Free/Libre and Open Source Software (FLOSS) as an option for Non-Mission Critical Applications within XYZ Limited.

A Research Report
presented to the

Graduate School of Business Leadership

University of South Africa

In partial fulfilment of the

requirements for the

MASTERS DEGREE IN BUSINESS ADMINISTRATION,

UNIVERSITY OF SOUTH AFRICA

by

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June 2015

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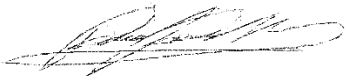
DECLARATION

I, Pedro Pablo Mena Salum, hereby declare that the work submitted in this thesis in partial fulfilment of the requirements for the Masters Degree in Business Administration (MBA) to the Graduated School of Business Leadership, University of South Africa, is my own original work. All sources used have been documented and acknowledged; and this paper has not previously been submitted in full or partial fulfilment of the requirements for an equivalent or higher education at any other recognised educational institution.



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1 June 2015

ACKNOWLEDGMENTS

First of all, I thank God for giving me the strength to complete these studies, without His help and given wisdom, this would not have been possible.

To my wife Natalie, whom from the beginning of this journey, knowing the sacrifice it entailed, has always been there for me, to encourage me, support me, and to always motivate me, in enduring this arduous path. Thank you for your unconditional love and patience.

I would like to express my sincere gratitude to my supervisor Derek Verrier whom patiently gave me guidance and the support in more than one occasion, especially through his positive words when I most needed them.

I am grateful to many of my colleagues and friends who supported me in obtaining information, cheering me, and offering me both their time and support during the research process.

Finally, I would like to offer my gratitude to my family in South Africa and in the distant land of Chile, as they kept me in their prayers and thoughts, while I was going through this journey. Thank you, Dankie, and Gracias.

PEDRO PABLO MENA SALUM

ABSTRACT

The topic of software adoption in organisations has attracted scholars to research and propose different approaches that aid companies to identify the main elements to consider when new systems are introduced into the business, such as stakeholder engagement, and associated cost of ownership amongst others. The importance of cost reduction initiatives undertaken by XYZ Ltd., has led this research to focus its investigation to identify the underlying components to reduce total cost of ownership of software considered to be non-mission critical. The study researched the different factors required to achieve sustainable cost reduction throughout the Corporate Office at XYZ Ltd. by adopting Free/Libre and Open Source Software as an alternative to commercially licensed software for non-mission critical applications. The research thoroughly covered an extensive evaluation of theoretical business frameworks, more than sixty relevant and current academic journals and publications as literature review, and a survey to capture the organisation's readiness and perception towards FLOSS adoption.

The key findings of this research revealed that FLOSS can bring financial sustainable benefits to the organisation, but hidden costs need to be thoroughly assessed before taken a decision to implement it. More than 50% of the employees surveyed perceives Open Source Software an attractive option to adopt as alternative software to unlock cost reduction and avoid vendor lock-in, however technical teams sees it as risky and complex to maintain and support. Finally, the study concludes that FLOSS adoption for non-mission critical applications has been proven to be an economically attractive option, nevertheless knowledge about Open Source Software as well as the different methodologies behind its development, have to be explored and learned by the technical teams, as they are a key component for successful adoption and will eventually be responsible to support and maintain such applications.

KEYWORDS

Open Source Software, FLOSS, software licensing, cost reduction, stakeholder engagement, company's culture, project appraisal, Open Source Software maturity, resistance to change, non-mission critical applications, vendor lock-in.

