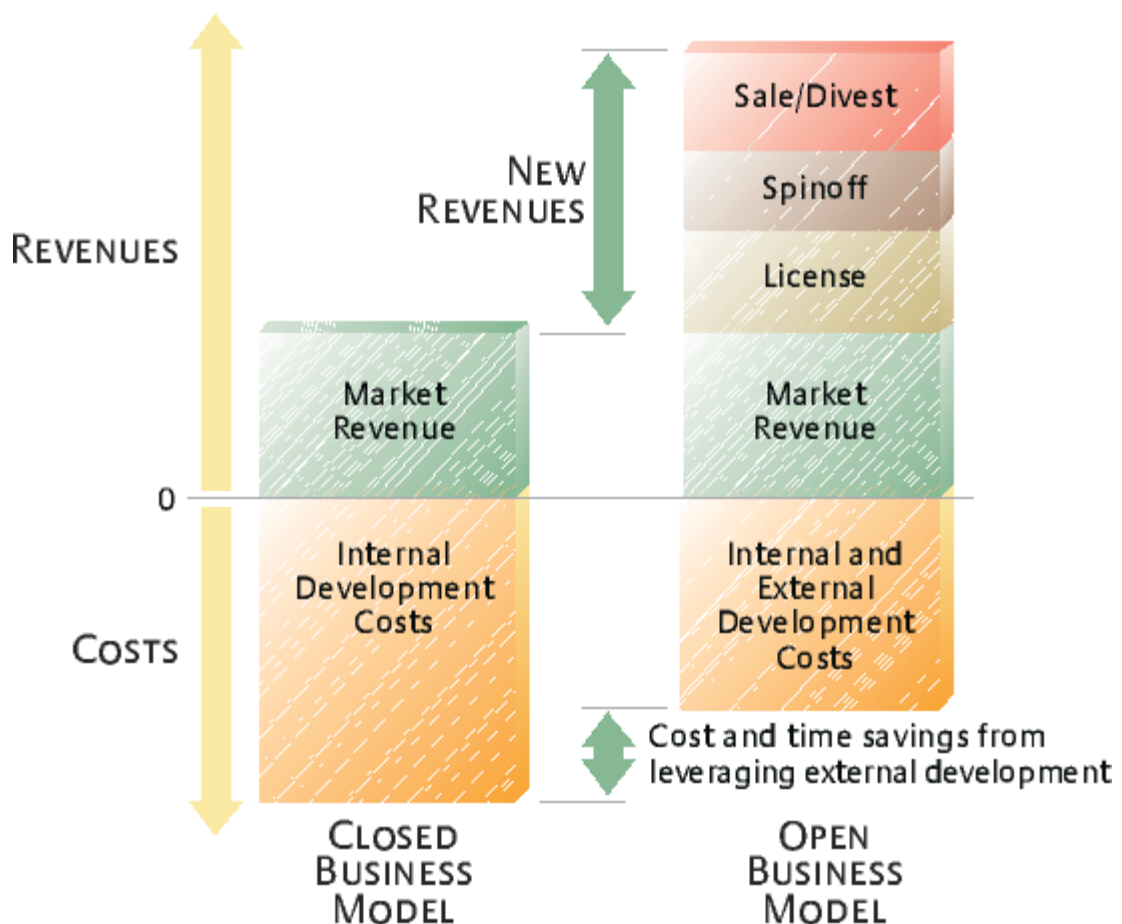


Figure 2-6 Open Innovation Theoretical and Conceptual Framework Source: (Chesbrough Henry, 2007)

In the same vein, the Open source software has fitted well in Open innovation theory and applications. This is because the organisation is able to benefit from the innovations designed and developed from external, which is one of the concepts of Open innovations. Furthermore, the Private companies have started donating or releasing Some software

under the various open source licenses in order to benefit from the creativity that is under open source foundations concepts and schemas.

For example, Oracle corporation has control of one of the two versions of Mysql databases, One being community under the open source software licenses which is available to anyone. Oracle Corporation derive benefits by accessing the innovation contribution that are contributed by the Open source community.

However, innovations cannot be said the same under proprietary software because the source code is not available to everyone. Therefore, innovations under proprietary software can only come from the owners or developers of the software. In the situation where the owner or developer has other projects or objectives to achieve , innovation becomes far-fetched or delayed in some cases.

2.9 LESSONS LEARNT FROM REVIEWED LITERATURE

The literature review showed that the different measures/approaches have been taken by different governments and their departments in relation to open source software, but it did not show how it can reduce costs of running the government agency ICT departments, especially in the monetary terms, and there is not much information about open source usage in Zambia.

The reviewed literature showed that there are different models used to assess the suitability and good attributes of the software to be acquired or developed, however, there was a gap of most organizations not using some of these models when acquiring the software. It was noted that the that technology users are categorized in five (5) groups, nevertheless, the literature review did not show that all the groups are in management or position to influence the adoption of the technology in an enterprise.

The theories suggested that attitude and subjective norms are important for persuasive communication and showing what an individual wants or intend to do, though It did not show how subjectivity norms or attitudes can be managed when making decision. Open innovation showed how the organisations to use the model and reduce costs especially in information technology industry, however, some organisations do not use it.

2.10 LITERATURE REVIEW SUMMARY

This chapter looked at the open sources software verses proprietary software. The differences were reviewed and looked at the security, reliability, customizability, support

interoperability, innovation in open source software verses proprietary software, total cost of ownership and how different governments and their respective departments are looking at open source software.

Then discussed the models used when acquiring enterprise software namely; McCall, Deutsch willis and Evans and Marchniak models. These models cover the following; reliability, usability, integrity, survivability, correctness, efficiency interoperability, safety, maintainability, flexibility, portability, reusability, expandability, manageability and verifiability

It also reviewed the technology adoption life cycle. This model has five (5) phases, which include innovators, early adopters, early majority, late majority and laggards.

Furthermore, the review covered theories of adopting technology. The three (3) models are Theory of Reasoned Action, Theory of Planned Behaviour and Technology Acceptance Model.

In addition, innovations under the open source software verses Proprietary software were reviewed. , Furthermore, the discussion covered how other countries have responded to opportunities that come with Open source software.

CHAPTER THREE

THEORETICAL AND CONCEPTUAL FRAMEWORK

3.1 OPEN SOURCE SOFTWARE AND PROPRIETARY SOFTWARE THEORETICAL AND CONCEPTUAL FRAMEWORK

According to Svinicki 2010 a conceptual framework is an interconnected set of ideas (theories) about how a particular phenomenon functions or is related to its parts. The framework can be used as the basis for understanding the causal or correlational patterns of interconnections across events, ideas, observations, concepts, knowledge, interpretations and other components of experience. A conceptual framework provides not knowledge of “hard facts” but, rather, “soft interpretation of intentions” (Levering, 2002, p. 38). Conceptual framework helps to show or explain things/events by the observers or researchers. This research is looking at costs in relation to the procurement or acquiring software.

Therefore, the conceptual framework diagram below is trying to show how the software, costs and software attributes related or interconnected in this research. The problem of high cost of proprietary software compounded with low funding from government is being discussed and analysed by looking at the drivers of the high costs of ICT systems at Zambia Revenue Authority.

This conceptual framework will be discussed using Independent, dependent and moderating variables. Independent variables are values that can be changed in a given model or equation. They are input(s), which is used by the model to change the out. Dependent variables are values that result from the independent variable (s) or depends on an independent variable(s). Moderating variable affects the relationship between the independent variable (predictor variable) and dependent variable (criterion variable). Moderators may be characteristics of people, objects or situations.

In this study, the independent variable is software while the dependent variable is cost which changes according to the software acquired between proprietary and open source software. The moderating variables are software characteristics such as reliability, security, compatibility/interoperate, skills required to run and manage the software, the organisation policies. These characteristics do vary between open source software and proprietary software. The diagram below shows how these components are inter-related.

The moderating variables help the Authority to evaluate the software and make a sound decision pertaining to the procurement of the software.

This is important because it helps the researcher to identify the areas to look at critically, how they are interconnected or related. Furthermore, it helps in explaining to the readers and observers what is being investigated and discussed. The diagram also helps in illustrating the research in form of the concept or model.

This research will help the authority to save money which can later be used for other activities such as training more employees, buy more resources, improve taxpayers' experience through the robust systems. It will also provide more opportunities for innovations, software solutions being implemented on time and according to the business requirements.

In some situations, moderating variables influence or are factors in determining the cost of the software. For example, the open source software operating system like Linux is cheaper compared to the proprietary software but because the organisations or individuals have no technical skills install and manage the software it becomes expensive. Similarly, the proprietary software good and well supported but because of security related issues, the software becomes more expensive. For example, Microsoft operating system windows is expensive in terms of managing its security because it attracts a lot of virus and other mal-software. This is because Windows operating requires extra software to secure it against the malware and other virus.

In addition, the research will help the Authority in implementing the solutions as it should be, the taxpayers will be happy, the government of Zambia will have more revenue because the ICT systems will run at affordable costs, and taxpayers will be served well and they will respond by paying taxes on time. Tax compliance among taxpayers will increase because the systems will be up and running 24/7. It will entail Zambia Revenue Authority will collect and administer taxes at an affordable cost.

It will also improve the image of the country especially among the people passing through the country because they will be served well.

The objectives of this study are alignment to Open Innovation model. Therefore, Conceptual framework is based on the Open Innovation model discussed above in the literature review under Innovations in Open source software versus Proprietary software. This model advocates for organisations to integrate external knowledge, expertise into

their innovative process, improving their offerings while cutting costs and more effectively managing risks (Brant and Lohse, 2014). Chesbrough wrote this theory in 2003. Therefore, the first hypothesis of this research is:

Ho: The cost of buying and managing Proprietary software is higher compared to Open source software.

the second hypothesis of this research is:

H2: The cost of buying and managing Proprietary software and Open source software is the same.

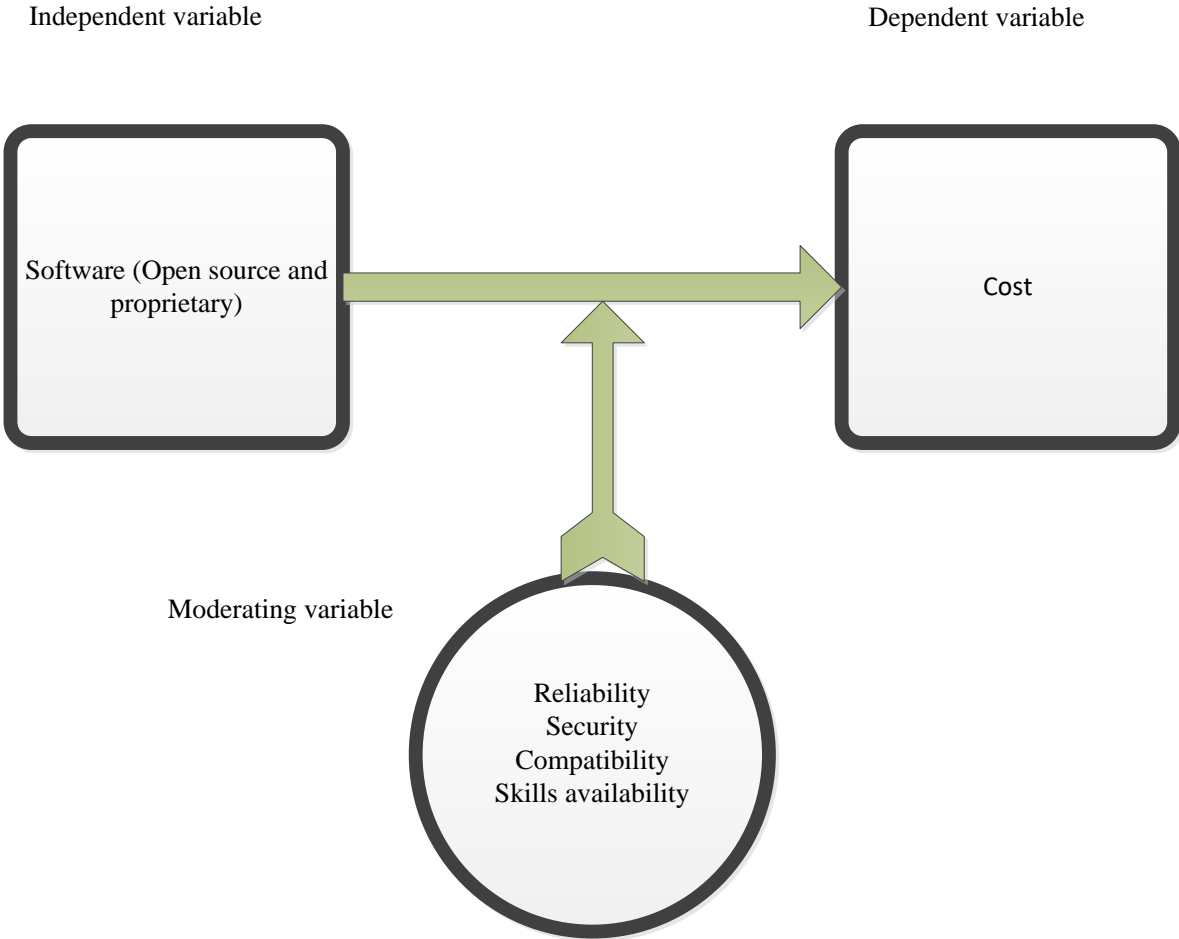


Figure 3-1 Theoretical and Conceptual Framework

3.2 SUMMARY

The chapter has discussed the theoretical and conceptual framework to be used in this research. The justifications for using this model have been outlined. The discussion has gone further to explain the independent and dependable variables that are coming from the

concept. The research is based on Open Innovation model discussed in the literature review. The hypotheses have been outlined based on the chosen model.

CHAPTER FOUR

METHODOLOGY AND METHODS

4.1 INTRODUCTION

This chapter discusses the research methodology that was used in this study. It outlines a detailed description of the research approach adopted in the study. This includes; research design, sample, data collection, ethics and summary.

Dawson, 2002 defines the research methodology as steps or guidelines taken to integrate the research questions and the objectives to data collection, analysis, and interpretation in a logical way. While according to Saunders et al, 2009 the research philosophy adopted contains important assumptions about the way in which someone view the world. These assumptions underpin research strategy and the methods chosen as part of that strategy and these are; Positivism, Realism, Interpretivism, Pragmatism.

Positivists believe that reality is stable, can be observed and described from an objective viewpoint. Positivism paradigm is associated with objectivism epistemology which is a methodological philosophy in quantitative research where the methods of natural sciences to discover the study of social science is applied. Ontology view of the researcher's is of the nature of reality or being external, objective and independent of social actors.

Realism is the view that theories refer to real features of the world. 'Reality' here refers to whatever it is in the universe (i.e., forces, structures, and so on) that causes the phenomena we perceive with our sense (Maxwell, 2016). In Realism, ontology view of the researcher is of objective. It exists independently of human thoughts and beliefs or knowledge of their existence (realist), but is interpreted through social conditioning (Saunders et al, 2009).

Interpretivist or Interpretivism says that that only through the subjective interpretation of and intervention in reality can that reality be fully understood or viewed. Ontology view of the researcher is of socially constructed, subjective, may change and multiple. The research in the phenomena in their natural environment is key to the interpretivist philosophy, together with the acknowledgement that scientists cannot avoid affecting those phenomena they study (Crotty, 1998).

Pragmatism states that the most important determinant of the epistemology, ontology and axiology to adopt is the research question, where one may be more appropriate than the other for answering particular questions. For example, if the research question does not suggest unambiguously that either a positivist or interpretivist philosophy is adopted, this confirms the pragmatist's view that it is perfectly possible to work with variations in research epistemology, ontology and axiology (Saunders et al, 2009).

These philosophies are used or can be applied in different situations. There is nothing like one is important than others. For example, the views of the researcher working on the behaviour of the members of staff in an organisation may be different from a researcher who is working on the cost or expenses incurred in the same organisation.

4.2 PHILOSOPHY

The research philosophy in this study is Pragmatism where the researcher's view of the nature of reality or being is external, multiple, view chosen to best enable answering of research question (Mark Saunders et al, 2009). This philosophy covers both positivist and interpretivist views.

In this approach the epistemology, the researcher's view regarding what constitutes acceptable knowledge is either or both observable phenomena and subjective meanings can provide acceptable knowledge dependent upon the research question. Focus on practical applied research, integrating different perspectives to help interpret the data. In addition, axiology the researcher's view of the role of values in research let the values play a large role in interpreting results, the researcher adopting both objective and subjective points of view. Last but not the least the data collection techniques most often-used are mixed or multiple method designs, quantitative and qualitative.

There are different research approaches, however, the widely used are three researches namely qualitative, quantitative and mixed method (Leedy and Ormrod ,2005). Saunders et al, 2009 defines mixed methods approach as the general term for when both quantitative and qualitative data collection techniques and analysis procedures are used in a research design. It is subdivided into two types. This approach uses quantitative and qualitative data collection techniques and analysis procedures either at the same time or one after the other (sequential). This means that, although mixed method research uses both quantitative and qualitative world views at the research methods stage, quantitative data are analysed quantitatively (Saunders et al, 2009).

It should also be noted that deductive approach works from the more general point of view to the specific conclusion. It does not attempt to find patterns in data but uses observation with the intention of validating the pattern. Deductive reasoning mostly comes in quantitative research where the researcher attempts to bring out data and present a statistical analysis. While Inductive approach works the other way, moving from specific observations to broader generalizations and theories. This reasoning is varies in nature, is more open-ended and exploratory. It starts with specific observations and measures, then find patterns and regularities, formulate some tentative hypotheses.

This approach was adopted because of the following reasons; it enables the researchers to engage with multiple experiences of the same phenomena while at the same time directing the inquiry towards practical, problem-solving(Cordeiro and Kelly, 2019) , it highlights that knowledge links experience and action. In addition, pragmatic research investigates what people say as well as observing what they do and how they act(Mawlood, 2017).it provides multiple angles argument because it combines quantitative and qualitative techniques hence provides more evidence. It also provides the platform to conduct Triangulation. Triangulation is the use of several means (methods, data sources and researchers) to collect data on the same topic (Mawlood, 2017).

According to Thurmond, 2011 the benefits of triangulation include increasing confidence in research data, creating innovative ways of understanding a phenomenon, revealing unique findings, challenging or integrating theories, and providing a clearer understanding of the problem.

4.3 RESEARCH DESIGN

The research design means planning a strategy of conducting research. It is a detailed plan of how the goals of research will be achieved. Research design can be exploratory, descriptive or both in nature. There are two main types of data namely primary and secondary. Primary data comes mainly from questionnaires, interviews prepared by the research (e) etc. Secondary data is usually sourced from books, articles, and published reports electronic databases. This is also echoed by Flaherty, Honeycutt Jr and Powers, 2015 that primary data is collected directly from the participants which is done through the help of observations, interviews, and surveys. Whereas, secondary

data on the other hand is based on the collection of data from all the secondary resources such as previous research studies (Clark, 2013).

This research had four objectives to help the researcher to appreciate and understand the challenges outlined in the problem statement above. The three (3) objectives are as follows;

- a. To investigate and present the various costs incurred when purchasing, licensing and carrying out maintenance of the exiting ICT systems at ZRA. Questionnaire was given out to the respondents to collect data under this objective, and document review was conducted.
- b. To find out the major characteristics considered when acquiring software for Zambia Revenue Authority ICT systems. Questionnaire was give out to the respondents to collect data under this objective, and document review was conducted.
- c. To understand the motives for not adopting or using open source software despite huge licensing and maintenance costs that come with proprietary software. Questionnaire was give out to the respondents to collect data under this objective, and document review was conducted.

The objectives had corresponding questions, which broken down and formulated questionnaires. In addition to the use of the questionnaires to collect data, interviews and document reviews were deployed to collect data. Below is research design matrix in this research.

4-1 Research Design Matrix

RESEARCH QUESTIONS	OBJECTIVES	SAMPLING AND DATA COLLECTION	DATA COLLECTION METHODS	DATA ANALYSIS
What are the costs pertaining to the acquiring, licensing and maintenance of the existing ZRA ICT	To find out the various costs incurred when purchasing , licensing and carrying out maintenance of	Online Pricing and Licensing, Quotations, Receipts and supporting documentation from the software	Global and Documentary review and Survey Questionnaires	Univariate and Bivariate

systems? (Realist ontology).	the exiting ZRA ICT systems	vendors/suppliers by availability sampling		
What are the major characteristics considered when acquiring software for Zambia Revenue Authority ICT systems? (Nominalist and realist ontology)	To find out the major characteristics considered when acquiring software for Zambia Revenue Authority ICT systems.	Zambia Revenue Authority Documents by availability sampling	Documentary review	Univariate and Bivariate
		Population of all Zambia Revenue Authority ICT and procurement employees	Survey Questionnaires	
Why Zambia Revenue Authority does not considering open source software despite huge licensing and maintenance costs that come with proprietary software? (Nominalist and realist ontology)	To understand the motives for not adopting or using open source software despite huge licensing and maintenance costs that come with proprietary software.	Population of all Zambia Revenue Authority ICT and procurement employees	Survey Questionnaires	Univariate and Bivariate
		Zambia Revenue Authority Documents by availability sampling	Documentary review	
	ZRA employees who are in decision making positions will be enlisted using	Survey Questionnaires		

		purposive sampling.		
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4.4 RESEARCH METHODS

According to Bryman Alan, 2008 a research method is simply a technique for collecting data. It can involve a specific instrument, such as a self-completion questionnaire or a structured interview schedule, or participant observation whereby the researcher listens to and watches others. There are two different types of research methods and these are Mono method and Multiple methods(Saunders et al., 2009). The term multi-method refers to those combinations where more than one data collection technique is used with associated analysis techniques and mono method is where single data collection technique and corresponding analysis procedures is used(Saunders et al., 2009).

In this research the following methods were used to collect data; Questionnaires, interviews and documentation review.

a. Questionnaire

It is technique of data collection in which each selected person within targeted sample is asked to respond to the same set of questions in a predetermined order (Bryman, 2008). The questions are prepared and then given to the members of the targeted community. Self-administered questionnaires were used. Self-administered questionnaires are those that are usually completed by the respondents. These questionnaires are administered electronically using the email. This approach was adopted in this research because of the following reasons;

- A lot of information was to be collected from many within targeted sample in a short period of time and cost effective way
- There is consistent because all the participants read and respond to the same questions. The responses are gathered in a standardised way, so questionnaires are more objective, certainly more so than interviews
- It helped in achieving anonymity because the respondents were not writing their names on the questionnaire.
- It is convenient for the respondents because there was flexibility in terms of time to respond.
- It is easy to analyse data especially when it is quantified

b. Interviews

Individual interviews are way of collecting data for the research in by discussing or asking questions verbally. The interviews can be over the phone, face-to-face, video conference call and other technologies. In this research the face-to-face interviews were conducted for the following reasons;

- It offers an opportunity to both researcher and interviewee to clarify questions, correct misunderstandings, offer prompts to be, probe responses and follow up on new ideas in a way that is just not possible with other methods.
- The researcher can read facial expression or voice tone when the interviewee is responding to a question, which can help researcher to assess if the response is valid or not.
- interviews promote standardization of both the asking of questions and the recording of answers and this feature has two closely related virtues from the perspective of quantitative research reducing error due to variation in the asking((Bryman, 2011).

c. Documents and other materials

This processes involves reading the documents such as user manual, procedures, policies, books and other relevant documents. This method was also adopted because it provide consistent and approved information that may not be provided or collected using interviews and questionnaires. Some of the documents reviewed were;

- Zambia Revenue Authority Corporate strategy
- Zambia Revenue Authority (ZRA) Information communication technology(ICT) policy
- Zambia Revenue Authority(ZRA) Information communication technology (ICT) strategy

4.5 SAMPLE

The mixed research methodology deals with the different kinds of sampling methods. Sampling is a beneficial process to select a specific set of relevant data from universal data (Saunders et al., 2009). The right kind of respondent selection sampling is necessary to carry out the research productively and effectively. Below are some of the important terminologies used in sampling;

Population is basically the universe of units from which the sample is to be selected. The term 'units' is employed because it is not necessarily people who are being sampled. The researcher may want to sample from a universe of nations, cities, regions, firms, etc. (Finch and Hayes, 1994). Sample, the segment of the population that is selected for investigation. It is a subset of the population. The method of selection may be based on a probability or a non-probability approach.

Probability sample is a sample that has been selected using random selection so that each unit in the population has a known chance of being selected. It is generally assumed that a representative sample is more likely to be the outcome when this method of selection from the population is employed. The aim of probability sampling is to keep sampling error (Saunders et al., 2009).

Non-probability sample is a sample that has not been selected using a random selection method. Essentially, this implies that some units in the population are more likely to be selected than others.

Sampling frame is the listing of all units in the population from which the sample will be selected while representative sample is a sample that reflects the population accurately so that it is a microcosm of the population. Microcosm a community, place, or situation regarded as encapsulating in miniature the characteristics of something much larger (Oxford Dictionary, 2015)

Sampling bias is a distortion in the representativeness of the sample that arises when some members of the population (or more precisely the sampling frame) stand little or no chance of being selected for inclusion in the sample.

Sampling error is an error in the findings deriving from research due to the difference between a sample and the population from which it is selected. This may occur even though probability sampling employed. Non-sampling error is error in the findings deriving from research due to the differences between the population and the sample that arise either from deficiencies in the sampling approach, such as an inadequate sampling frame or non-response, or from such problems as poor question wording, poor interviewing, or flawed processing of data (Saunders et al., 2009).

Zambia Revenue Authority has 67 members of staff who make decisions on the procurement of software and this research decided to interview and collect data from 64 participants out of 67 population. Questionnaires were given to 50 ICT member of staff

, 7 managers in ICT department and 7 procurement officers. Below is the formula used to compute the number of participants to interview. The interviewed participants were more than what was initially computed. This is because they were more questionnaires prepared and the researcher was anticipating that some participants may not respond to the questions submitted.

Determining sample size

$$n = \frac{N}{1 + N(e)^2}$$

Where

n required sample size

N the total population

e margin of error required

$$n = \frac{67}{1 + 67(0.05)^2} = 57$$

4.6 DATA COLLECTION INSTRUMENTS

According to Bryman, 2011 the concepts are the building blocks of theory and represent the points around which social research is conducted. Cost was identified as dependable variable and software as independent variable. It done after defining the theoretical and conceptual framework.

Operationalisation of variable was deployed in order to develop measurement of these variables in the research. Operationalization is the process of specifying the operations that will indicate the values of cases on a variable (Engel et al., 2014). The level of measurement is mathematical precision with which values of a variable can be expressed, the nominal level of the measurement, which is qualitative, has no mathematical interpretation; the quantitative levels of measurement is ordinal , interval and ration are progressively more precise mathematically(Bryman, 2011).

The research wanted to understand and appreciate the variables in different dimensions, therefore, most of the questions of the questionnaires were designed and prepared using The Likert scale which is essentially a multiple-indicator or multiple-item measure of a set of attitudes relating to a particular area. The goal of the Likert scale is to measure intensity of feelings about the area in question. In its most common format, it comprises

a series of statements (known as ‘items’) that focus on a certain issue or theme (Bryman, 2011).

The data was collected using the questionnaires and interviews techniques. The questionnaires were given to 67 respondents but 64 responded. This was done because it was anticipated that some may not respond. There were three (3) questionnaires. The questionnaires were designed according to the research objectives highlighted above.

To find out the various costs incurred when purchasing, licensing and carrying out maintenance of the existing ICT systems questionnaire. This questionnaire had two (2) ordinal questions and one (1) ratio question.

To find out the major characteristics considered when acquiring software in Zambia Revenue Authority ICT systems questionnaire. This questionnaire had six (6) ordinal questions and three (3) and nominal questions. The ordinal questions had scale from 1 to 5 as follows; Strongly disagree, Disagree, Do not know, Agree, Strongly Agree.

To understand the motives for not adopting open source software despite huge licensing and maintenance costs that come with proprietary software questionnaire. This questionnaire had four (4) nominal questions, four (4) ordinal questions and three (3) Interval questions. Similarly, The ordinal questions had scale from 1 to 5 as follows; Strongly disagree, Disagree, Do not know, Agree, Strongly Agree. The questionnaires are in Appendix for reference.

Initially questionnaires were given to six (6) respondents, this was done to test how the questions were prepared and then assess the most difficult questions for the respondents. The entire six (6) respondent responded to the questions, however, some errors, misspelling and grammatical errors were observed. These issues raised in the initial survey were corrected before distributing the rest.

Then sixty (6) respondents were given questionnaires. In this phase, 58 respondents responded to the questionnaires. The collected data was tabulated on excel sheet. The questionnaires are in Appendix for reference.

4.7 CREDIBILITY AND VALIDITY

According to Saunders et al, 2012 the possibility of getting the answer wrong means that attention has to be paid to two particular emphases on research design reliability

and validity. These factors must be in place to ensure that the research is reliable and valid.

Reliability refers to the consistency of a measure of a concept and covers stability, internal reliability and inter-observer consistency (Bryman Alan, 2011). It covers; participant error which is any factor that adversely alters the way in which a participants performs, participant bias which is any factor that produces a false response , researcher error which is factor which alters the researcher's interpretation, researcher bias which is any factor that induces bias in the researchers recording of responses.

In this research, these four (4) challenges were managed as follows; the respondents were given questionnaires to respond to at their own time. This allowed respondents to respond when they were free from the Authority work. In addition, they were given copies of research approval letters from University of Zambia and Zambia Revenue Authority. This was done to show that they are allowed to respond freely. Furthermore, an explanation was given to all the respondents on how to respond to the questionnaires and they responded anonymously. Interview questions were prepared before conducting interviews and this was done to ensure that there is consistency when asking questions. Questionnaires are in appendix.

Validity is concerned with whether the findings are really about what they appear to be about, for example if there is the relationship between two variables (Saunders et al, 2012). The three (3) main validity issues are; Construct validity is concerned with the extent to which research measures what it claims to measure, Internal Validity is established when a research demonstrates a causal relationship between two variables. External Validity is concerned with whether a study's research findings can be generalised to other relevant settings or groups.

In this research these issues were managed as follows; the literature review was conducted and found out that this research has never been done by anyone; similarly after reviewing the literature it was observed that there is a relationship between independent variables and dependent variable. Software (Open source software and Proprietary software) has relationship with Cost the dependent variable. Depending on the software chosen to be deployed the cost changes. Last but not the least, the research purposive sampling was used to ensure that all the sections and sectors in the organisation are

represented. This will ensure that the results can be generalised and replicated in case of a need to do so.

4.8 ETHICS

Within business and management research, there are two dominant philosophical standpoints and these are deontology and teleology. The deontological view argues that the ends served by the research can never justify the use of research, which is unethical. Consequently, if you adopted this view you would never use, for example, deception to obtain your research data, even if deception was necessary to ensure the data were valid and reliable. In contrast, the teleological view argues that the ends served by your research justify the means (Saunders et. al, 2012).

Therefore, ethical considerations in research are critical. Ethics are the norms or standards for conduct that distinguish between rights and wrong (Fouka1 and Mantzorou, 2015). They help to determine the difference between acceptable and unacceptable behaviors on the part of the researcher. The ethical privacy of the participants interviewed was maintained. Private or sensitive data that was collected as part of the research was not disclosed in any shape as the confidentiality of all participants who provide information has been respected. None of the information collected from the respondents has been tampered with.

A consent was sent out to each of the research participants that were being interviewed to let them know what the research interview was about and that their information provided would strictly be used for academic purposes only and therefore not be misused. In addition, the introduction letter from the University of Zambia and approval from Zambia Revenue Authority were shown to the participants that want to know if the research was authorised.

The verbal and written consent of the individuals interviewed was sort before the questionnaire or interview was given out. This was taken serious as the failure to make the research participants aware of the purpose or nature of the research adopted would have resulted in unethical research being carried out (Saunders et. al, 2012). Furthermore, the following was in place so that the participants are comfortable as there were responding to the questionnaires;

- a. Ensured that participants are familiar with questions and understand the organisation policy and software requirements

- b. Participants were given sufficient time to respond
- c. Provided a clear account of purpose and type of access information is required
- d. Highlighted possible benefits to the organisation
- e. Used suitable language
- f. Replied to queries
- g. Being open to serendipitous events.

Research ethics therefore relates to questions about how we formulate and clarify our research topic, design our research and gain access, collect data, process and store our data, analyse data and write up our research findings in a moral and responsible way.

This means that the researcher has to ensure that the way research design is both methodologically sound and morally defensible to all those who are involved. Inevitably, what is morally defensible behaviour as researchers will be affected by broader social norms of behaviour (Fox and Stutchbury,2009)

4.9 SUMMARY

The chapter discussed the research methodology used in this research. The chapter looked at the philosophy of the research, which is Pragmatism. This approach covers Positivism and realism. In other words, it is called mixed methods.

The research used Taro Yamane's formula in Determining sample size. The proposed sampling was purposive so that all the sections and departments in the Authority are were presented. Sixty seven (67) participants were given questionnaires and 64 responded to the questionnaires given out.

Questionnaires, interviews and documentation were deployed to collect data. The data collected was tabulated in Microsoft excelsheet. Credibility and Validity issues were discussed and measures to manage them to ensure that research is credible and valid. Furthermore, the ethics as research was discussed and provide the guidelines to be followed.

CHARTER FIVE

PRESENTATION OF FINDINGS AND ANALYSIS

5.1 INTRODUCTION

The data analysis of this dissertation deals with analyzing quantitative and qualitative findings. While quantitative research deals with statistical graphs, qualitative research deals with categorization of relevant data similarities and conflicts. According to Saunders et al., 2012 quantitative and qualitative approaches are integrated so that they provide the best results. It is for the stated reason above that pragmatic approach was adopted. In addition, this approach helps in providing the solution (s) to the prevailing challenges or problems.

As indicated above the methods used to collected data were; questionnaires, interviews, reading the available literature in the Authority and on internet.

Three (3) questionnaires were prepared; one questionnaire was covering or collecting data pertaining to the objective relating to the question, which reads, “What are the major characteristics considered when acquiring software for Zambia Revenue Authority ICT systems?” The second questionnaire was dealing with data pertaining to third objective with the question, which reads, “Why Zambia Revenue Authority does not adopt or use open source software despite huge licensing and maintenance costs that come with proprietary software?” The third questionnaire was prepared to collected data pertaining to objective with the questions which reads “What are the costs pertaining to the acquiring, licensing and maintenance of the existing ICT systems?”

The interviews were conducted and seven (7) managers were interviewed. The interviews covered different questions including some few of the questions on the questionnaires to get clarifications.

These questionnaires had questions that helped the researcher to collect data and also understand the business processes that relates to the procurement of the software in Zambia Revenue Authority. The questionnaires also helped the respondents in sense that they responded to the questions at they own free time.

5.2 TO FIND OUT THE VARIOUS COSTS INCURRED WHEN PURCHASING, LICENSING AND CARRYING OUT MAINTENANCE OF THE EXITING ZRA ICT SYSTEMS

The findings after reviewing the documentation and conducting interviews were that there were many costs but major costs were;

- I. Initial cost buying software
- II. Training
- III. Deployment cost
- IV. Total cost of ownership
- V. Licensing costs
- VI. Processes of choosing the bidders.

Costs were arranged in the order of being most expensive as follows; The Total cost of ownership was the major costs, followed by licensing, then Training, Deployment, procedure and processes of choosing the bidders.

The data collected on costs showed that the Authority spends more money on the proprietary software. For example, the costs for proprietary software namely Database, availability/grid, Business Intelligence software were collected and analysed and it was noted that 95.31% of money was spent on Oracle database, then 3.26% was on Oracle grid software, 1.36% on Oracle business intelligence. When compared to open source software it was found that proprietary software was expensive. Mysql database was only 0.06% compared to 95.31% of Oracle database and yet these software do the same task of managing data for the systems. The application servers used on the core system is Oracle WebLogic, which is expensive, compared to Apache or Tomcat Web servers. Oracle WebLogic is sold according to number of users or number of processors on the server where is installed.

In addition to the initial cost paid to the developers of proprietary software, the Authority continues paying annual subscription fees and support. Annual subscription and support fee paid to Oracle Corporation is 22% of the initial costs plus 3% as inflation escalator. Inflation-escalator is a clause in a contract providing for increases or decreases in inflation depending on fluctuations in the cost of living, production.

During the interviews with one of the Application managers, the emphasis was on proprietary software being expensive. Similarly, Database manager said that Oracle database was one of the most expensive software ZRA uses. This is so because Zambia Revenue Authority's core system use proprietary software.

The table and figure below is showing the prices of some of the proprietary and open source software at Zambia Revenue Authority.

Figure 5-1 some of the software costs sampled

Software Type	Proprietary software.		Open Source Software	
	Name	Cost (\$)	Name	Costs (\$)
Database	Oracle database	3,028,125.00	Mysql database	2000.00
Business Intelligence	Oracle Business Intelligence	43,125.00	Pentaho	0
Cluster/Grid	Oracle Data Grid	103,525,875.00	ProxySQL	200.00
Application Server	Oracle WebLogic	850,000.00	Tomcat Apache and Apache	0

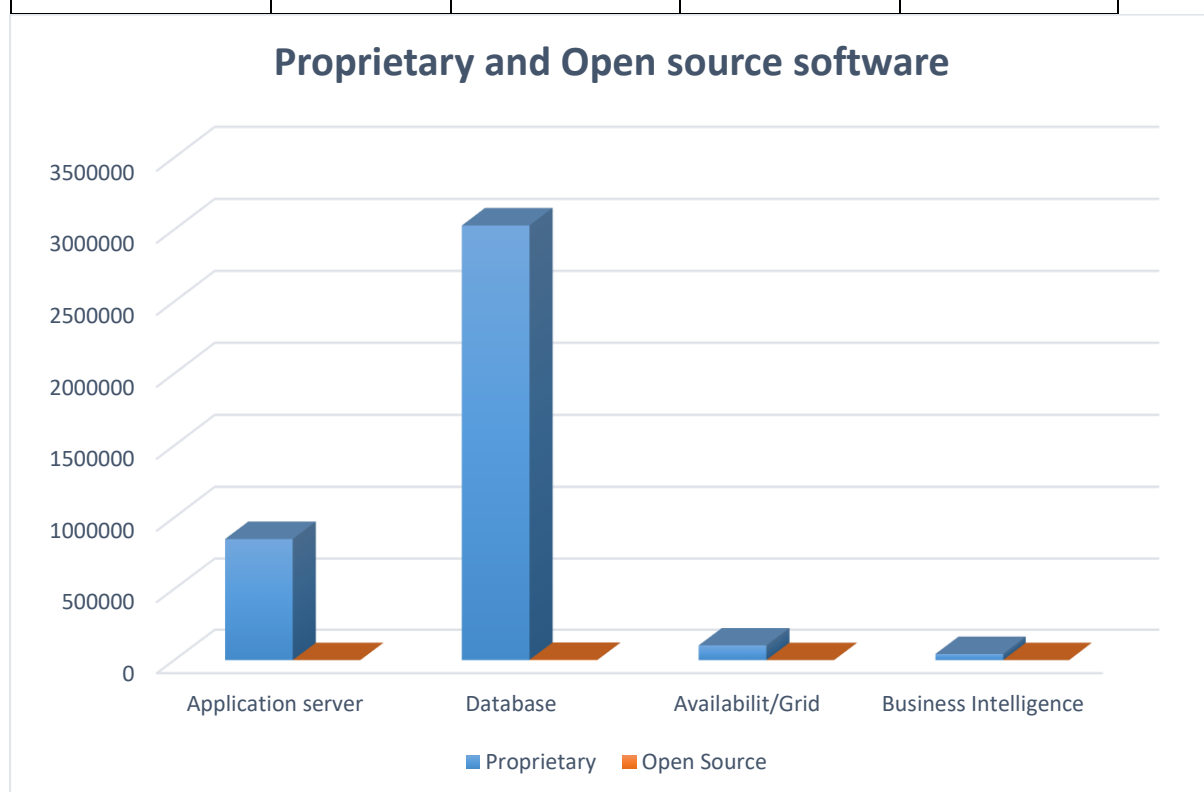


Figure 5-2 Some of the costs incurred in relation to software procurement at ZRA

5.3 SOME OTHER COSTS INCURRED

The figure below shows the costs that have been incurred by Zambia Revenue Authority in the procurement of the software from 2013 to 2018. This includes applications software like Taxonline , AsycudaWorld, Database software like Oracle database , SAP for financial management, Electronic Fiscal device system. It should be noted that Electronic Fiscal device system is not the core system but used open source software hence it is cheaper compared to the other systems.