CONTENTS

List of Acronyms

CAPEX	-	Capital Expenditure
DCF	-	Discounted Cash Flow
DOI	-	Diffusion of Innovation
ERP	-	Enterprise Resource Planning
FLOSS	-	Free/Libre and Open Source Software
FSF	-	Free Software Foundation
FSFE	-	Free Software Foundation Europe
FV	-	Future Value
GNU	-	GNU is Not UNIX
GPL	-	General Public License
ICT	-	Information and Communication Technology
IRR	-	Internal Rate of Return
IT	-	Information Technology
NPV	-	Net Present Value
OPEX	-	Operational Expenditure
OS	-	Operating System
OSI	-	Open Source Initiative
OSS	-	Open Source Software
PV	-	Present Value
TCO	-	Total Cost of Ownership
WACC	-	Weighted Average Cost of Capital
WWW	-	World Wide Web
XML	-	eXtensible Markup Language
S	-	Present Value (in equations)
t	-	Specific Point in Time (in equations)
α	-	Discounted Rate (in equations)

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CHAPTER 1 - Introduction and Background

1.1 Topic

Adoption of Free/Libre and Open Source Software (FLOSS) for non-mission critical applications at Corporate Office within XYZ Limited.

1.2 Problem in Context

An entity within the major world gold producers, XYZ Ltd., with its headquarters in South Africa and 20 gold mining operations in various countries as well as several exploration programmes in both the established and new gold producing regions of the world, is discussed in this study.

Although the company produced close to 4.9M oz. of gold in 2013, generating a large amount of income and utilising approximately $2B n in capital expenditure, the challenging market landscape in 2013, reflected in the sharp fall in the gold price, reduced revenues and cash flows as well as the credibility of its investors. The company thus had to rapidly re-strategise and present a rescue plan in order to return positive cash flows and maintain the return value to its shareholders.

The company's new strategy, *Safely Generate Sustainable Cash Flows and Returns*, is supported by five fundamental pillars or key business objectives:

- Focus on people, safety and sustainability
- Optimise overheads, costs and capital expenditure
- Improve portfolio quality
- Ensure financial flexibility
- Maintain long-term optionality.

In the last two years, the IT department has gone through a series of changes and restructuring processes; from being a decentralised discipline across different regions and operations to becoming a central group, thus creating a centralised IT shared services department. These changes have had several repercussions on the ways in

which activities are carried out, policies, standards, the company's culture, an increase in IT spend, and supplier relationships, amongst others.

The IT function is a complex, diverse and changing environment. It strives to create value for the company's shareholders, employees and the business through safely and responsibly exploring and marketing its products across the organisation. Additionally, the department's current strategy seeks to add value to the business through the implementation of different technologies and to offer a tool set of diverse products and services. However, the department's current IT strategy does not support the recent strategic realignment by XYZ Ltd., nor does it make provision for the five main pillars of the company's said new strategy.

1.3 Problem Review

For historical reasons as well as the innovative restructuring process, the IT department at XYZ Ltd. does not have a fully defined global governance plan for the implementation ***of non-mission critical*** applications or any central mechanism to assist in the control of purchasing of software in order to keep track of the number and type of applications used by different business units. Nevertheless, all ***mission critical*** applications and systems that require IT infrastructure, such as access to databases or those that require installation on a server, are currently tracked and under control of the IT department. ***Mission critical*** refers to essential systems, software, or applications within the organisation that are critical for the functioning of the business; for example, an Enterprise Resource Planning (ERP) system.

The lack of centralised IT governance as well as the freedom of each business unit to purchase their own software licenses, without a central entity to assist in advice on what should be allowed or not, has to date resulted in issues such as large sums of total spend on software licenses renewals, maintenance and support on an identified application pool of over 200 different software applications used globally across the organisation. Although the individual spend might not seem significant when compared to the cost of the ERP system, in its totality it is substantially high. Additionally, certain other issues have been identified, such as high levels of duplication of software, thus losing opportunities to consolidate, optimise and standardise.

Although the company is already taking steps to rectify this issue where the major spend is related to ***mission critical*** applications, spend on the ***non-mission critical*** application space has not been addressed. Although it might be regarded as having a lesser impact on the business, this existing fragmented portfolio of applications in different fields becomes difficult to maintain and integrate with other systems in the organisation. Besides this, and more importantly, it creates a high level of vendor dependencies, or vendor locked-in situations, increasing the Total Cost of Ownership (TCO) associated with these applications.