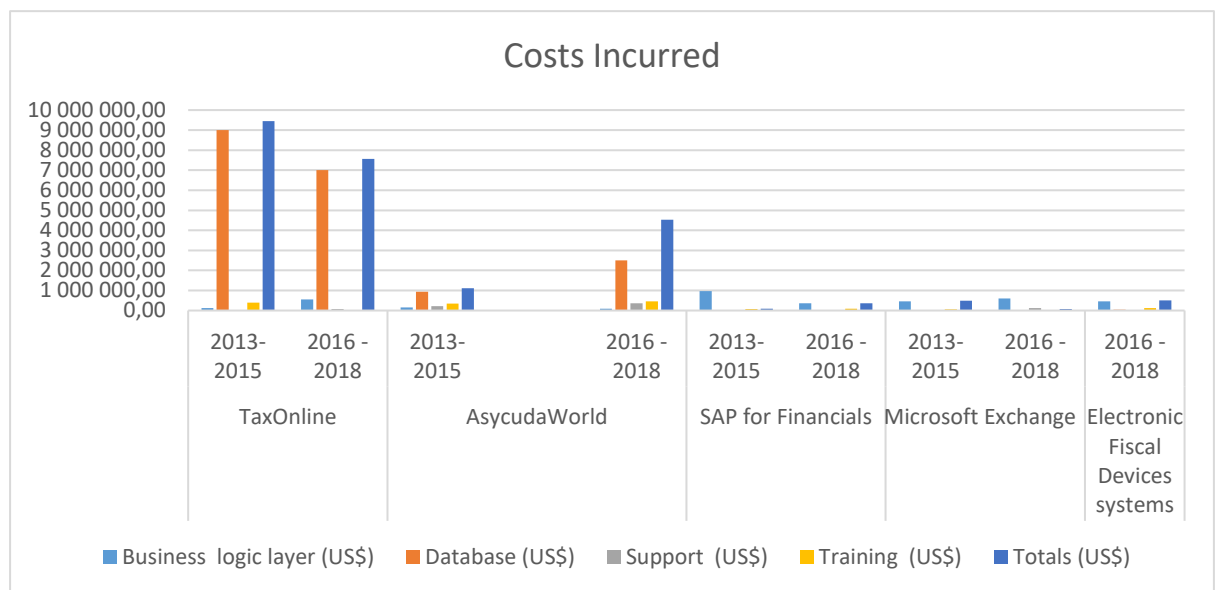


Figure 5-3 some of the costs incurred

5.4 SOME OF THE RECEIPTS, INVOICES AND QUOTATIONS AT ZRA

The screenshots below are showing some of the receipts, invoices and quotations relating to proprietary software bought at Zambia Revenue Authority.

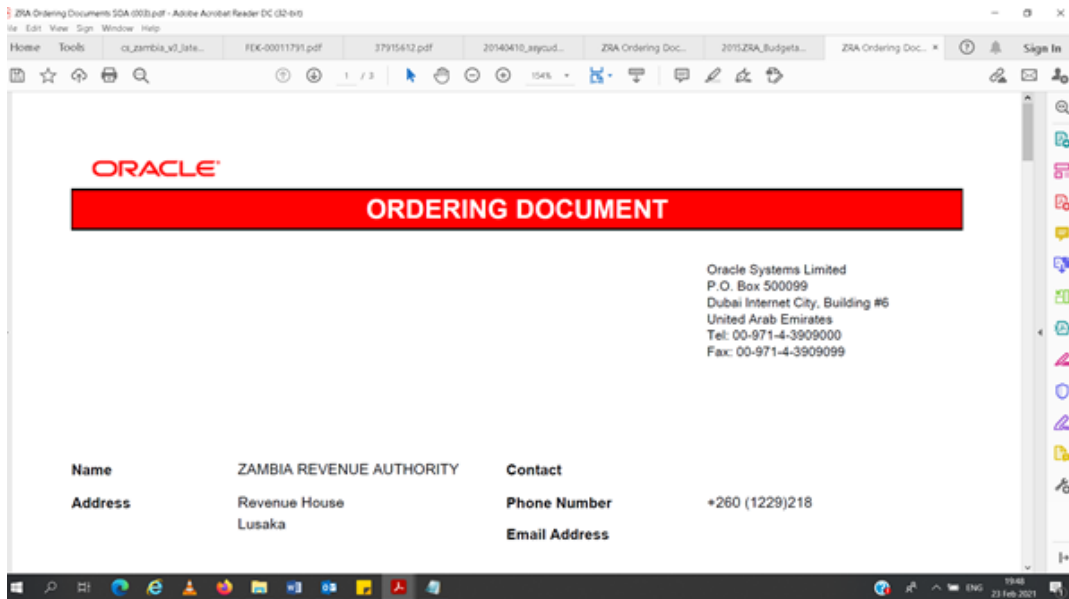


Figure 5-4 Ordering document

Description / License Type	Quantity	List Fee	Discount %	Net Fee
Oracle SOA Suite for Oracle Middleware - Processor Perpetual	2	115,000.00	55.0	51,750.00
Software Update License & Support		25,300.00	55.0	11,385.00
Oracle WebLogic Suite - Processor Perpetual	2	90,000.00	55.0	40,500.00
Software Update License & Support		19,800.00	55.0	8,910.00
Oracle SOA Management Pack Enterprise Edition - Processor Perpetual	1	25,000.00	55.0	11,250.00
Software Update License & Support		5,500.00	55.0	2,475.00
Programs and Program-Related Service Offerings Fees		280,600.00		126,270.00

Fee Description	Net Fee
Program Fees	103,500.00
Software Update License & Support Fees	22,770.00
Total Fees	126,270.00

Figure 5-5 Part of Ordering document

2015ZRA_Budgetary WebQuote # 1743797 (003).pdf - Adobe Acrobat Reader DC (32-bit)

File Edit View Sign Window Help

Home Tools cs_zambia_v3_L... FEK-00011791... 37915612.pdf 20140410_essyc... ZRA Ordering ... 2015ZRA_Bud... ZRA Ordering ... 2015ZRA_Bud... x Sign In

1 / 2 154%

All amounts in USD

Line #	Part #	Description	License Level	Quantity	List Fee	Unit Selling Price	Net Fee	Support Duration	DDR Service	Support Net Price	Restriction Details
1.0	L93012	Oracle Cloud Management Pack for Oracle Database - Processor Perpetual	Full use license	1	7,500.00	5,625.00	5,625.00	1 Year		1,237.50	
2.0	L88612	Oracle SOA Management Pack Enterprise Edition - Processor Perpetual	Full use license	1	25,000.00	18,750.00	18,750.00	1 Year		4,125.00	
3.0	A90649	Oracle Diagnostics Pack - Processor Perpetual	Full use license	1	7,500.00	5,625.00	5,625.00	1 Year		1,237.50	
4.0	A90650	Oracle Tuning Pack - Processor Perpetual	Full use license	1	5,000.00	3,750.00	3,750.00	1 Year		825.00	
		Oracle WebLogic									

1954 23 Feb 2021

Figure 5-6 Receipt from Oracle

ORACLE® Oracle Systems Limited Dubai Internet City, Building # 6
PO Box 500099
Dubai - United Arab Emirates

19-Dec-15

ZAMBIA REVENUE AUTHORITY
Revenue House Cairo
Lusaka

SERVICE DETAILS

Program Technical Support Services							
Service Level: Software Update License & Support							
Product Description	CSI #	Qty	License Metric	License Level / Type	Start Date	End Date	Price
Oracle Active Data Guard - Processor Perpetual	19436920	1		FULL USE	23-Feb-16	22-Feb-17	651.47
Oracle Business Intelligence Foundation Suite - Named User Plus Perpetual	19436920	50		FULL USE	23-Feb-16	22-Feb-17	10,409.44
Oracle Database Enterprise Edition - Processor Perpetual	19436920	60		FULL USE	23-Feb-16	22-Feb-17	161,452.50
Oracle Real Application Clusters - Processor Perpetual	19436920	16		FULL USE	23-Feb-16	22-Feb-17	20,847.20
Oracle WebLogic Server Enterprise Edition - Processor Perpetual	19436920	20		FULL USE	23-Feb-16	22-Feb-17	28,325.00
Program Technical Support Fees:							USD 221,685.61
Total Price:							USD 221,685.61

Figure 5-7 Payment Receipt

5.5 FURTHER ANALYSIS OF PROPRIETARY SOFTWARE AND OPEN SOURCE SOFTWARE COSTS USING INDEPENDENT-SAMPLES T-TEST TOOL IN MICROSOFT EXCEL

The test was carried out to test the two (2) hypotheses in this research.

Ho: The cost of buying and managing Proprietary software is higher compared to Open source software.

H1: The cost of buying and managing Proprietary software and Open source software is the same.

Table 5-8 software costs used to do t-Test

Software Type	Proprietary software.		Open Source Software		
	Name	Cost (\$)	Name	Costs (\$)	
Database	Oracle database	3,028,125.00	Mysql database	2000.00	
Business Intelligence	Oracle Business Intelligence	43,125.00	Pentaho	0	
Cluster/Grid	Oracle Data Grid	103,525,875.00	ProxySQL	200.00	
Application Server	Oracle WebLogic	850,000.00	Tomcat Apache and Apache	0	

The screenshot below is the t-Test paired two sample for means output from Microsoft excel sheet.

	A	B	C
1	t-Test: Paired Two Sample for Means		
2			
3		<i>Proprietary software</i>	<i>Open Source Software</i>
4	Mean	26861781,25	550
5	Variance	2613759842535160	943333,3333
6	Observations	4	4
7	Pearson Correlation	-0,217059791	
8	Hypothesized Mean Difference	0	
9	df	3	
10	t Stat	1,050802942	
11	P(T<=t) one-tail	0,185262147	
12	t Critical one-tail	2,353363435	
13	P(T<=t) two-tail	0,370524293	
14	t Critical two-tail	3,182446305	

Figure 5-9 the t-Test paired two sample for means output

With the results above, the researcher is unable to reject the first hypothesis (H₀) which says the cost of buying and managing Proprietary software is higher compared to Open source software. This is because P(T<=t) 0.37052 is higher than alpha, 0.05. However, the research rejects the hypothesis that says that cost of buying and managing Proprietary software and Open source software is the same. This based on the P(T<=t) 0.37052 which is higher than alpha, 0.05.

The screenshot below is Anova: Two factor Without Replication output from Microsoft excel sheet.

	A	B	C	D	E	F	G	H
1	Anova: Two-Factor Without Replication							
2								
3	SUMMARY							
		<i>Count</i>	<i>Sum</i>	<i>Average</i>	<i>Variance</i>			
4	Proprietary	4	4024775,875	1006193,969	1951637725683,00			
5	Open Source	4	2200	550	943333,33			
6								
7	Application server	2	850000	425000	361250000000,00			
8	Database	2	3030125	1515062,5	4578716257812,50			
9	Availabilit/Grid	2	103725,875	51862,9375	5338118222,26			
10	Business Intelligence	2	43125	21562,5	929882812,50			
11								
12								
13	ANOVA							
14	<i>Source of Variation</i>	<i>SS</i>	<i>df</i>	<i>MS</i>	<i>F</i>	<i>P-value</i>	<i>F crit</i>	
15	Rows	2022639583766,50	1	2022639583766,50	2,075499317	0,245321	10,12796	
16	Columns	2931321331968,25	3	977107110656,09	1,002642862	0,49916	9,276628	
17	Error	2923594675080,76	3	974531558360,25				
18								
19	Total	787755590815,51	7					
20								
21								
22								

Figure 5-10 Two factor Without Replication output from Microsoft excel sheet.

In addition, with the results above, firm up the earlier decision to reject the first hypothesis (H₀) which says the cost of buying and managing Proprietary software is higher compared to Open source software. This is because F-critical value was very higher compared to F value, and P-Value was higher than alpha, 0.05.

5.6 TO FIND OUT THE MAJOR CHARACTERISTICS CONSIDERED WHEN ACQUIRING SOFTWARE FOR ZAMBIA REVENUE AUTHORITY ICT SYSTEMS.

In order to understand and appreciate this objective, the questionnaire was prepared to look at what are the major characteristics considered when acquiring software for Zambia Revenue Authority ICT systems? This questionnaire had a list of the questions that were trying to help to understand and appreciate major characteristics considered when acquiring software for Zambia Revenue Authority ICT systems.

This questionnaire had nine (9) questions and all them were supposed to be answered by respondents. However, very few participants did not respond to the questions.

- a. QUESTION 1. What are five (5) factors that make Authority opt for propriety software on its core systems despite proprietary software being expensive?

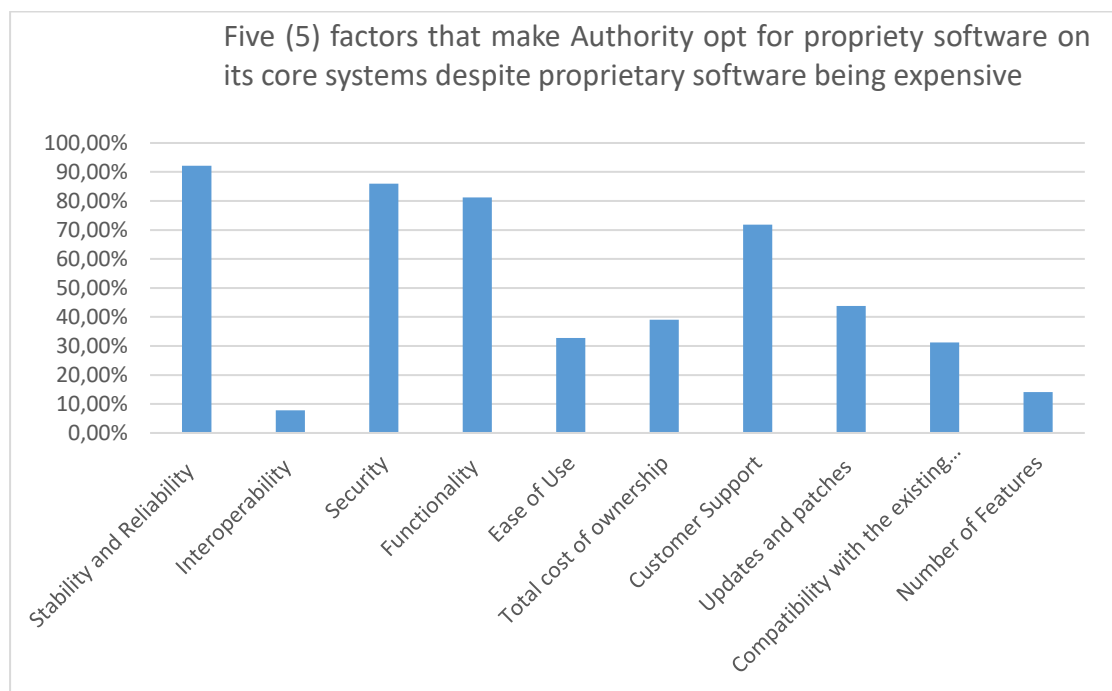


Figure 5-11 Responses to Question 1

From 320 respondents, 18.44% said that it was Stability and Reliability, 17.19% said that it was Security, Functionality had 16.25%, while Customer Support had 14.38%, then Updates and patches had 8.75%

- b. QUESTION 2: Kindly arrange or list the software characterises circled/ticked in 1 in order of importance

The order of importance was as follows;

- I. Stability and Reliability
- II. Security
- III. Functionality
- IV. Customer Support
- V. Updates and patches

- c. Question 3: Is ICT policy or framework used to guide members of staff evaluating and buying software for Zambia Revenue Authority?

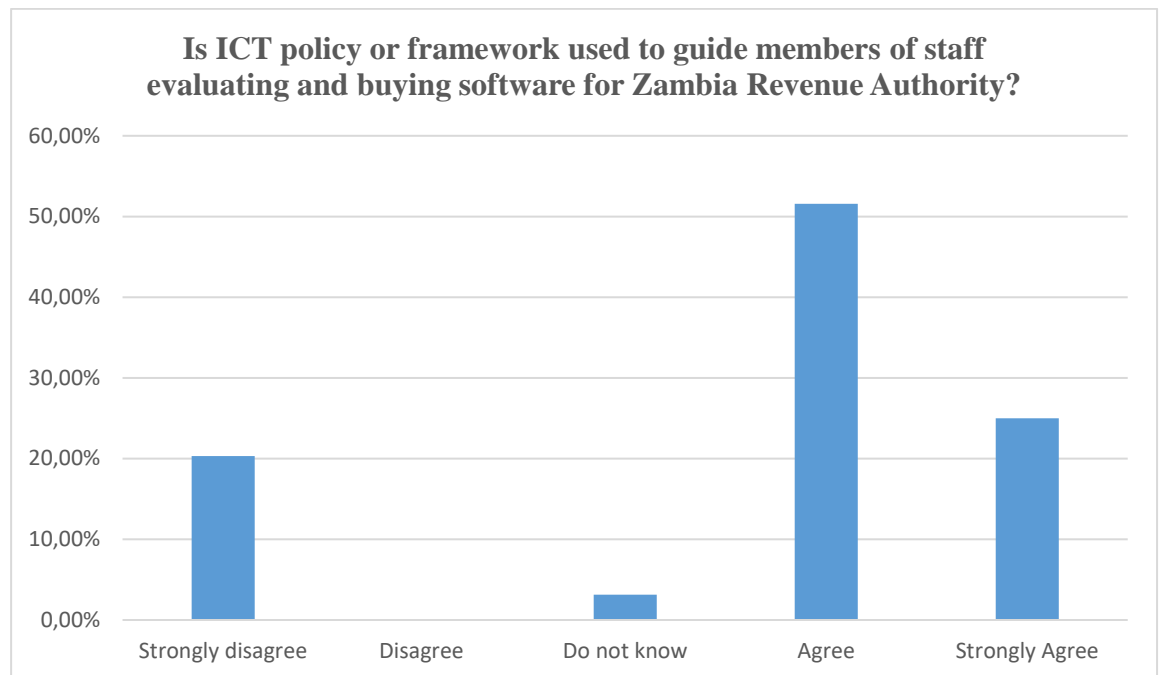


Figure 5-12 Responses to Question 3

51.56% agreed, 25% strongly agreed, while 20.31% strongly disagreed and 3.13% did not know what to say.

- d. Question 4: Is the vendor or developer's history important when acquiring software for the Authority.

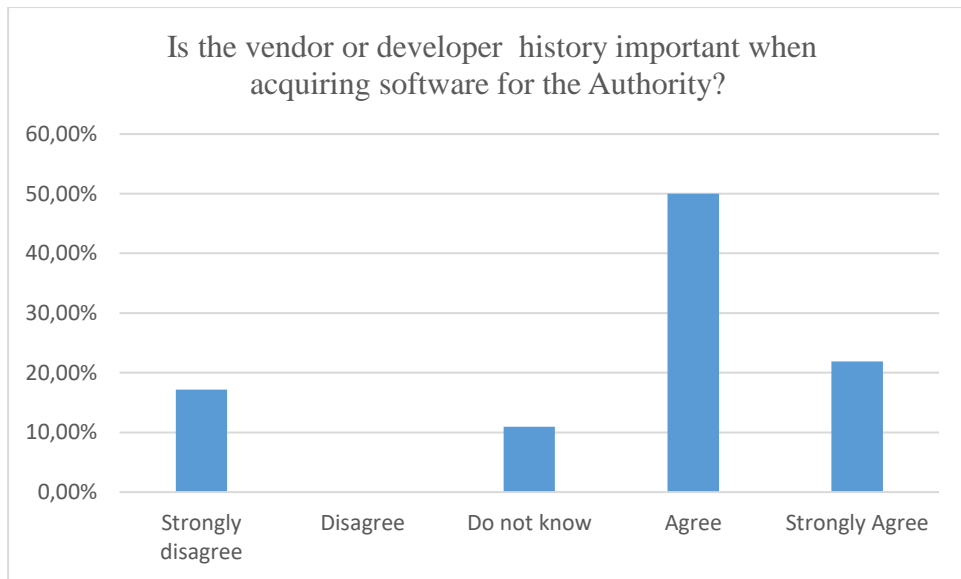


Figure 5-13 Responses to Question 4

50% agreed that that the vendor or developer history was important when acquiring software for the Authority, 21.88% strongly agreed while 17.19% strongly disagreed and 10.94% did not know what to say.

- e. QUESTION: 5 What are top five (5) attributes of a Vendor or Developer are considered when evaluating the supplier of the software?