Recent events have indicated that the IT department at XYZ Ltd. is seeking to reduce and optimise spend, starting at the Corporate Office where the highest level of fragmentation on a single location has been identified. This is being addressed by means of an analysis of options, such as rationalisation of software licenses, since all employees have frequently been granted software licenses that they might or not use, instead of only those that really require them. Nevertheless, the company has overlooked the possibility of adopting ***free software*** where possible and appropriate. Although it has come at a cost, one of the main reasons for not previously considering this option was that historically, the company has only used commercially licensed software which has allowed it access to maintenance and support, so that risk can be minimised and user experience maintained at a high level.

1.4 Problem Statement

The use of an identified wide portfolio of non-mission critical applications in all business units throughout the Corporate Office makes it of relevance to explore alternatives, such as the use of free software as an option to reduce cost. This is therefore a situation that can be interrogated by raising the following question:

How to reduce cost of ownership of non-mission critical applications through the adoption of Free/Libre and Open Source Software (FLOSS) as an alternative to commercially licensed software?

1.5 Research objectives

- Which are the ***key factors that determine attractiveness*** when replacing commercial licensed software with Free/Libre and Open Source Software (FLOSS) for non-mission critical applications?

- What are the ***user acceptance factors*** the company needs to take into consideration to successfully implement Free/Libre and Open Source Software (FLOSS)?

- What are the ***viability factors*** that will influence the IT department to adopt Free/Libre and Open Source Software (FLOSS) for non-mission critical applications?

1.6 Importance and Benefits of the study

The company in which the research will be performed has not yet explored this option which provides an alternative solution to its current strategy for costs reduction initiatives. In developing this research, the author has attempted to discover the main elements that will assist the said organisation to reduce the TCO associated to the ***non-mission critical*** applications. Additionally, since the topic has not been fully assessed by current literature, as it has only focused on ***mission critical*** applications/systems, this study will contribute to the body of knowledge through the testing of current theories and the identification of factors the company needs to appraise before adopting ***FLOSS*** for ***non-mission critical*** applications.

This research will also help XYZ Ltd. to select a set of tools that will assist it to achieve user expectations, as well as to create a sustainable, low cost software maintenance and support system, which is nevertheless of high quality.

1.7 Limitations and Delimitations

The research is limited to determining the factors that contribute to the successful adoption of FLOSS, with its focus only on Corporate Office level. It is essential to emphasise that this study does not intend to develop a framework around which type

of FLOSS license to use, neither to enter into the arguments of the philosophical discussion that the free movement attracts, but rather to identify the key elements that make FLOSS options suitable to substitute for commercially licensed software.

Additional limitations that might have hampered the study are listed below:

- Limited sample size was used for survey and interviews, due to time constraints
- Unwillingness of research respondents to participate in this research
- Honesty of the answers provided by respondents.

Nevertheless, the results of this study might be useful as a basis for further research in similar companies, as well as being applicable to the rest of XYZ Ltd. globally.

Lastly, the following assumptions were considered for this study:

- Sufficient data collection has been gathered in support of the hypothesis
- The research objectives are suitable for the methodology selected
- The literature reviewed is sufficient to state that this research area has not been sufficiently explored
- The number of available selected respondents will suffice to make a fair representation of the population.

1.8 Short Literature Review

Since the late 1990's, more and more companies have been exploring the use of ***Open Source Software***, primarily in order to reduce costs of ownership related to the use of software, such as license, support, and maintenance fees.

The free software movement dates from 1984, when the development of the GNU is Not UNIX (GNU) free operating system was launched, followed by the GNU General Public License (GNU GPL) under which such an Operating System (OS) was distributed; this license was designed to protect freedom for all users of a program. Since then, the term ***free software*** has been utilised to describe software which allows

users, individuals or companies, to freely run it, to study and change its source code and to redistribute copies with or without changes (Stallman 2012).

Fifteen years later, after the 1983 creation of the Free Software Foundation (FSF) the Open Source Initiative (OSI) was formed during 1998, intended as a marketing campaign for free software. Since then, the ***open source*** definition has been introduced to avoid misunderstanding of the term ***free software*** (Stallman 2012).

Although the definition given by OSI is 3 pages long, the American Heritage Science Dictionary defines open source as the "source code that is available to the public without charge. Open-source code is often enhanced, improved and adapted for specific purposes by interested programmers, with the revised versions of the code being made available to the public. For example, most of the code in the Linux operating system is open-source" (Dictionary.com 2015). As explained by Stallman (2012), while ***free software*** is a social movement, ***open source*** is a development methodology where the latter refers to ways in which to make the software better.

Later in 2001, the term ***Free/Libre and Open Source Software*** (FLOSS) is defined and used in order to be neutral between free software and open source software, thus aiming to avoid debates over the better term to use, free or open source software. Figure 1 below portrays how this comes together. The word *libre* is used to eliminate the ambiguity from the word free as in freedom, in other non-English languages, such as Spanish, and Italian.

Figure 1 FLOSS Explained

Forge (2000) mentions that the open source software paradigm has been developing progressively since its point of origin to the extent that it can be regarded as a new economic model, whereby cooperation is one of the main contributions to its success. Although concerns about product quality due to the lack of monetary remuneration

have been raised, open source has reached impressive levels of usability on the World Wide Web (WWW), which comprises the software infrastructure supporting the internet, with software such as Linux operating systems and Apache web servers. The willingness to change from using trusted brand names, which so far have proved expensive, to open source products will depend on the readiness of people to do so.

Nevertheless, “the term free software does not refer to price, but to the freedom of use, it implies no owners” (Forge 2000, p.5). Based on this premise, although FLOSS is delivered free of charge, companies had looked to generate revenues out of the activities associated with it, such as a customised version for which they offer maintenance and support, thus proposing a more economical alternative, of the same or better quality than its commercial equivalent. An example of this is the case of Red Hat for Linux.

*“*Most people prefer to buy a branded water at reasonable cost, as it is a life-giving essential, than to trust the water company. The same goes for open source. But the brand may be Red Hat for Linux, rather than Evian or Badoit for water, with an operating system and support at a low $50 to $70, rather than the thousands for the alternatives” (Forge 2000, p.7)

With the proprietary in-house software development almost extinct, Wang and Wang (2001) mention that there are many requirements to be considered when choosing suitable software, whether or not the nominee is Open Source Software (OSS) or commercial, thus making the adoption of OSS a real challenge. They propose an evaluation framework to compare and analyse OSS in order to determine its suitability for the requirements of the company. The evaluation criteria principally consider elements such as availability of technical support, future functional upgradability, open-standard compatibility, high reliability, budgetary concerns and licensing as well as project scope, amongst others.

The above authors argue that, “for an OSS candidate to be considered operationally robust and highly reliable, it must have been operational in a large number of applications and its performance evaluated and reviewed, as well as for the most part, OSS is considered free in the sense that generally no or minimal costs (for example,

shipping and handling) are involved. However, there are indirect costs, including development, technical support, and maintenance efforts" (Wang & Wang 2001, p.91). Their findings reveal that OSS is a competitive candidate for adoption of commercial software, due to the commercial-grade support provided for OSS.

Forge (2006), cited in Pruett and Choi (2013, p.436), proposes open source as a solution for economic growth. Although the price is not the main variable for OSS to enter the market, the author argues that unhappy customers of commercial software might turn to OSS as an option. Additionally, studies in the field of OSS have revealed that the quality of open source components is sometimes greater than its commercial equivalent. It is also mentioned that personal motivation, organisational culture, and age are some of the factors affecting the successful adoption of OSS in organisations (Spirov 2007, cited in Pruett & Choi 2013, p.436).

Whereas the lack of technical support is identified as the primary reason for rejecting OSS adoption, economic factors have made the organisations examine the benefits to be gained from OSS adoption, instead of evaluating their ability to adopt such a system. Thus they propose a threefold evaluation approach: "internal human capital, external human capital, and community capital". The latter refers to free support located primarily outside the institution, as opposed to purchased support (Goode 2005; Chau & Tam 1997; Li et al. 2005, cited in Pruett & Choi 2013, p.436-439).