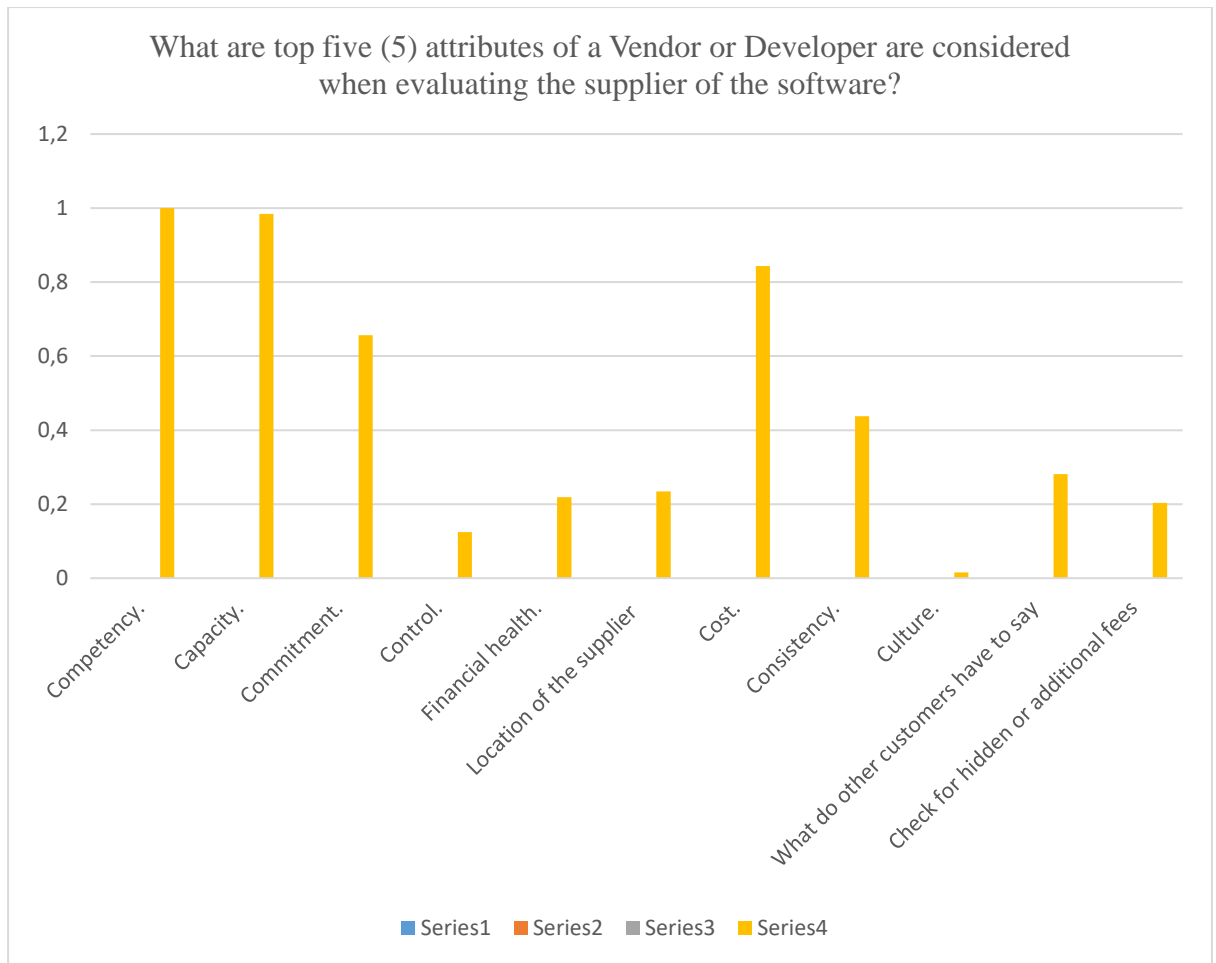


Figure 5-14 Responses to Question 5

The top five (5) attributes of a Vendor or Developer that considered when evaluating software;

- I. Competency
 - II. Capacity.
 - III. Cost
 - IV. Commitment.
 - V. Consistency.
- f. Question 6: Are comprehensive on-site checks conducted before software is acquired?

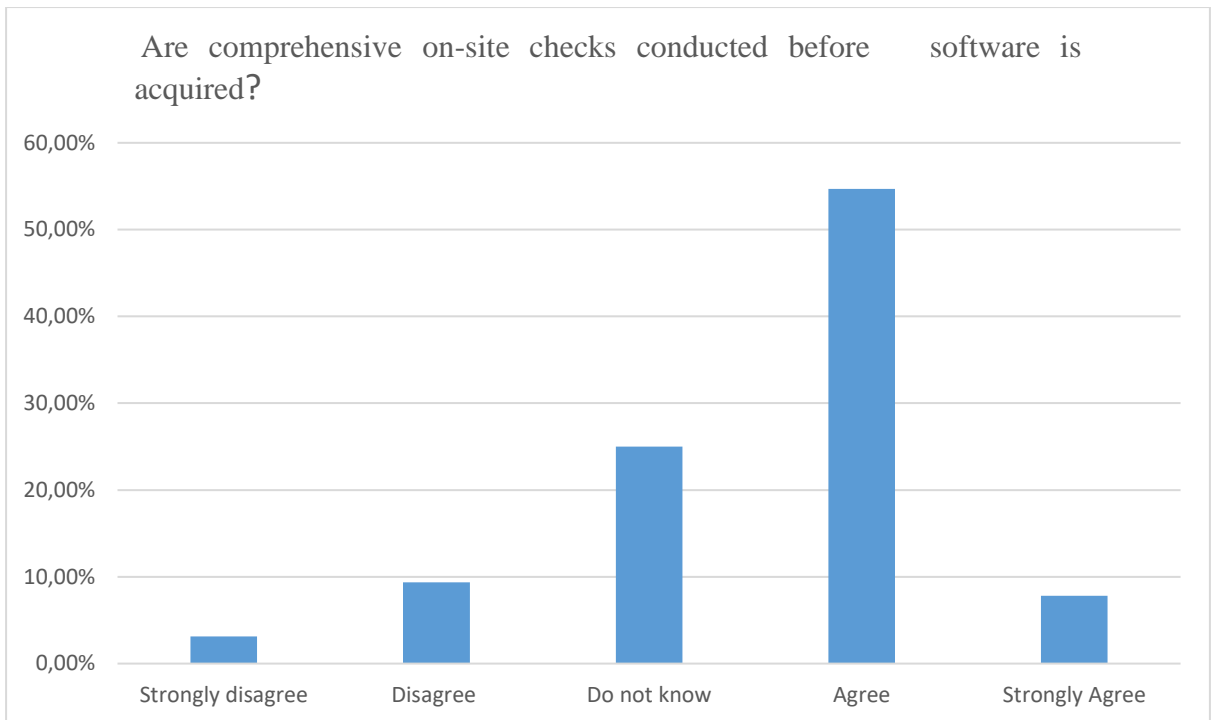


Figure 5-15 Responses to Question 6

54.69% agreed that comprehensive on-site checks are conducted before software is acquired, 25% did not know if on-site checks happen and then 7.81% strongly agreed that it happens while 3.13% strongly disagreed

g. Question 7. Does the level of skills and knowledge in the organisation influence the software acquisition?

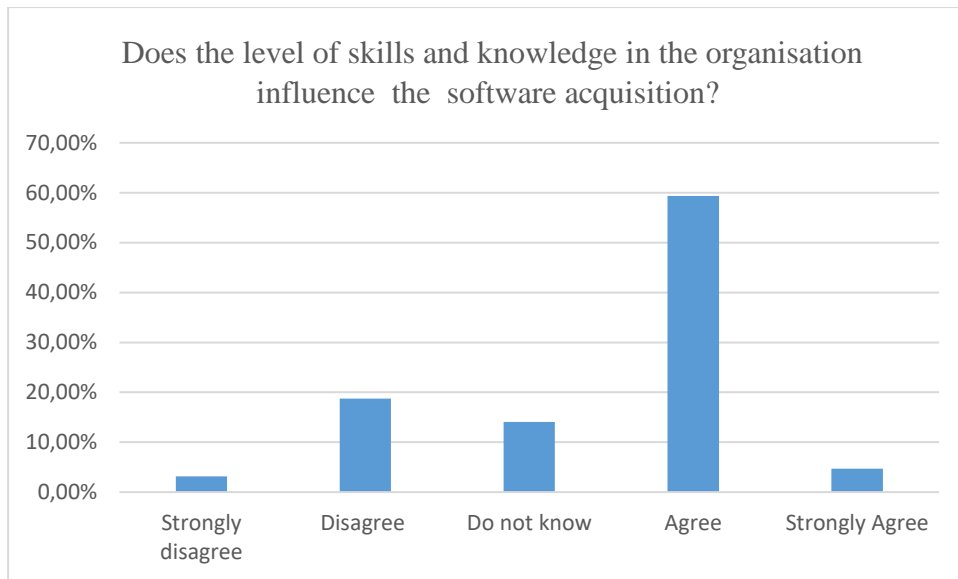


Figure 5-16 Responses to Question 7

59.38% level of skills and knowledge in the organisation influence the software acquisition, 18.75% disagreed, 14.06% do not know while 4.69% strongly agreed and 3.13% strongly disagreed.

h. Question 8: If yes what level of skills do you expect the Authority (Members of staff) to have?

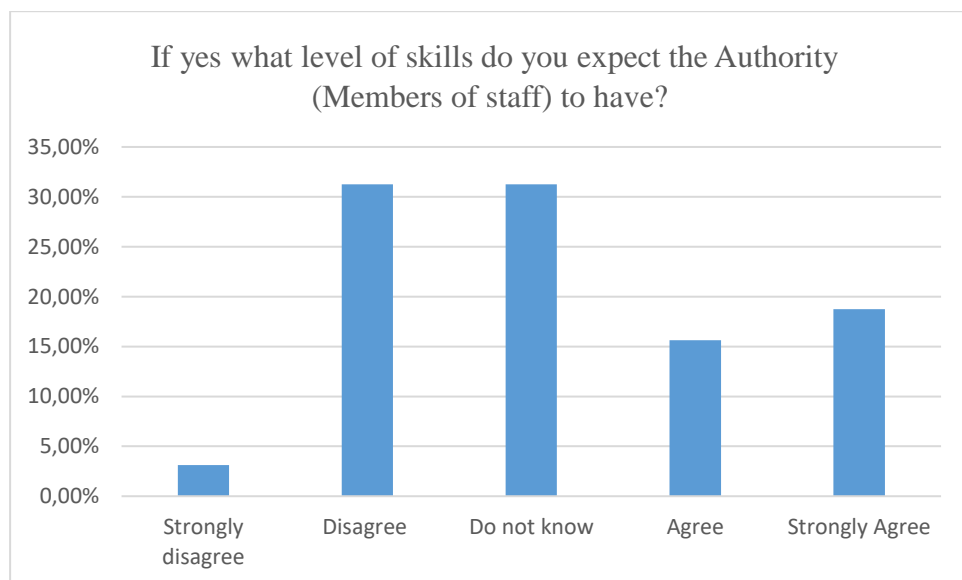


Figure 5-17 Responses to Question 8

31.25% did not know and 31.25% disagreed while 18.75% strongly agreed, then 15.63% agreed. 3.13% strongly disagreed.

- i. QUESTION 9. Do you consider the maturity of technology (software) being used or deployed?

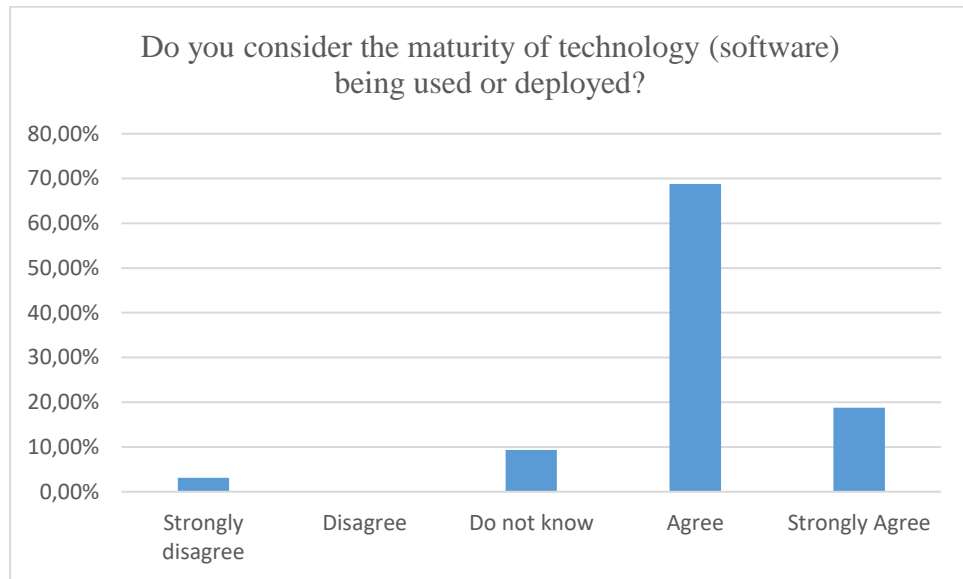


Figure 5-18 Responses to Question 9

68.75% agreed that the maturity of technology (software) being used or deployed is considered, 18.75% strongly agreed while 9.38% did not know and 4.03% strongly disagreed.

5.7 FURTHER ANALYSIS OF WHAT ARE THE MAJOR CHARACTERISTICS CONSIDERED WHEN ACQUIRING SOFTWARE FOR ZAMBIA REVENUE AUTHORITY ICT SYSTEMS.

Further analysis was conducted to determine whether there is an association (relationship) between question 3 and question 9.

Question 3: Is ICT policy or framework used to guide people evaluating and buying the Authority ZRA?

QUESTION 9. Do you consider the maturity of technology (software) being used or deployed?

It was critical to examine the association between ICT policy/framework and the maturity of technology in this context because ICT policy or framework should guide and reflect in the decisions being made or work being carried out. To enable the research determine the relationship between these two Chi-squared test was adopted.

The chi-square test is mostly used to study the significance of relationship between two categorical variables or attributes. It is a distribution free test and also referred as non-parametric test and often find applications in social sciences to study relationship pattern between two social characteristics.

Test statistics measure the agreement between actual counts and expected counts assuming the null hypothesis. The chi-square test of independence can be used for any variable; the group (independent) and the test variable (dependent) can be nominal, dichotomous, ordinal, or grouped interval(McHugh,2013)

Computations were done as tabulated below;

5.8 OBSERVED COUNTS

5-1 Observed counts

	Strongly disagree	Disagree	Do not know	Agree	Strongly Agree	
Question 3	13	0	2	33	16	64
Question 9	2	0	6	44	12	64
	15	0	8	77	28	128

Using alpha =0.05

$$df = (\text{rows}-1)(\text{columns}-1)$$

$$df = (2-1)(5-1)$$

$$df = (1)(4)$$

$$df = 4$$

P value is 9.48

Decision Rule

If the X^2 value is greater than 9.48 , there is a relationship between these two questions

Expected

Expected Frequency = (Row Total * Column Total)/N.

5-2 Expected

	Strongly disagree	Disagree	Do not know	Agree	Strongly Agree
Question 3	7.5	0	4	38.5	14
Question 9	7.5	0	4	38.5	14

5-3 computations

	Strongly disagree	Disagree	Do not know	Agree	Strongly Agree
Question 3	$(13-7.5)^2$ /7.5 =4.03	$(0-0)^2$ /0 =0.0	$(2-4)^2$ /4 =1	$(33-38.5)^2$ /38.5 =0.79	$(16-14)^2$ /14 =0.29
Question 9	$(13-7.5)^2$ /7.5 =4.03	$(0-0)^2$ /0 =0.0	$(2-4)^2$ /4 =1	$(33-38.5)^2$ /38.5 =0.79	$(16-14)^2$ /14 =0.29

$$X^2 = 4.03 + 0.00 + 1.00 + 0.79 + 0.29 + 4.03 + 0.00 + 1.00 + 0.79 + 0.29$$

$$= = 12.22$$

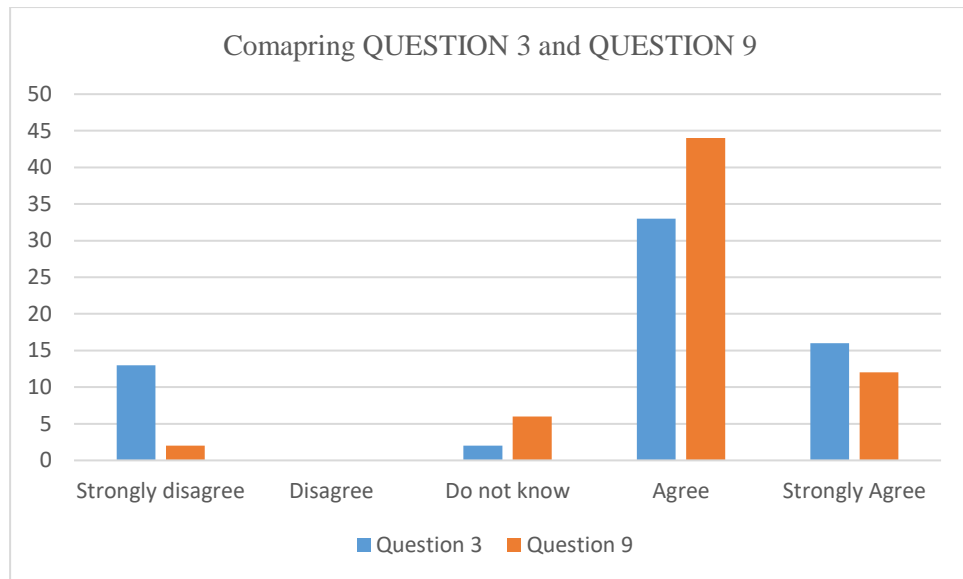


Figure 5-19 Relating question 3 and 9

The conclusion was that there was relationship between ICT policy and maturity of technology questions

5.9 TO UNDERSTAND THE MOTIVES FOR NOT ADOPTING OR USING OPEN SOURCE SOFTWARE DESPITE HUGE LICENSING AND MAINTENANCE COSTS THAT COME WITH PROPRIETARY SOFTWARE.

In order to understand and appreciate this objective, the questionnaire was prepared to look at Why Zambia Revenue Authority does not consider open source software despite huge licensing and maintenance costs that come with proprietary software? This questionnaire had eleven (11) questions and all them were supposed to be answered by respondents. However, very few participants did not respond to the questions.

- a. QUESTION 1. What are five (5) factors that make Authority opt for propriety software on its core systems despite propriety software being expensive?

5-4 Responses to questionnaire

Factors	Percentage	Actual Reponses
Exit costs	0,00%	0
Customer support	19,37%	61
Interoperability	6,35%	20
Security	16,51%	52

Functionality	12,70%	40
Ease of Use	0,00%	0
Organisation Strategy	10,79%	34
Total cost of ownership	0,00%	0
Organisation Knowledge	3,17%	10
Updates and patches	18,10%	57
Staff technical skills	13,02%	41
	Total	315

64 members of staff at Zambia Revenue Authority were given questionnaires to respond to the questions above. The members consisted of staff from Information communication technology (ICT) and procurement department. There were about 315 responses as tabulated above. The top five (5) factors and in order of importance were; Customer support, Updates and patches, security, staff technical skills and functionality.

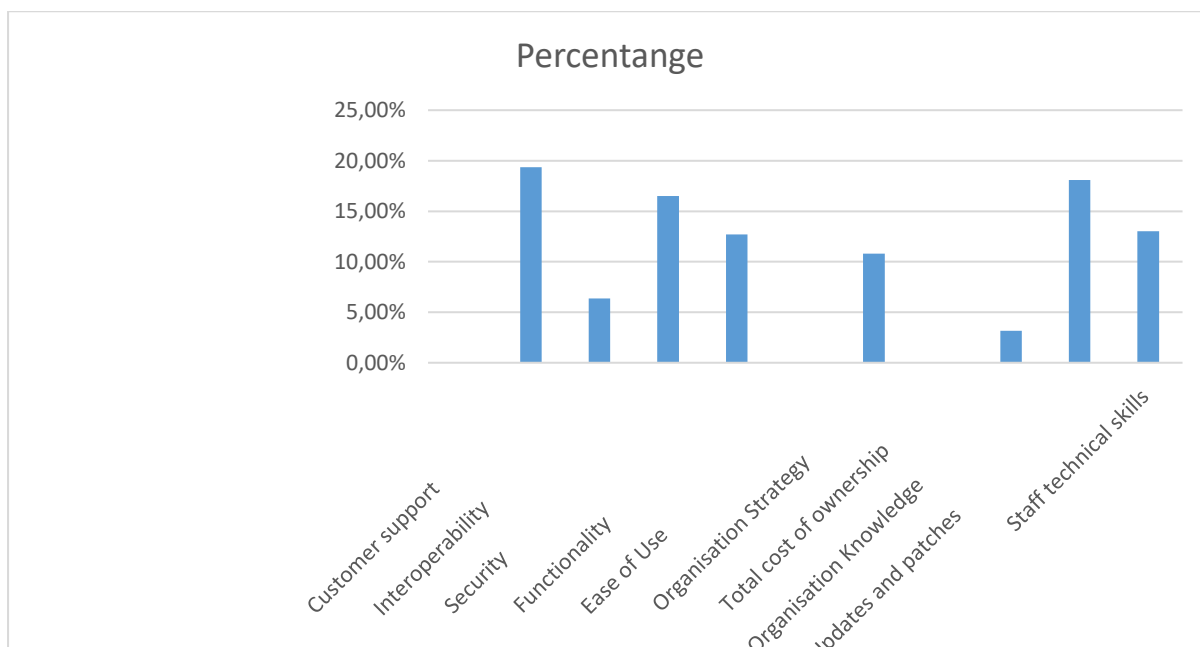


Figure 5-20 Responses to Question 1

- b. QUESTION 2. Kindly arrange the factors highlighted in question one (1) in order of importance

The graph below shows the factors in the order of importance

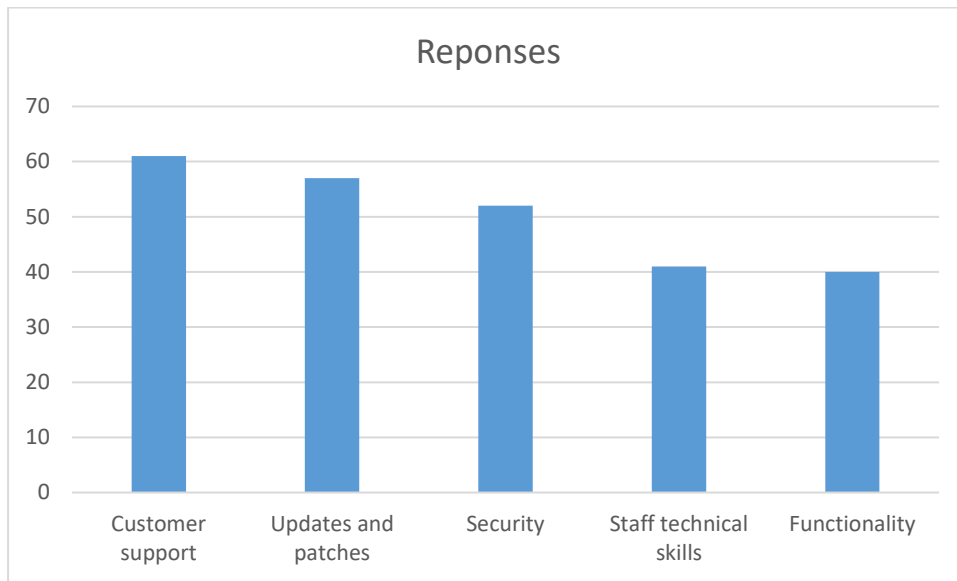


Figure 5-21 Responses from Question 2

The customer support had 19% of responses, Updates and patches 18%, Security 16%, Staff technical skills 13% and Functionality had 12.7%. This was in accordance with information collected after interviewing some members of staff that are involved in recommending, acquiring the software for the Authority. For example, during interviews the Manager – database administration and business continuity stressed the importance of customer care and security of the software were critical as these help in determining the life cycle of the software.