Poba-Nzaou et al. (2014) mention that in recent times, different organisations have deployed applications that are OSS mission critical as well as non-mission critical equally across different IT projects. With a focus on cost reduction when considering OSS options, studies have evidenced that total cost of ownership (TCO) could be reduced between 20% to 60% concerning commercial software versus open source software, with regard to mission critical systems, such as ERP (Torkar et al. 2011; Fitzgerald & Kenny 2003; Niemi et al. 2009 and Klaiss 2008, cited in Poba-Nzaou et al. 2014, p.478).

When considering risks associated with the adoption of OSS, Poba-Nzaou et al. (2014) emphasise the importance of assessing the context in which the application will be adopted, taking into consideration the environmental and organisational milieu. In

addition, contractual, financial and legal risks are also considered as linked to relationships with partners, the capacity to pay for licensing fees and the risk of losing the competitive advantage from an open source waiver of IP, respectively (Poba-Nzaou et al. 2014).

Although the author points out that current research studies regarding OSS adoption "are narrow and preliminary" (Poba-Nzaou et al. 2014, p.478), the study concludes that one of the elements relevant to the adoption process is the internal and external knowledge of OSS (Ven & Verelst 2011, cited in Poba-Nzaou et al. 2014, p.478), while another is the use of Diffusion of Innovation (DOI) theory to assess and explain the mission critical OSS adoption process.

1.9 Research Design

Performing a research design means connecting a time based plan, procedures for every research activity, defining and identifying a selection of sources and type of information and specifying a framework and relationship amongst the variables under study, as well as giving an answer to questions such as the cost of the research project, type of sampling to be used and which techniques to utilise in order to gather information. As described by Coldwell and Herbst (2004), research design is the strategy for the study and the plan by which the strategy is to be carried out.

From the above source it is possible to understand that in order to carry out a research design it is necessary to identify how the data should be processed, which is in fact the core of the research, since the data will be converted into comprehensible information in order to obtain the answers for the research question. Amongst the different identifiers of design, as listed by Coldwell and Herbst (2004), these approaches will help to describe the type of strategy the researcher needs to take into account when developing the plan for the research project. The approaches are: observation, interrogation/communication, exploratory, formalised, experimental, ex post facto, descriptive, causal, case studies and statistical studies, and finally, field, laboratory and simulation.

In order to develop the research project under discussion, the most suitable tactic was to use a mixed method approach:

- *Descriptive*, since the problem in the study required the researcher to gather different personal points of view from company's members, data had to be collected through questionnaires.

- *Exploratory,* since it was necessary to develop a study that would lead to the development of a hypothesis based on the management model and actual findings.

Amongst the different types of research, it was possible to find three classes: experimental, quasi-experimental, and non-experimental. For this research project, a quasi-experiment was considered to possibly be the most suitable type of research. A non-experimental design, as mentioned by Coldwell and Herbst (2004), is the survey research design. In order to develop the research project, it was necessary to ask people questions and examine the relationship between variables as well as capturing attitudes or patterns of the subjects under study. Furthermore, this approach also helps to obtain a snapshot of a particular situation. Amongst the methods utilised by this class of research, it is possible to mention questionnaires and interviews, which are cost-effective and exploratory.

1.10 Population and sampling

A representative sample means that the sample is capable of providing an accurate picture of a larger population, where a sample is a group of observations of members taken from that population.

Firstly, in order to obtain a representative sample, one of the most commonly used methods is to take a random sample, which means that every member of the population taken has the same opportunity of being chosen. The underlying principle here is that if a sample is representative of the population, it is possible to trust the findings of that the research, which, based on the data collected, can be extrapolated to all the individuals in this population. Moreover, in order to preserve data integrity, with regard to representativeness, researchers need to take into account factors such as how the population is structured, sample frame and situation, amongst others.