- c. Question 3: Has the Authority used open source software on any of core systems?

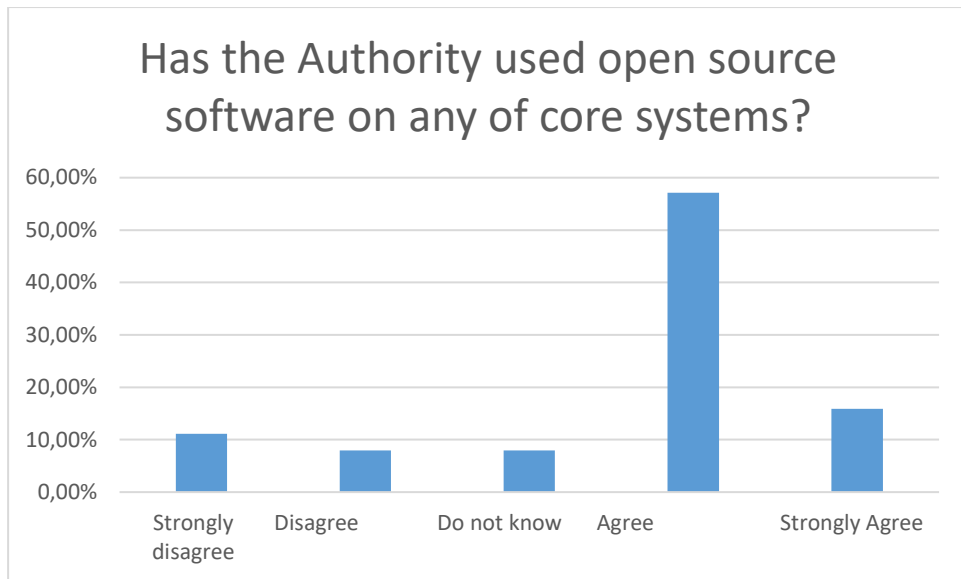


Figure 5-22 Responses to Question 3

57.14% of the sample agreed that the Authority use open source, the 15.87 strongly agreed while 11.11% strongly disagreed that the Authority does not use software. However, further investigation were instituted and it was discovered that there was use of open source software as the operating system. It was also noted that the Authority does not use open source databases like Mysql, Mariadb, postgres database on the core systems. It was further noted that operating system is not the major consumer of the budget when it comes to software costs. The manager responsible indicated that support from a vendor was important for the product to be used properly.

- d. Question 4. If Agree or Strong agree in 3 what has been the experience?



Figure 5-23 Responses to Question 4

57.14% of the respondents declared that experience with open source software was very good, then 17.46% is good 9.52 responded that it is bad while the rest did not know what to say. In the interview, it was discovered that most of these people who had experience with using open source software had that experience before they joined Zambia Revenue Authority. For example, one manager indicated that he used it when he was working for private company in Namibia.

- e. QUESTION 5. Do you think proprietary software is more reliable and secure than similar open source software?

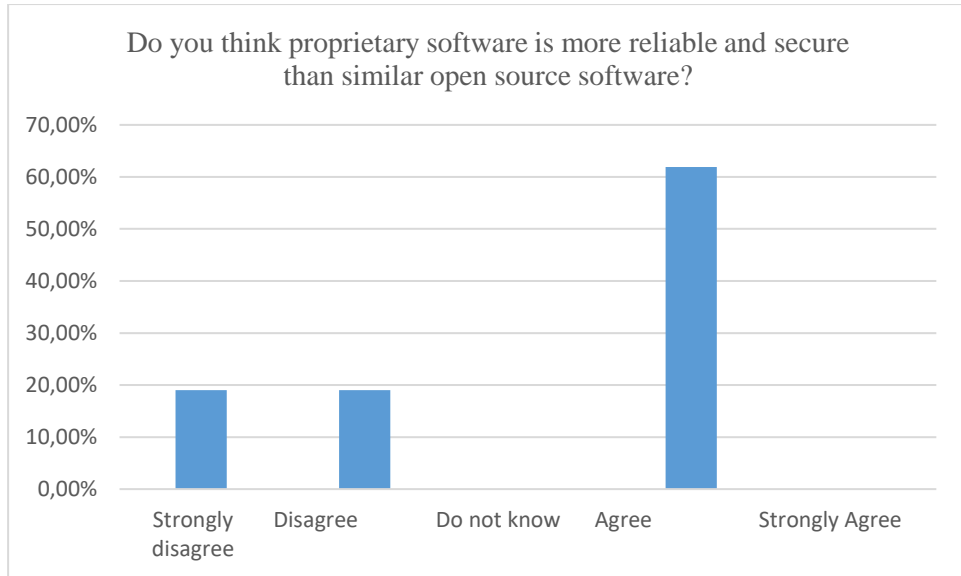


Figure 5-24 Responses from Question 5

61.90% agreed that proprietary software is more reliable and secure than similar open source software, 19.05 % disagreed, while 19.05% strongly disagreed.

- f. QUESTION 6. How quickly do the service or software vendor respond in the event of Zambia Revenue Authority having a challenge or problem?

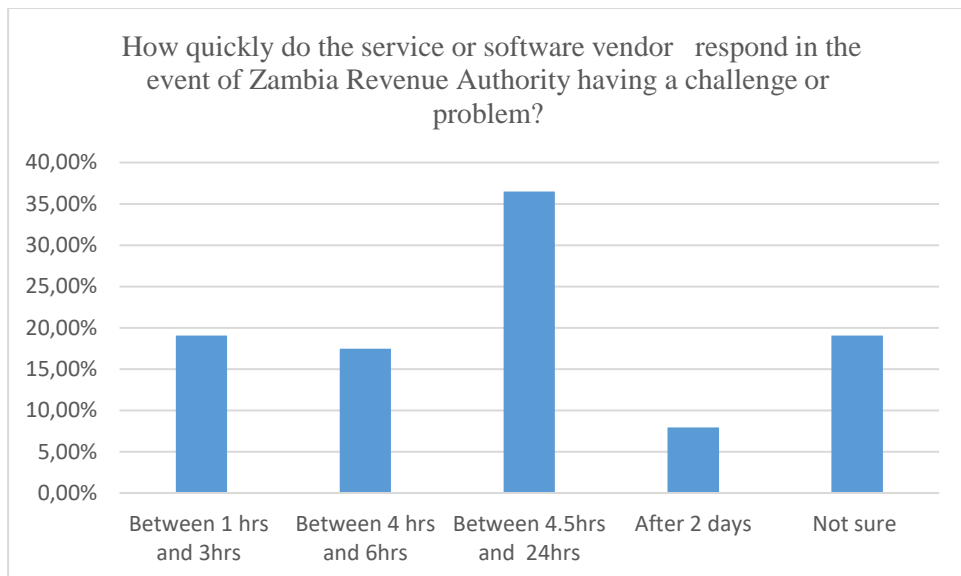


Figure 5-25 Responses to Question 6

36.51% indicated that vendors respond or resolve problems related to the supplied software between 4.5 to 24 hrs, 19% said it takes less than or equal to one (1) hour, 17% indicated that software vendors resolve the problems between 4hrs to 6 hours and 19% were not sure.

g. QUESTION 7: Are security vulnerabilities easily corrected in proprietary software?

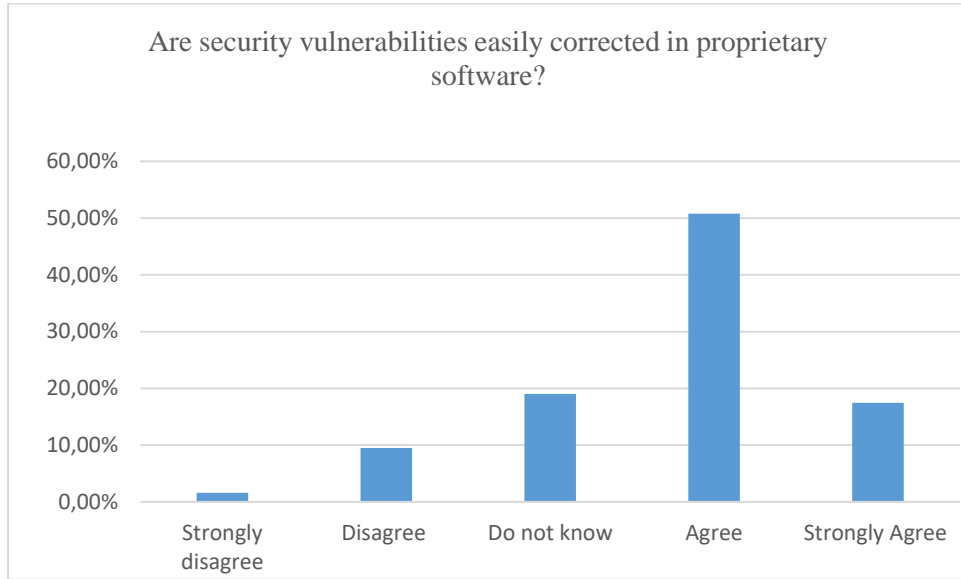


Figure 5-26 Responses to Question 7

50.79% agreed that vulnerabilities in proprietary software are easily corrected while 17.46% strongly agreed to the same, then more than 9.52% disagreed.

h. QUESTION 8 :If yes, how long does it take to correct the software?

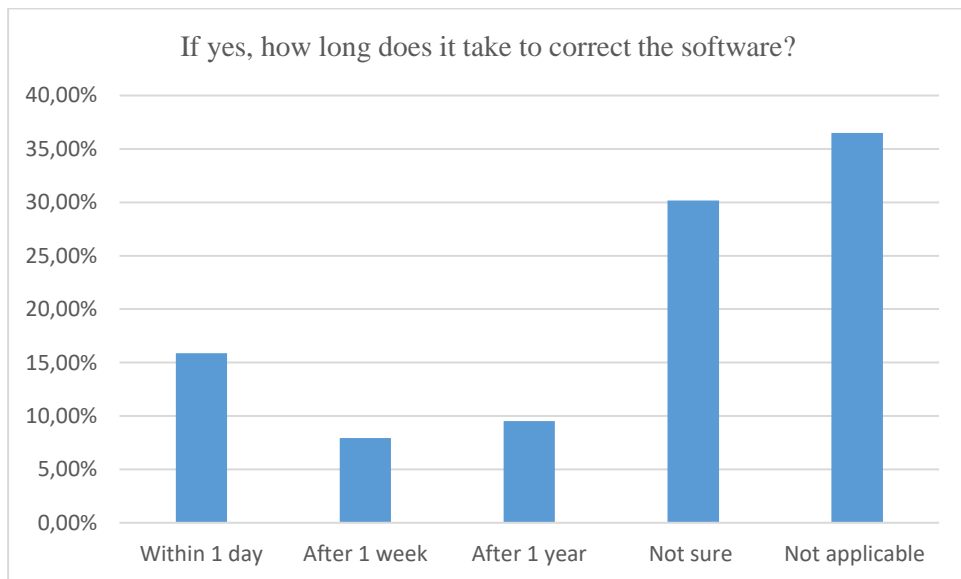


Figure 5-27 Responses to Question 8

36.51% said it was not applicable, then 30.16% were not sure how long it to have the software is corrected while 9.52% said that it takes I year. 7.94% said it takes one (1) day and 15.87% said it takes one (1) day. However, in the interviews it was noted that response depends on a vendor. Some vendors are faster than others.

- i. QUESTION 9. If no, how are the challenges or problems resolved?

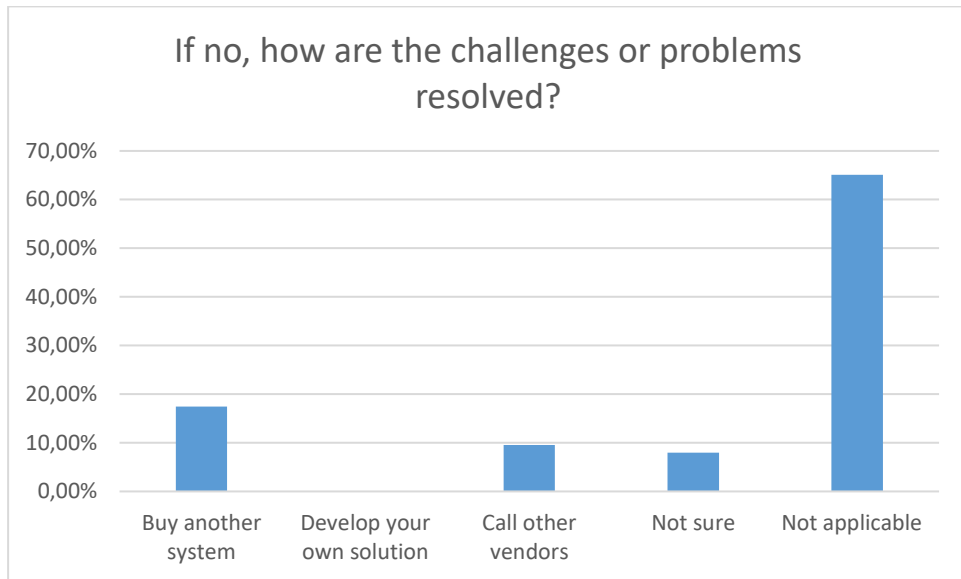


Figure 5-28 Responses to Question 9

65.08% of the respondents declared that it was not applicable to them 17.46% said that the solution was to buy another similar system, 9.52% call other vendors to come and resolve the problem, none talked about developing the system.

- j. QUESTION 10. How easy is it to integrate proprietary software with existing system?

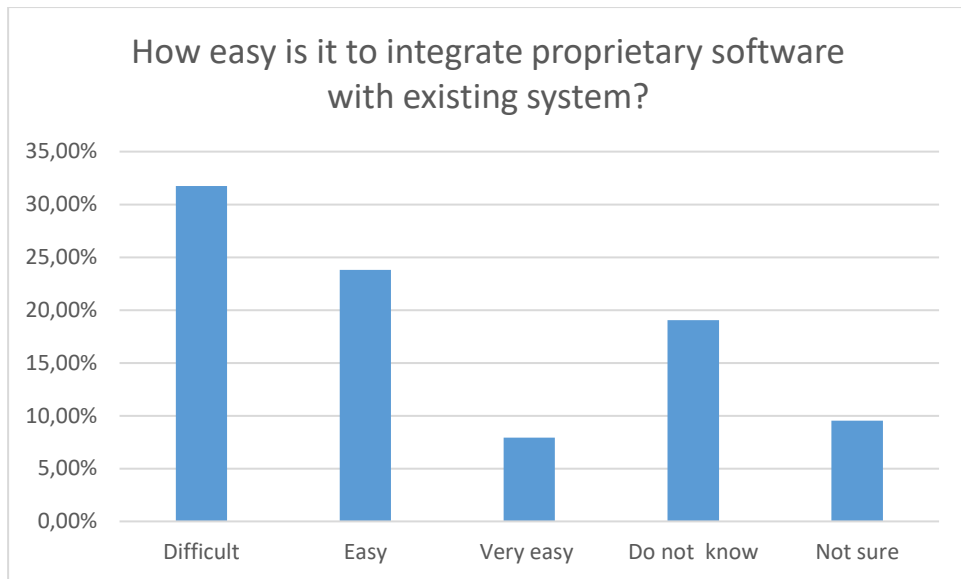


Figure 5-29 Responses from Question 10

31% of the respondents said that it is difficult, 23.81% declared that it was easy, 19.05% said that they did not know, 9.52% did not know and only 7.94% said it was easy.

- k. QUESTION 11. Do ZRA ICT policies and strategies address the use of open-source software in the Authority?

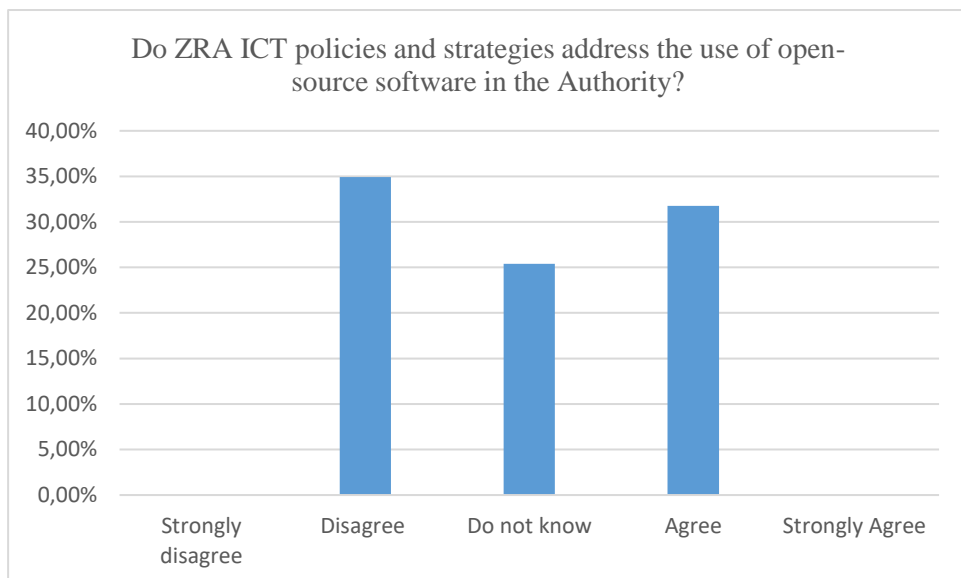


Figure 5-30 Responses to Question 11

- l. 34.92% of the respondents disagreed, 31% agreed that the ICT policies and strategies address the use of open-source, 25.40% said that they did not know

5.10 FURTHER ANALYSIS OF THE MOTIVES FOR NOT ADOPTING OR USING OPEN SOURCE SOFTWARE DESPITE HUGE LICENSING AND MAINTENANCE COSTS THAT COME WITH PROPRIETARY SOFTWARE

Further analysis was conducted to determine whether there is an association (or relationship) between question 6 and question 7 and question 8

QUESTION 6. How quickly do the service or software vendor respond in the event of Zambia Revenue Authority having a challenge or problem?

QUESTION 7. Are security vulnerabilities easily corrected in proprietary software?

QUESTION 8 :If yes, how long does it take to correct the software?

It was important to examine the association between software supplier’s response in an event of a challenge/problem, how vulnerabilities are fixed by the same suppliers, and how long it takes to resolve the problem.

Again, Chi-square was used to find out the association.