Secondly, the sample size is a characteristic of a sample that determines how representative the selected sample is of the population under study. The size will determine the accuracy of a survey, where the larger the sample size, the more closely it represents the population, therefore the more representative it becomes. In essence, since the findings from the sample can be extrapolated to the entire population a sample is used to avoid investigating the entire population, which in most cases is almost impossible. Nevertheless, if the sample size is too small, it will not be representative enough of the population (Coldwell & Herbst 2004).

In this study, the target population were all employees at Corporate Office. For sampling purposes, and to increase the level of representativeness, the research was based on a total population of 250 employees, where the sample size of employees, and confidence interval were determined after the researcher obtained the company's approval to do such a survey.

1.10.1 Data collection

Amongst the data collection methods available for this kind of research, various techniques exist, including questionnaires, surveys, interviews, focus groups, and a case study. However, for the purpose of this study two methods were selected: questionnaires and interviews.

On the one hand, questionnaires have to be developed according to the key concepts of the theory, but need to be expressed in a clear and simple language that will elicit the required data. These questionnaires were applied equally to the entire population. A decision had to be taken concerning whether they were to be generic, or personalised, and which structure would be followed (Coldwell & Herbst 2004).

Interviews are useful for understanding people's experiences and obtaining a full range of information, since the interviewee can express her/himself. This method to gather data would be difficult to capture from a questionnaire. Additionally, since the interviews complement the questionnaire, they were not intended to be applied to the whole population (Coldwell & Herbst 2004).

1.10.2 Reliability and validity

Reliability refers to having a sample without errors or biases. In other words, the data collected should be a trustworthy representation of the population. When data is collected, it is expected to be reliable in order to use it in the analysis and to be able to generalise its findings. In order to maintain reliability when measuring observations, the methods to be used in this process must be consistent, so that it will be possible to repeat the test and trust that its results are reliable (Coldwell & Herbst 2004).

One of the reasons why interviews were not the main method of data collection, but were rather used as complementary was to cover aspects that the questionnaires could not. For instance, when a person is interviewed, the results might mislead the findings, since there is no method to ensure that respondents are being honest (Coldwell & Herbst 2004).

The concept of validity refers to demonstrating that what is being measured by an instrument is the particular data which is supposed to be measured. Validity is not possible without authentic data, since the evidence has to be consistent in order to be valid. Additionally, validity can be categorised in two types: internal validity describes findings that are valid for just a specific study while external validity describes findings that can be generalised to other situations too (Coldwell & Herbst 2004).

1.11 Chapter divisions

- Chapter 1 explains the problem in context as well as the purpose of the research, it explores a short literature review, and proposes the research methodology followed.
- Chapter 2 firstly explores the existing managerial theory, with its main focus on financial management theory and organisational performance. A literature review of more than sixty publications spanning 1999 to 2014 is presented which examines the available literature relevant to open source software, economic factors driving its adoption, success aspects of adoption and associated risks.

- Chapter 3 defines the research designed and methodology used, in order to achieve comprehensive findings.
- Chapter 4 contains data analysis and findings, starting with the financial and business theory, to then identify the trends provided by the literature, and it finishes with the statistical analysis of the data collected through the survey.
- Chapter 5 offers specific conclusions to each element of the analysis, and finalises with a set of general conclusions for the research and further recommendations.

CHAPTER 2 - Theoretical Framework and Literature Review

2.1 Introduction

This chapter addresses two main areas: firstly, management theory which explores the most relevant managerial theories with the central focus being on the financial management theory and organisational performance, so that these models can be used to unravel and understand the phenomena under study and secondly, a literature review of publications by accredited scholars and researchers relevant to the topic under study. Through a review of more than sixty publications, it examines the available relevant literature.

2.2 Theoretical Considerations

2.2.1 Financial Management Theory

Some of the main business tools used by companies to measure as well as apprise how attractive it will be to embark on an investment or a project where funds are required, are those proposed by the financial management theory, such as Net Present Value (NPV), Internal Rate Of Return (IRR), and Payback Period (Firer et al. 2008). The Net Present Value is based on the principle of time value of money, thus providing decision makers with a mechanism to determine, from an economic perspective and in terms of today's value of money, whether or not to go forward with such an initiative.