5-5 Observed counts

	Strongly disagree	Disagree	Do not know	Agree	Strongly Agree	
Question 6	12	11	23	5	12	63
Question 7	1	6	12	32	11	62
Question 8	10	5	6	19	23	63
	23	22	41	56	46	188

Using alpha =0.05

$$df =(rows-1)(columns-1)$$

$$df =(3-1)(5-1)$$

$$df = (2)(4)$$

$$df = 8$$

P value is 15.507

Decision Rule

If the X^2 value is greater than 15.507, there is a relationship between these three questions or issues.

Expected

Expected Frequency = (Row Total * Column Total)/N.

5-6 Expected

	<i>Strongly disagree</i>	Disagree	Do not know	Agree	Strongly Agree
Question 6	7.71	7.37	13.74	18.77	15.41
Question 7	7.59	7.26	13.52	18.46	13.17
Question 8	7.71	7.37	13.74	18.77	15.41

5-7 computations

	Strongly disagree	Disagree	Do not know	Agree	Strongly Agree
Question 6	$(12-7.71)^2 / 7.71 = 2.39$	$(11-7.37)^2 / 7.37 = 1.79$	$(23-13.74)^2 / 13.74 = 6.24$	$(5-18.77)^2 / 18.77 = 10.10$	$(12-15.41)^2 / 15.41 = 0.75$
Question 7	$(1-7.59)^2 / 7.59 = 5.72$	$(6-7.26)^2 / 7.26 = 0.22$	$(12-13.52)^2 / 13.52 = 0.17$	$(32-18.46)^2 / 18.46 = 9.93$	$(11-13.17)^2 / 13.17 = 0.56$

Question 8	$(10-7.71)^2$ /7.71 =0.68	$(5-7.37)^2$ /7.37 =0.76	$(6-13.74)^2$ /13.74 =4.36	$(19-18.77)^2$ /18.77.5 =0.01	$(23-15.41)^2$ /15.41 =3.75
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$$\begin{aligned}
 X^2 &= 2.39 + 1.79 + 6.24 + 10.10 + 0.75 + 5.72 + 0.22 + 0.17 + 9.93 + 0.56 + \\
 &\quad 0.68 + 0.76 + 4.36 + 0.01 + 3.73 \\
 &= \mathbf{47.43}
 \end{aligned}$$

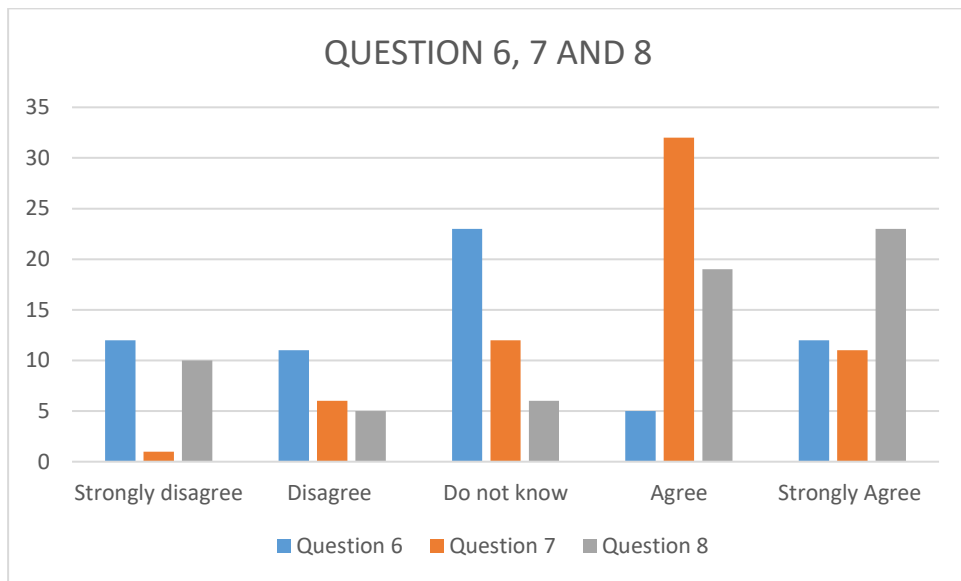


Figure 5-31 Relating/Comparing Question 6, 7 and 8

The conclusion was that there was a relationship between how quickly do the service or software vendor respond in the event of Zambia Revenue Authority having a challenge or problem, how security vulnerabilities are easily corrected in proprietary software and if yes, how long does it take to correct the software

Further analysis was conducted to determine whether an association (or relationship) between question 5 and question 7

QUESTION 5. Do you think proprietary software is more reliable and secure than similar open source software?

QUESTION 7. Are security vulnerabilities easily corrected in proprietary software?

5-8 Observed counts

	Strongly disagree	Disagree	Do not know	Agree	Strongly Agree	
Question 5	12	12	0	39	0	63
Question 7	1	6	12	32	11	62
	13	18	12	71	11	125

Using alpha =0.05

$$df = (\text{rows}-1)(\text{columns}-1)$$

$$df = (2-1)(5-1)$$

$$df = (1)(4)$$

$$df = 4$$

P value is 9.48

Decision Rule

If the X^2 value is greater than 9.48 , there is a relationship between these two questions

Expected

Expected Frequency = (Row Total * Column Total)/N.

5-9 Expected

	Strongly disagree	Disagree	Do not know	Agree	Strongly Agree
Question 5	6.55	9.07	6.05	35.78	5.54
Question 7	6.64	8.93	5.95	35.22	5.46

5-10 computation

	Strongly disagree	Disagree	Do not know	Agree	Strongly Agree
Question 5	$(12-6.55)^2 / 6.55 = 4.53$	$(12-9.07)^2 / 9.07 = 0.95$	$(0-6.05)^2 / 6.05 = 6.05$	$(39-35.79)^2 / 35.79 = 0.29$	$(0-5.53)^2 / 5.53 = 5.53$
Question 7	$(1-6.45)^2 / 6.45 = 4.61$	$(6-8.93)^2 / 8.93 = 0.96$	$(12-5.95)^2 / 5.95 = 6.15$	$(32-35.22)^2 / 35.22 = 0.29$	$(11-5.46)^2 / 5.46 = 5.62$

$$X^2 = 4.53 + 0.95 + 6.05 + 0.29 + 5.53 + 4.61 + 0.96 + 6.15 + 0.29 + 5.62$$

$$= \mathbf{34.98}$$

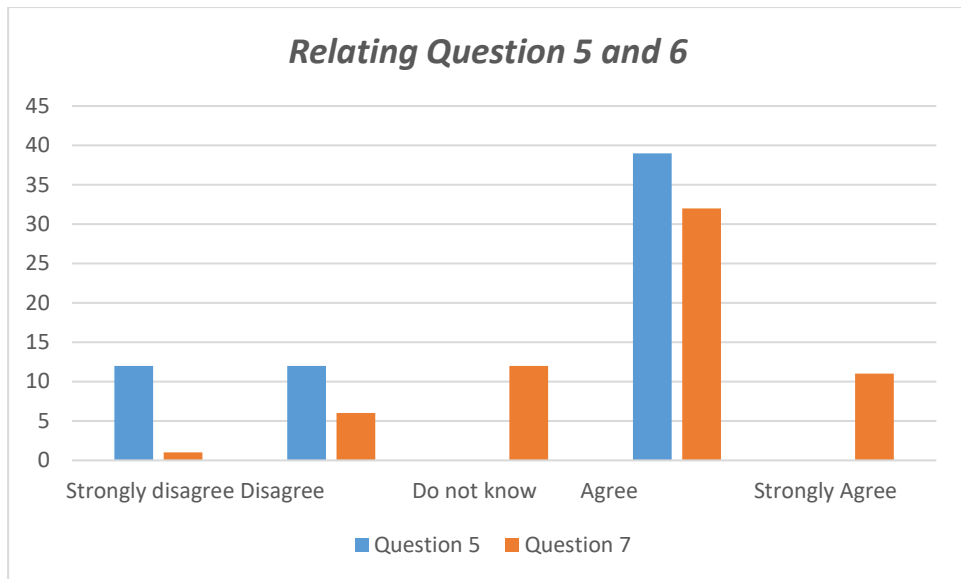


Figure 5-32 Relating Question 5 and 7

The conclusion was that there was a relationship between proprietary software being more reliable and secure than similar open source software, and security vulnerabilities being easily corrected in proprietary software

5.11 INTERVIEW RESEARCH RESULTS.

The table below shows summary of the responses given by the interviewees during the interviews.

Theme	Pattern	Interview Quotes	Relevance
Database	Oracle database	“It is one of the most expensive software ZRA uses“	The software bought is very expensive
	MSSQL database	“It is paid for at the end of the year ,but also expensive”	
Licensing	Databases licensing	“Paid at the time of buying software”	This is part of the software initial costs
	Application servers licensing	“Not expensive as database”	
Training	Long term training	“These are usually offered by colleges and universities”	The source of skills and knowledge

	Short courses	“offered by higher learning institutions, and software providers ”	
Support	Onsite support	“it is given if included in the contract at the time of buying”	How support is given and rendered
	Remote support	“Usually this is linked to annual subscription fees”	
		“Sometimes they do not respond”	

5.12SUMMARY

The chapter looked at the data collected using questionnaires, interviews and documentation reviewed. The data was presented using bar charts, tables and description. Furthermore, Independent-samples t-test and Anova statistical computation was carried out to analyse if hypotheses in the theoretical and conceptual framework were true or false. The results showed that proprietary software is expensive compared to open source software. In addition, the samples t-test results showed that there is relations between Zambia Revenue Authority framework and how the software vendors/suppliers are assessed.

CHAPTER SIX

DISCUSSION OF FINDINGS

This chapter discusses the findings from the research and relates with the research literature review. In addition, it links some findings to the best practise or recommended procedures, rules and conceptual framework designed.

6.1 TO FIND OUT THE VARIOUS COSTS INCURRED WHEN PURCHASING, LICENSING AND CARRYING OUT MAINTENANCE OF THE EXISTING ZRA ICT SYSTEMS

6.1.1 Costs

The documents availed showed that Zambia Revenue Authority spends a lot of money on proprietary software like Oracle, Microsoft, SAP, Teammate. However, it does not spend as much on one system that uses open source software. This system is Electronic Fiscal devices (EDFs) systems that uses MySQL database, which is open source software, and freely downloaded and installed. ZRA does not spend much on this system compared to the systems that use proprietary software like Oracle database, Microsoft SQL database.

Similarly, the proprietary application server used in very expensive compared to the Tomcat Apache or Apache web servers. The application servers manage the applications as it execute its task. For example, Electronic Fiscal devices (EDFs) uses Tomcat Apache as the web server. This application is able to perform just like Oracle Weblogic application despite it being free.

However, it was note that the perception of Open Source software by individuals make impossible for organisation to start using the Open source software in the core system. For example, some members of staff within the orgnaisation think that Open Source software in not safe because source code is available to everyone so it can be modified and insert malicious code. Furthermore, some members of the staff believe that Open source software is not user friendly. These are some the perceptions that can cost open source.

Therefore, the members of staff especially of Information technology should engage other members of staff and demonstrate that it is easily to use open source software. This will lead to increase of numbers of employees and department using Open source software. This will be in line with Technology Acceptance Model (TAM) model wich

states that new technology acceptance should exhibit characteristics of intermediate factors of perceived usefulness and perceived ease of use to affect users' behavioural intention (William et al, 2009).

Unlike proprietary software, open source software license scheme does not require the organisation using the software to be paying annual subscription fees and support fees like proprietary software. Furthermore, the users of open source software benefit from the knowledge and efforts of other developers contributing to the development of the software. In this way, the organisations and individuals using open source software cut or reduce software costs because there is no requirement to be paying license and support fees, developing or innovating starting from the scratch. This supports and conforms to Open Innovation model developed by Chesbrough. Chesbrough, 2003 defines open innovation as the use of purposive inflows and outflows of knowledge to accelerate internal innovation, and expand the markets for external use of innovation, respectively.

Brant and Lohse (2014) stress that Open innovation model enables firms to integrate external knowledge, expertise into their innovative process, improving their offerings while cutting costs, and more effectively managing risks.

In addition, the data analysis conducted using Independent-samples t-test showed the results that did not support the rejection of the first hypothesis (H_0) which says the cost of buying and managing Proprietary software is higher compared to Open source software. This is because $P(T \leq t) 0.37052$ is higher than $\alpha, 0.05$. However, the research rejected the hypothesis that says that cost of buying and managing Proprietary software and Open source software is the same. This is based on the $P(T \leq t) 0.37052$ which is higher than $\alpha, 0.05$.

In conclusion on cost, the Proprietary software is expensive compared to Open source software and this has been supported by the reviewed literature reviewed and statistical tests carried out.

6.2 TO FIND OUT THE MAJOR CHARACTERISTICS CONSIDERED WHEN ACQUIRING SOFTWARE FOR ZAMBIA REVENUE AUTHORITY ICT SYSTEMS.

6.2.1 Software characteristics

The findings show that Zambia Revenue Authority considers the top five (5) characteristics considered when acquiring software are; stability and reliability , security, functionality ,customer support , updates and patches. This is important because even when the literature was reviewed under open source software verses proprietary software these are the same characteristics that were highlighted and are important because they vary in terms of implementation in open sources and proprietary software. Patches, security, customer support are implemented differently under open source software compared to proprietary software. For example, patch management under open source software is frequent because they are different and many developers or contributors, unlike the proprietary software where it is not as frequent because it depends on one supplier/ developer of the software.

Furthermore, in accordance with best practices and Forbes Technology Council,2017 stresses the importance of organisation considering the following factors when buying Enterprise Software; The Service Level Agreement, security, customer support, alternative options

However, it was surprising that factors like costs, interoperability, ease of use, staff technical skills were not among the top five (5) factors considered because these are equally critical. For example, Marlene Jia, 2017 explains that the arguably most important factor is the price. How much a solution costs is just part of the picture, how much it costs in comparison to the organisation current solution will tell whether it's going to be saving organisation money or not. A lot of people on a strict budget might want to look at price before anything else, since if something's outside the budget, there's no point wasting time with it.

In addition, it shows that some of moderating variables namely reliability, security, customer support, skills availability outlined in conceptual framework in chapter two(2) play a very important role in costing of the software. For example, without adequate customer support the costs of software goes higher because the Authority or any organisation needs to look for extra costs to cover the gap of support. Furthermore, if software security is well developed, it becomes cheaper for an individual or

organisation using the software because there is no need of buying extra software or hire security experts to come and implement some more security measures.

6.2.2 Supplier's history

It was also noted that most of the respondents agreed that the history of the supplier is important. The history does not only show that the organisation knows what it is doing, but also gives assurance to the client that the organisation is financially sound. This is critical because some organisations start operating and easily fold up and then clients suffer. For example, the documents reviewed at Zambia Revenue Authority showed that one of the requirements when an organisation is bidding a tender to supply software at Zambia Revenue Authority. The bidder should submit the statement of account certified by the bank. Depending on the value of the tender the organisation can demand that bidder responding to a tender submits a certified bank statement for 3 or 6 month.

Furthermore, it was noted that some members of staff in information technology department seem to love proprietary software despite the software being expensive. The reasons were that there was support delivered by the suppliers of software, well written documentation and coming from highly recognised software houses. In some cases, it was agreeable that some support is given. However, there are number of cases where support is not given despite the organisation paying annual subscription fees. For example, during the interview with the Manager – Database administration it came to the attention of the researcher that one of the databases running on the proprietary software engine crashed but the supplier has not provided support to recover the database, instead the supplier keeps on suggesting that the Authority should buy third party software to recover the crushed database.

This scenario is in accordance with concept framework in this research that shows that the depending on the software selected and other moderating variables the cost of software will be high or low. In the case of Electronic Fiscal Devices system using Open source software is cheaper as compared to the systems using proprietary software.

6.2.3 Maturity of technology (software)

According to the questionnaire respondents 68.75% agreed that the maturity of technology (software) being used or deployed is considered, 18.75% strongly agreed. This was in line with the Technology Adoption Lifecycle that was reviewed in the

literature review, which states that most of the people fall under early adopters and Early majority. The responses also showed that they were few participants who indicated that maturity of the software is not important and these are the people who can be considered as innovators.

The question of the maturity was important in this research because most of solutions are based on open source seem to be new to the organisation that has been always buying the proprietary software. The concept of open source software has been in existence for some time, however, many people think that it is new.

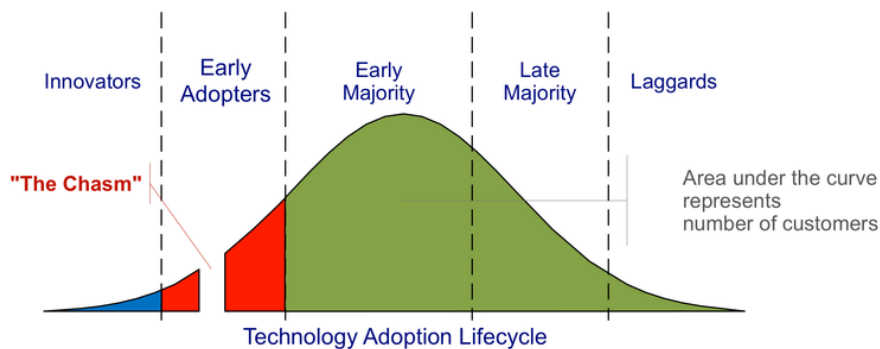


Figure 6-1 Technology Adoption Lifecycle

This has an impact on the adoption of use of open source software, especially where most of the organisation members of staff consider maturity of the software before adopting the software. However, it has been noted that open source technology has been in existence for some time, therefore, it must not be ignored based on vendor or software history.

In addition, Chesbrough, 2003 defines open Innovation as the use of purposive inflows and outflows of knowledge to accelerate internal innovation, and expand the markets for external use of innovation, respectively. As result, open source software has enabled different organisations in private and public sectors to carry out a lot of experimentation in software business that is ongoing almost every day. As a result of these experimentation and trails the organisation have come with different innovations. There are many reasons why this is achieved and these are ; Open source software is cheaper, source code is available to anyone willing to work with it, developers use open standard methods , there are a lot of developers in different parts of the world.

This confirms why concept framework showing that moderating variable like software source code being available to anyone, many developers contributing and others contribute to the cost reduction of the software and in this case open source software is cheaper because software being available to anyone.

6.2.4 Security

Respondents took the issue of security serious; most of them explained that open source software was more secure than proprietary software. Examples that were given includes; few malware on open source Linux operating system, most of the ports are closed by default, in-built functionalities like firewalls.

The responses from participants resonate with what was reviewed in the literature. However, it should be noted that the security of software goes beyond software. For example, the system cannot be secure if the own or users of the system are not careful with their login credentials.

6.2.5 Knowledge and skills

It was noted that knowledge and skills were very important and more than 68 % of respondents agreed that it influences the decision made to buy a particular software. This is because the members of staff would want to buy what they know and comfortable with. It further agrees with the model of adopting the technology which states that users of technology go for the technology that helps them to achieve their objectives and ease to use. Forbes Technology Council,2017 stresses the need to buy software that will have positive impact on the organisation and especially the employees who are the users or consumers of the software.

The Authority should also empower its members of staff to appreciate and understand various technologies so that it can be easy to adopt different technologies and hence increase the options when it comes to acquiring software.

6.3 TO UNDERSTAND THE MOTIVES FOR NOT ADOPTING OR USING OPEN SOURCE SOFTWARE DESPITE HUGE LICENSING AND MAINTENANCE COSTS THAT COME WITH PROPRIETARY SOFTWARE.

6.3.1 The purpose of software

Among the documents that were reviewed was Zambia Revenue Authority (ZRA)

Information communication technology (ICT) policy that states that the business user requirements influences the decisions made to buy the software. This is also supported by the model of technology adoption was reviewed in the literature review chapter, and states that accepting new technology through intermediate factors of perceived usefulness and perceived ease of use to affect users' behavioural intention (William et al, 2009).

The findings also show that open source software is user friendly in terms of the graphical user interface (GUI) , unlike the in the past where most of powerful open source software had command line interfaces. This lead to some users to be uncomfortable using open source software.

Therefore, one of the driving force to adopt the technology is what the users look for something that helps them to achieve what they want and how easy it is to use. If the open source software can help the organisation to achieve its objective and perceived to be ease to use, then it should be adopted.

6.3.2 ICT framework/policy

It was observe that the 50% of respondents stated that they are guided by the policies to make decision to buy software. This is important because if change has to be effected in the respect of software acquisition the organisation should start with the framework and policies. However, in Zambia Revenue Authority ICT policy there is no policy directing the organisation to be using open sources nor proprietary software, but it emphasises on looking at what the user requirements are saying and software that can help the organisation to achieve its objectives.

It was also noted that there is a relationship between ICT policy and how mature the technology (software) is. This is so important because the policy guides the Authority how it conducts its information technology business. For example, database administration unit of the Authority does not use latest version of the software on production databases, but second or third latest versions. This prevents the Authority from using the latest version that may have serious bugs and disrupt the business of managing taxes on behalf Government of Zambia.

The policy does not favour any type of software the way it has been structure, therefore, it open to any software that meets the needs of the Authority. However, the issue of

software being cost effective has been stressed in the policy document and should be considered as the decisions are being made.

To change the perception of Open source software, the ICT should come up with a policy with statements that are covering the fears and lack of confidence from some member staff. The Australian Tax office has come up with statements in its Open source policy to correct the Open source software perception.

6.3.3 Fixing bugs and errors in Proprietary software

Most of the respondents said that it takes long to fix some bugs and errors in the proprietary software because they depend on the supplier and there procedures and rules to follow before the fixes are developed and deployed. This was in accordance with what was reviewed in the literature review chapter. In one classic example is where the virus ‘WannaCry’ hit the world, affecting over 200,000 machines in more than 150 countries on Friday 12th May 2017. The ongoing attack continued to spread across systems that have not been updated with recent security updates (The Telegraph, 2018). It was discovered that many of these machines were running Microsoft Windows that did not get software patches from Microsoft Corporation. In case of open source software, there are a lot of developers to fix bugs and other errors unlike the proprietary software that depends on the owners of software to find solutions or fix bugs and errors. There is a strong perception that the suppliers or developers manage errors and bugs under proprietary software. However, it is the case in some situations because the supplier may not have developers or even given access to the source code. It is important that the software evaluators are aware of how the bugs and errors are managed before buying the software. During the interviews it was noted that situations where the supplier has to contact the actual developers of the software. This take long to resolve some of these problems.

6.3.4 Integration

More than 60% of respondents indicated that it was very difficult to integrate proprietary software with other software because some of their interfaces or components are not exposed and only known by the suppliers. This means that integration can only done by the supplier or in conjunction with the software supplier. This is in accordance with the literature reviewed in chapter two (2) which says that the proprietary software owners do not divulged specifications that would allow other

companies to duplicate the product or come up with the similar software that may work with other software (Emmott, 2014).

In addition, it becomes expensive for the Authority to interface these proprietary software. For example, it was observed that the financial system called SAP used by the Authority is not well integrated with Customs and Domestic systems because the integration approach proposed by SAP is not user and costly friendly. Hence, the Authority has devised other ways of interfacing which are semi- manual.

6.4 SUMMARY

The chapter looked at costs of both proprietary software and open source software, software characteristics considered when purchasing software, history of the supplier, how mature technology is, the purpose of buying the software, how bugs and errors in proprietary software are resolved. In addition, integration, knowledge and skills and security were discussed.

The discussion also demonstrated that conceptual framework designed confirms with the literature review and findings. The discussion acknowledged that moderating variables like security, integrations, knowledge and skills play important role in formulating the costs structure of the departments and the authority. In addition, the discussion showed that opens source software is cheaper compared to the proprietary software and present a lot of opportunities for development and innovation. It further demonstrates that educating the members of staff about open source software would help in accelerating the adoption of the open source software.

CHAPTER SEVEN

SUMMARY OF CONCLUSION AND RECOMMENDATIONS

7.1 CONCLUSION

The purpose of this research was to study how to reduce costs of running the core ICT systems of a government agency using open source software: A case of Zambia Revenue Authority. A Case of Zambia Revenue Authority. Zambia Revenue Authority is a government agency charged with the responsibility of collecting and administering taxes on behalf of the Government of the republic of Zambia. The Authority was formed under the Zambia Revenue Authority Act, now Chapter 321 of the Laws of Zambia (Zambia National Assembly, 1993).

Zambia Revenue Authority procures software based on business and technical requirements. According to Zambia Revenue Authority, 2015 ICT policy it is very crucial to specify the business and technical requirements that are to be met, before deciding on the development or purchase of new software, and purchase of new computers and peripherals requires careful consideration in line with the business needs. The cost of running the core systems at Zambia Revenue Authority includes the following; Paying salaries of information communication technology members of staff, training technical members of staff, purchase of hardware, purchase of software, purchase of power to use in the running of the servers.

Zambia Revenue Authority has continued procuring expensive proprietary enterprise software solutions from big private companies like Oracle, SAP, and TATA, while there is alternative software. This problem has been compounded with inadequate funding from government of Republic of Zambia.

The literature review covered; costs, open source software, proprietary software, then look at the reliability, security and interoperability /openness of software, models of adopting technology, models or frameworks used when acquiring Enterprise software, in addition, skills required to manage software, innovations in Open source software and proprietary software. Open Innovation model/theory was used to come up with Conceptual Framework. Chesbrough wrote this theory in 2003.

The research looked at number of research methodologies and opted to use Pragmatism which states that the most important determinant of the epistemology, ontology and axiology to adopt is the research question, where one may be more appropriate than the

other for answering particular questions. The method used to collect data were questionnaires, interviews and documentation review.

The findings from the research through the methods highlighted above were tabulated and further analysed. The top five(5) characteristics considered by Zambia Revenue Authority when acquiring software are ; stability and reliability ,security, functionality ,customer support , updates and patches.

The history of the software supplier is important because it gives confidence to current and potential clients. In addition, the Authority likes using the mature technology so that there are no problems. It likes to have the software that meets the business needs.

Software integration is easily achieved using open source software unlike using proprietary. In the same vain open source software is patched and fixed faster compared to proprietary software.

The Proprietary software bought at Zambia Revenue Authority is expensive compared to Open source software and this has been supported by the reviewed literature and statistical tests carried out. In terms of not only the cost but also the innovations that comes with open source software are cheaper compared to proprietary software. Open source software licenses are free, hence it can allow the organisation to spend money meant for licenses on other activities or projects.

7.2 RECOMMENDATIONS

This section looks at measures, activities and programmes that can be put in place to help the Authority to adopt open source software for the core systems. The following are recommendations;

- Zambia Revenue Authority must put a deliberate programme or policy in place that must ensure that employees given responsibility to evaluate the software to procure to evaluate all the options of software or solutions available. For example, the software evaluation committee should sign that they have evaluated all the available options. In addition, the Authority must carry out change management among the ICT and decision makers to change the wrong perception about open source software use and implementation. The literature review has shown that software costs depend on the type of the software selected between open source software and proprietary software, and supports and conform to Open Innovation model.

Zambia Revenue Authority must conduct seminars and workshops bi-annual to sensitise the employee in decision-making positions about the benefits of open source software. In addition, the theories like Open Innovation must be explained during the gathering. For example, in the literature review Chesbrough, 2003 defines open Innovation as the use of purposive inflows and outflows of knowledge to accelerate internal innovation, and expand the markets for external use of innovation, respectively. Open innovation is a paradigm that assumes that firms can and should use external ideas as well as internal ideas, and internal and external paths to market, as they look to advance their technology. This theory has led to many innovations that has benefitted a lot of individuals and organisations.

Open Innovation model works well with open source software because the software source code is available to anyone and therefore, it empowers individuals and organisation to innovate and also benefit from other people's contributions and innovations at no cost.

- The Authority must review and change ICT policies accordingly to encourage the use of open source software. This should be deliberate to encourage the decision makers adopt such measures. For example, ZRA can stay that all the analytic systems should use MySQL database, which is Open source software. As explained in the literature review, some countries have come up with deliberate policies to adopt or consider open source software. For example, Australian Tax office has formulated Tax Office Free and Open Source Software Policy. This policy guides how the authority should use the open source software. (Australian Tax office, 2008);
- The Authority must analyse the cost involved in acquiring the software and compute the return on investments for both Open Source software and proprietary software. In this case, the open source will always provide alterative solutions. For example, instead of buying Oracle database the Authority can buy Mysql database which is open source.

Similarly, the Forbes technology council in the literature review explains how important it is to understand the purpose of the software and analysing the alternative solutions. For example, the Authority saved a lot of money by opting

to use Mysql database in the Electronic Fiscal Devices system. It was not going to be the same if the Authority opted for Oracle database.

- The Authority must consider trying new technologies without waiting for it to be fully mature. The new software can be tested and implemented on less critical systems then install on critical systems later. As explained in the literature review, there a lot of innovations under open sources software because they are a lot of developers contributing at no cost. The authority will benefit from pool of developers at no cost. In this world of competition, the Authority should be in the group of innovators who are technology enthusiasts. These are risk-oriented, leading-edge minded individuals who are extremely interested in technological developments. To mitigate the risk of failure, the Authority should test on their test environments before it deploys to production environments.
- The Authority must ensure that the software being acquired has been developed according to standards and open to interfacing with other systems. This will be achieved by adopting models like McCall, Deutsch and Willis, and Evans and Marciniak. These have been explained in the literature review . This is important because integration is important for the organisation. The authority will continue acquiring new systems and those may need to be interfaced or integrated with the existing systems. If the system is closed and not developed according to standard it becomes expensive to integrate the system. Most of the open source systems are open and developed according to standards.

7.3 LIMITATIONS OF THE RESEARCH

The limitation of the research is that it did not quantify the losses or cost incurred when a taxpayer is not happy or satisfied because the system is not in place or he/she has to cover a long distance to have access to the Zambia Revenue Authority system. In addition, the dissatisfaction of the Zambia Revenue Authority by failing to offer proper service to the taxpayers because of non-availability of the system.

7.4 FURTHER RESEARCH

The researcher recommends future research on the following topics;

- Research on how the learning institutions like universities and colleges in Zambia are contributing to the adoption of open source software in different organisations through their graduates.
- Research on how Open Source software can help small and medium businesses compete with big companies in Zambia.
- Assess the impact of adoption of open source software in government health organisations in Zambia especially in rural areas where there no proper information technology infrastructure.

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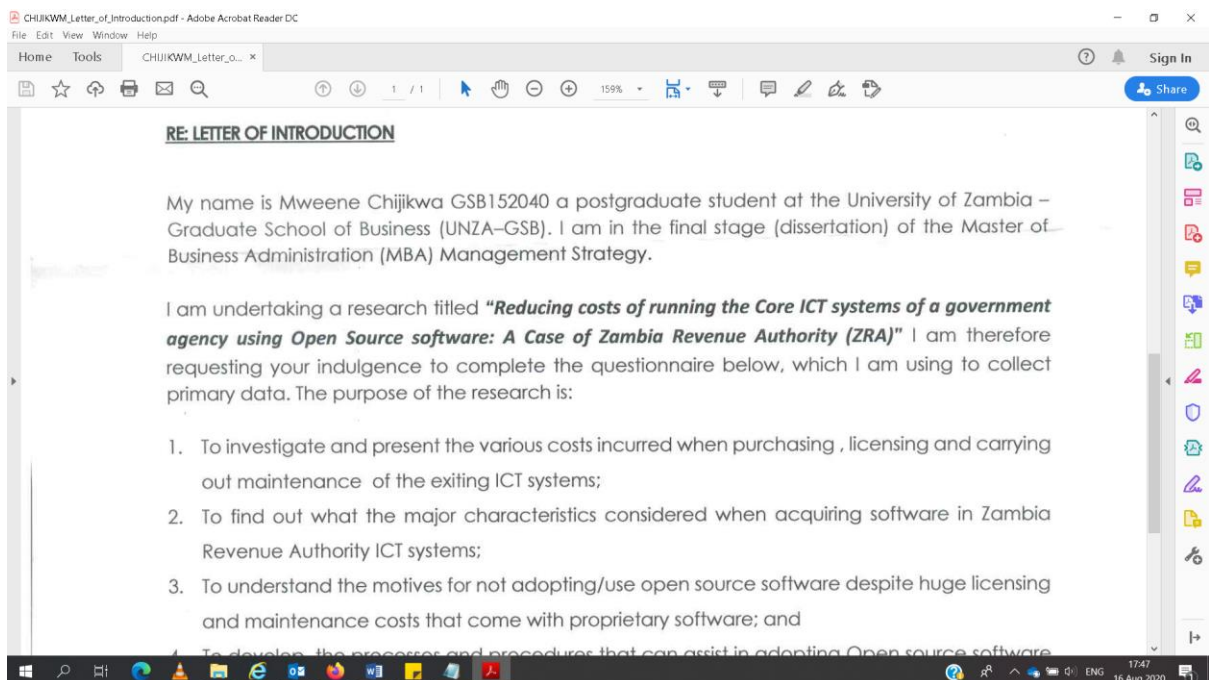
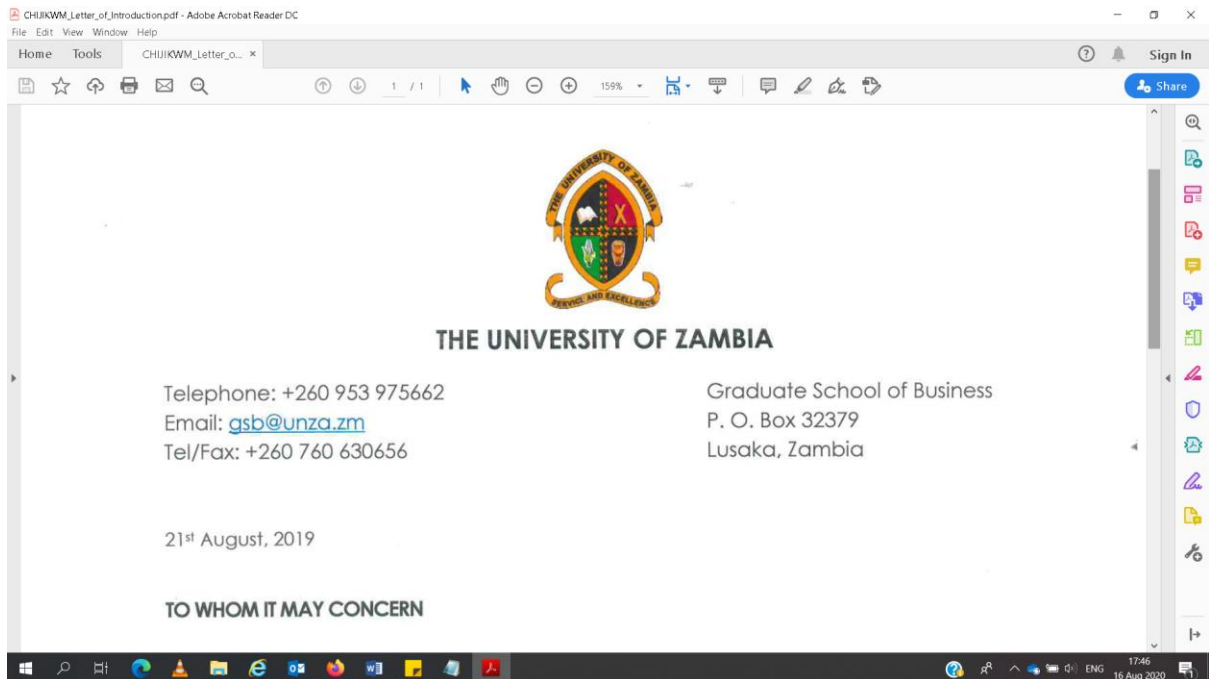
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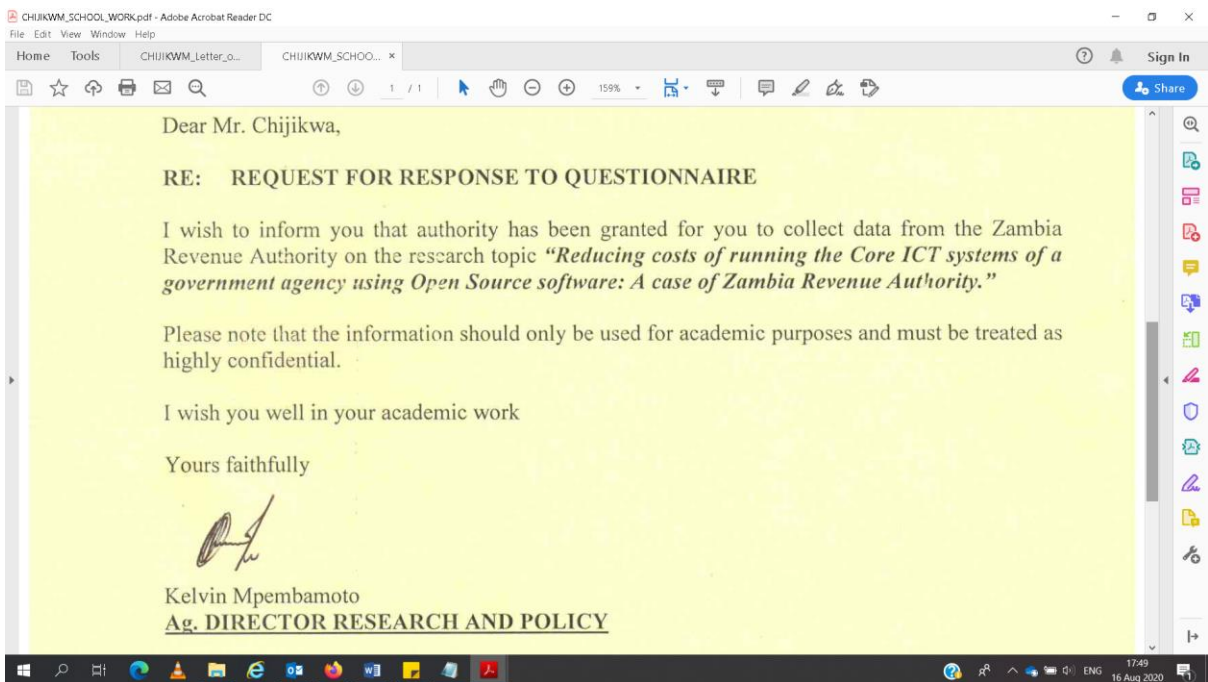
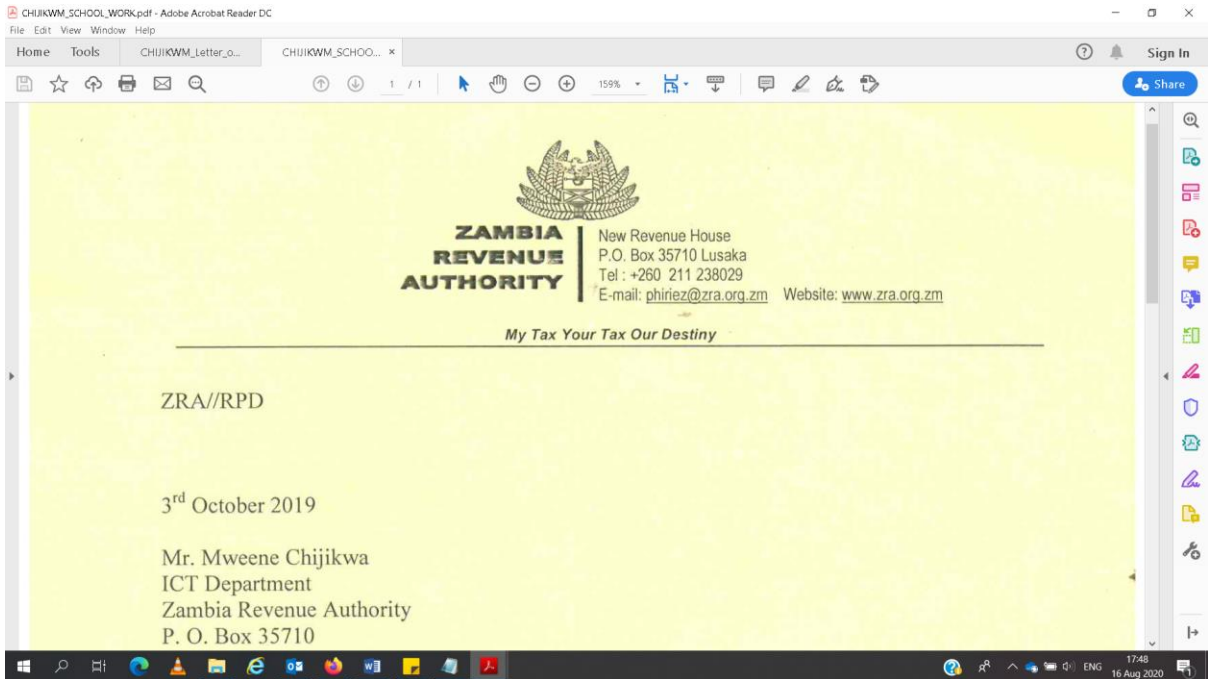
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APPENDICES

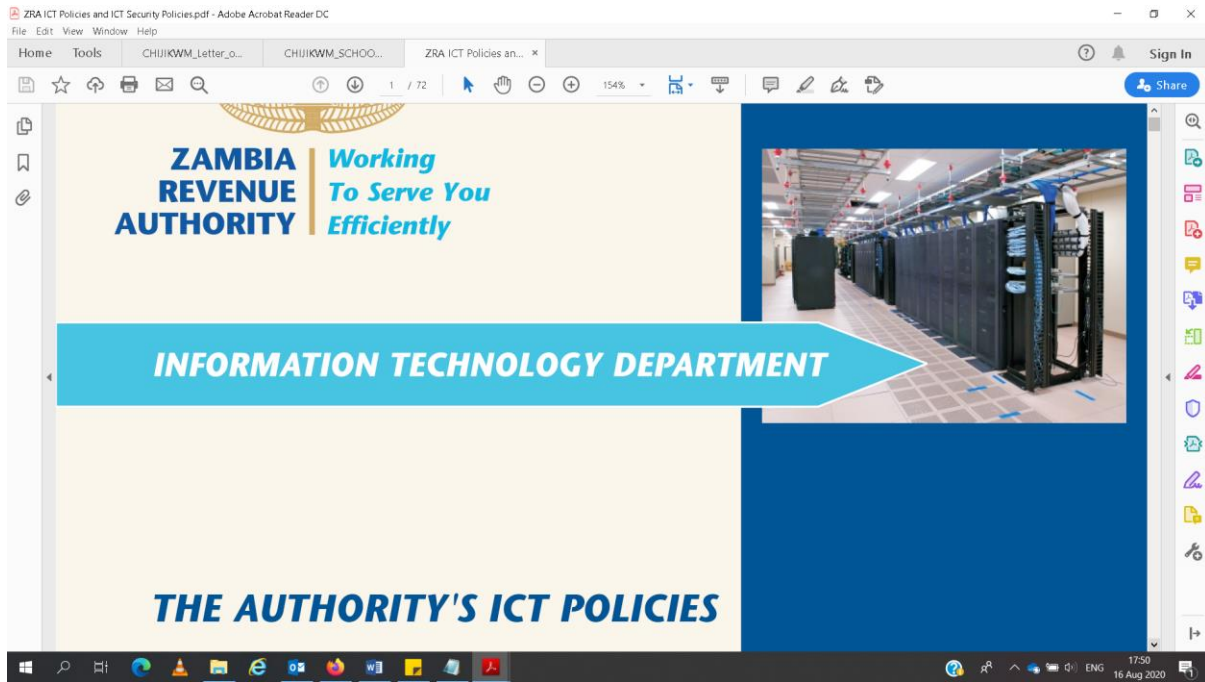
9.1 Introduction letter from the University of Zambia



9.2 Authorisation letter from Zambia Revenue Authority



9.3 Screenshot of ZRA ICT policy



9.4 SCREENSHOTS OF SOME OF THE COSTS INCURRED BY ZRA WHEN BUYING SOFTWARE

Line #	Part #	Description	License Level	Quantity	List Fee	Unit Selling Price	Net Fee	Support Duration	DDR Service	Support Net Price	Restriction Details
1.0	L93012	Oracle Cloud Management Pack for Oracle Database - Processor Perpetual	Full use license	1	7,500.00	5,625.00	5,625.00	1 Year		1,237.50	
2.0	L88612	Oracle SOA Management Pack Enterprise Edition - Processor Perpetual	Full use license	1	25,000.00	18,750.00	18,750.00	1 Year		4,125.00	
3.0	A90649	Oracle Diagnostics Pack - Processor Perpetual	Full use license	1	7,500.00	5,625.00	5,625.00	1 Year		1,237.50	
4.0	A90650	Oracle Tuning Pack - Processor Perpetual	Full use license	1	5,000.00	3,750.00	3,750.00	1 Year		825.00	
		Oracle WebLogic Server Management									

2015ZRA_Budgetary WebQuote # 1743797.pdf - Adobe Acrobat Reader DC

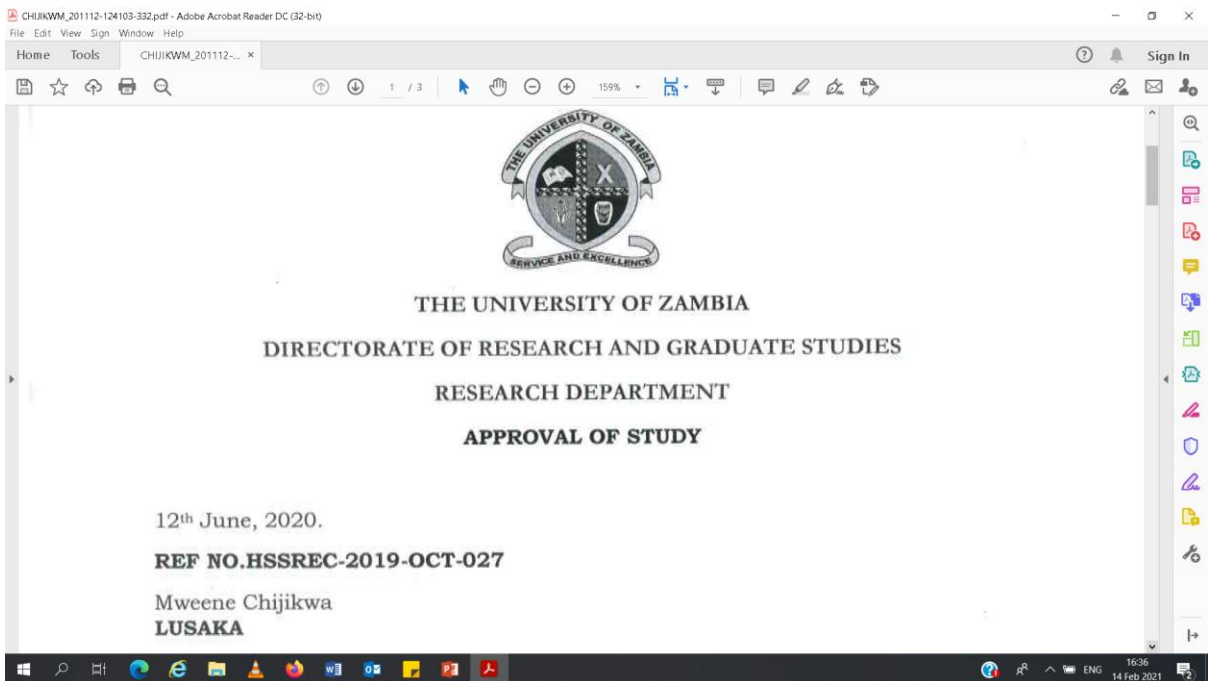
6.0	A90611	Oracle Database Enterprise Edition - Processor Perpetual	Full use license	17	807,500.00	35,625.00	605,625.00	1 Year	133,237.50
7.0	L47217	Oracle Active Data Guard - Processor Perpetual	Full use license	3	34,500.00	8,625.00	25,875.00	1 Year	5,692.50
8.0	L50206	Oracle Business Intelligence Management Pack - Processor Perpetual	Full use license	1	11,500.00	8,625.00	8,625.00	1 Year	1,897.50

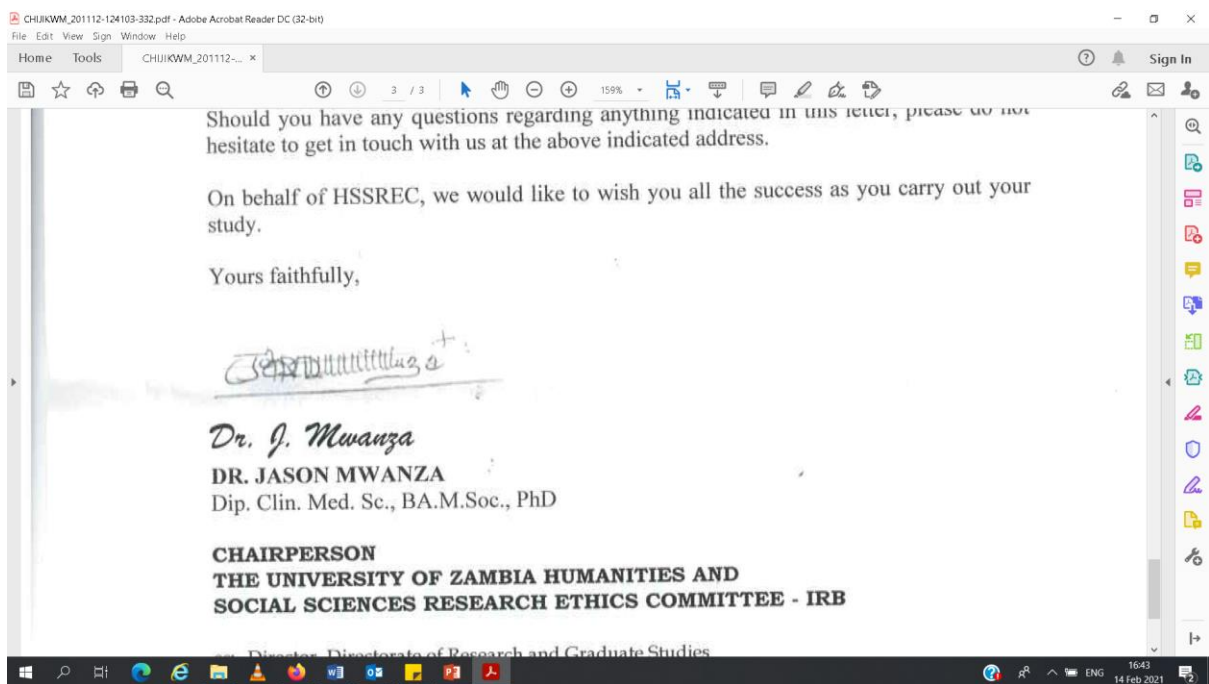
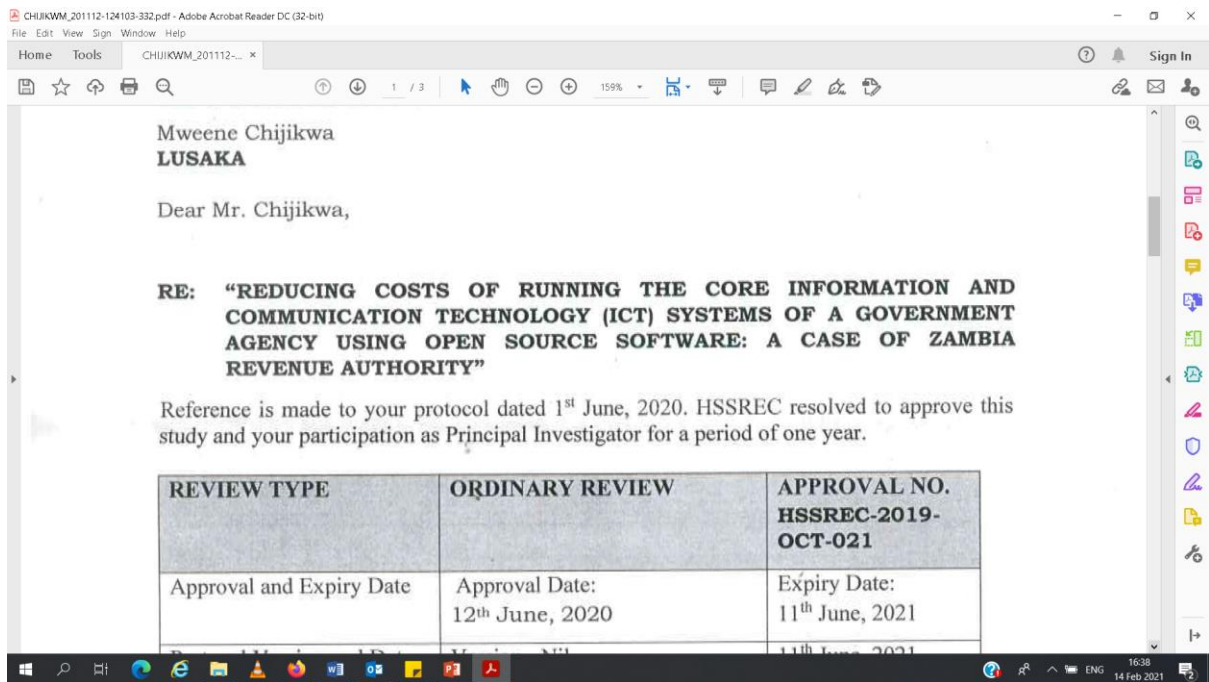
1 - 8

List Fee Total: 898,740.00
 Net Fee Total: 674,055.00
 Support List Fee Total: 197,722.80
 Support Net Fee Total: 146,292.10
Quote Total: 822,347.10 *

* Tax not included

9.5 APPROVAL OF STUDY : DIRECTORATE OF RESEARCH AND GRADUATE STUDIES .





9.6 Questionnaire: to find out what the major characteristics considered when acquiring software for zambia revenue authority ict systems.

1. Tick top five (5) software characteristics that are considered when acquiring/buying software for the Authority?

a.	Stability and Reliability	<input type="checkbox"/>
b.	Interoperability	<input type="checkbox"/>
c.	Security	<input type="checkbox"/>
d.	Functionality	<input type="checkbox"/>
e.	Ease of Use	<input type="checkbox"/>
f.	Total cost of ownership	<input type="checkbox"/>
g.	Customer Support	<input type="checkbox"/>
h.	Updates and patches	<input type="checkbox"/>
i.	Compatibility with the existing systems/tools	<input type="checkbox"/>
j.	Number of Features	<input type="checkbox"/>

2. Kindly arrange or list the software characterises circled/ticked in 1 in order of importance

- a. _____
- b. _____
- c. _____
- d. _____
- e. _____

3. Is ICT policy or framework used to guide people evaluating and buying software for ZRA?

a.	Strongly disagree	<input type="checkbox"/>
b.	Disagree	<input type="checkbox"/>
c.	Do not know	<input type="checkbox"/>
d.	Agree	<input type="checkbox"/>
e.	Strongly Agree	<input type="checkbox"/>

4. Is the vendor or developer history important when acquiring software for the Authority

a.	Strongly disagree	<input type="checkbox"/>
b.	Disagree	<input type="checkbox"/>
c.	Do not know	<input type="checkbox"/>
d.	Agree	<input type="checkbox"/>
e.	Strongly Agree	<input type="checkbox"/>

5. What are top five (5) attributes of a Vendor or Developer are considered when evaluating the supplier of the software?

a.	Competency.	<input type="checkbox"/>
b.	Capacity.	<input type="checkbox"/>
c.	Commitment.	<input type="checkbox"/>
d.	Control.	<input type="checkbox"/>
e.	Financial health.	<input type="checkbox"/>
f.	Location of the supplier	<input type="checkbox"/>
g.	Cost.	<input type="checkbox"/>
h.	Consistency.	<input type="checkbox"/>
i.	Culture.	<input type="checkbox"/>
j.	What do other customers have to say	<input type="checkbox"/>
k.	Check for hidden or additional fees	<input type="checkbox"/>

6. Are comprehensive on-site checks conducted before software is acquired?

a.	Strongly disagree	<input type="checkbox"/>
b.	Disagree	<input type="checkbox"/>
c.	Do not know	<input type="checkbox"/>

d.	Agree	<input type="checkbox"/>
e.	Strongly Agree	<input type="checkbox"/>

7. Does the level of skills and knowledge in the organisation influence the software acquisition

a.	Strongly disagree	<input type="checkbox"/>
b.	Disagree	<input type="checkbox"/>
c.	Do not know	<input type="checkbox"/>
d.	Agree	<input type="checkbox"/>
e.	Strongly Agree	<input type="checkbox"/>

8. If yes what level of skills do you expect the Authority (Members of staff) to have?

a.	Expert	<input type="checkbox"/>
b.	Advanced	<input type="checkbox"/>
c.	Immediate	<input type="checkbox"/>
d.	Beginner	<input type="checkbox"/>
e.	Not sure	<input type="checkbox"/>
f.	Not Applicable	<input type="checkbox"/>

9. Do you consider the maturity of technology (software) being used or deployed?

a.	Strongly disagree	<input type="checkbox"/>
b.	Disagree	<input type="checkbox"/>
c.	Do not know	<input type="checkbox"/>
d.	Agree	<input type="checkbox"/>
e.	Strongly Agree	<input type="checkbox"/>

9.7 Questionnaire: to understand the motives for not adopting/using open source software despite huge licensing and maintenance costs that come with proprietary software.

1. What are five (5) factors that make Authority opt for propriety software on its core systems despite propriety software being expensive?

a.	Exit costs	<input type="checkbox"/>
b.	Customer support	<input type="checkbox"/>
c.	Interoperability	<input type="checkbox"/>
d.	Security	<input type="checkbox"/>
e.	Functionality	<input type="checkbox"/>
f.	Ease of Use	<input type="checkbox"/>
g.	Organisation Strategy	<input type="checkbox"/>
h.	Total cost of ownership	<input type="checkbox"/>
i.	Updates and patches	<input type="checkbox"/>
j.	Staff technical skills	<input type="checkbox"/>

2. Kindly arrange the factors ticket in 1 in order of importance

- a. _____
- b. _____
- c. _____
- d. _____
- e. _____

3. Has the Authority used open source software on any of core systems?

a.	Strongly disagree	<input type="checkbox"/>
b.	Disagree	<input type="checkbox"/>
c.	Do not know	<input type="checkbox"/>
d.	Agree	<input type="checkbox"/>

e.	Strongly Agree	<input type="checkbox"/>
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4. If Agree or Strong Agree in 3 what has been the experience?

a.	Bad	<input type="checkbox"/>
b.	Good	<input type="checkbox"/>
c.	Very good.	<input type="checkbox"/>
d.	Excellent	<input type="checkbox"/>
e.	Do not know	<input type="checkbox"/>
f.	Not applicable	<input type="checkbox"/>

5. Do you think proprietary software is more reliable and secure than similar open source software?

a.	Strongly disagree	<input type="checkbox"/>
b.	Disagree	<input type="checkbox"/>
c.	Do not know	<input type="checkbox"/>
d.	Agree	<input type="checkbox"/>
e.	Strongly Agree	<input type="checkbox"/>

6. How quickly do the service or software vendor respond in the event of Zambia Revenue Authority having a challenge or problem?

a.	Between 1 hrs and 3hrs	<input type="checkbox"/>
b.	Between 4 hrs and 6hrs	<input type="checkbox"/>
c.	Between 4.5hrs and 24hrs	<input type="checkbox"/>
d.	After 2 days	<input type="checkbox"/>
e.	Not sure	<input type="checkbox"/>

7. Are security vulnerabilities easily corrected/fixed in proprietary software?

a.	Strongly disagree	<input type="checkbox"/>
b.	Disagree	<input type="checkbox"/>
c.	Do not know	<input type="checkbox"/>
d.	Agree	<input type="checkbox"/>
e.	Strongly Agree	<input type="checkbox"/>

8. If yes, how long does it take to correct the software?

a.	Within 1 day	<input type="checkbox"/>
b.	After 1 week	<input type="checkbox"/>
c.	After 1 year	<input type="checkbox"/>
d.	Not sure	<input type="checkbox"/>
e.	Not applicable	<input type="checkbox"/>

9. If no, how are the challenges or problems resolved?

a.	Buy another system	<input type="checkbox"/>
b.	Develop your own solution	<input type="checkbox"/>
c.	Call other vendors	<input type="checkbox"/>
d.	Not sure	<input type="checkbox"/>
e.	Not applicable	<input type="checkbox"/>

10. How easy is it to integrate proprietary software with existing system?

a.	Difficult	<input type="checkbox"/>
b.	Easy	<input type="checkbox"/>
c.	Very easy	<input type="checkbox"/>
d.	Do not know	<input type="checkbox"/>
e.	Not sure	<input type="checkbox"/>

11. Does ZRA ICT policies and strategies address the use of open-source software in the Authority?

a.	Strongly disagree	<input type="checkbox"/>
b.	Disagree	<input type="checkbox"/>
c.	Do not know	<input type="checkbox"/>
d.	Agree	<input type="checkbox"/>
e.	Strongly Agree	<input type="checkbox"/>

12. If Agree or Strongly Agree what is being done?

9.8 Questionnaire: to find out the various costs incurred when purchasing, licensing and carrying out maintenance of the exiting ict systems

1. What are major five (5) costs incurred when acquiring/buying software for the Authority?

- a. Training
- b. Reviewing the software
- c. Procedure and processes of choosing the bidders
- d. Hardware cost
- e. Deployment cost
- f. Total cost of ownership
- g. Licensing costs

2. Arrange the selected costs in 1 starting with most expensive?

- a. _____
- b. _____
- c. _____
- d. _____
- e. _____

3. Kindly provide costs details spend on buying software below for the last five(5) years
 - a. Application servers
 - b. Databases
 - c. Interfaces

9.9 Interview questions

1. What type of software do you use?
2. How expensive is the software?
3. Are members of staff trained in using both Open source software and proprietary software?
4. Do you receive support from the suppliers or developer of the software you are using?
5. Do you get software patches and other updates on time?
6. Where are the members of staff trained?