The time value of money concept refers to the expression: "money today cannot be worth the same as an identical cash sum to be received in a year's time" (Martin 2008, p.115). In this manner, if a sum of money *S* can be invested and earn interest at a rate of return of *α* per cent in a period of one year, at the end of the year, its future value will be:

$$Future\ value = S \times (1 + \alpha)$$

This expression indicates the future value of S after the period of one year, with an interest rate of α. In order to obtain the future value for a specific time (year, month or day) the above expression changes to:

$$Future\ value = S \times (1 + \alpha)^t$$

With t being any positive number to indicate the point in time for the desired future value of S. In addition, it indicates that one has the opportunity to grow the money, whether invested in the bank or any other financial institutions or government securities which can provide one with a rate of return of α per cent. For example, one could have ZAR 1,500 in cash and have the chance to put the money on a fixed time deposit at the bank with an interest rate of 8% per annum. Assuming that there is no risk in the bank and that the country is economically stable, after a period of three years the value of money in today's terms will be:

$$ZAR\ 1{,}500 * (1 + .08)^3 = ZAR\ 1{,}889.$$

When calculating if a project is worth doing or not, and how attractive it is for the company to take it further, decision makers use the NPV and DCF method. "The NPV is the difference between an investment's market value and its cost, whereas the DCF is the process of valuating an investment by discounting its future cash flows" (Firer et al. 2008, p.259). The latter allows the projected cash flows and future values to be discounted at a given discount rate per year. This will then calculate the present value for each period, whereby adding them, one can estimate the NPV, which in other words, is the total value of the project in terms of *today's money*. As described by

Martin (2008, p.151), the decision criterion for accepting a project is based on the following :

- *Any project with a positive NPV generates more cash that it costs, and is therefore worth doing.*

- *Any project with a negative NPV costs more than it makes, and so should be rejected.*

By combining all these concepts, if a future value of a sum S is expressed by

$$Future\ value = S \times (1 + \alpha)^t$$

where S can be understood as the present value of money, that is to say *value today*. If S (present value) is mathematically solved in the equation, it is possible to express the present value as follows:

$$Present\ Value = \frac{Future\ Value}{(1 + \alpha)^t}$$

$$discount\ factor = \frac{1}{(1 + \alpha)^t}$$

Then from the above, it is possible to define the NPV as the sum of all the future net cash flows in a project; in terms of present values using a beneficial discount rate, the latter will be determined by the company and will depend upon the riskiness of the project. Thus, this sum will express how much the project will be worth in terms of *today's money*. The general expression for NPV is described below, where a future value is the net cash flow (after tax) per year (or any period over which the project is appraised) (Firer et al. 2008).

$$NPV = \sum_{t=0}^{n} \left(\frac{Future\ Value_t}{(1 + \alpha)^t} \right)$$

Lastly, it is also important to underline that NPV is an absolute measure, as it takes in to account the actual sum of the project benefits.

The Payback Method is another tool that estimates how long the project under assessment will take to return the same amount of money used in the initial investment. In other words, it answers the question of how long the project takes to generate positive cash flows (Martin 2008*)*. This method finds the point in time in which the cash flow turns into a positive value; this means the point in time when the project has paid back the initial investment.

The NPV method as described above, takes into account all the cash flows, even those after the payback period, whereas the Payback Method stops when the cash flow turns into a positive value, ignoring the residuary cash flows. However, the Payback Method ignores one of the most important elements of the NPV: the time value of money. The NPV method takes into account the risk of the investment, while the Payback Method ignores this risk; thus it may suggest going ahead with a project that presents a fast payback, but which may be high risk to use on its own.

The reference to the above principle, *time value of money and the different described tools*, aims to understand the different economic aspects to be determined when evaluating the cost elements of using FLOSS at XYZ Ltd., in comparison to the current installed commercially-based software.

Although the NPV method looks for positive values as the parameters to determine how attractive it is to undertake a project, the organisation under study considers software an operational expenditure (OPEX). Therefore, when building a DCF and evaluating the NPV in order to answer one of the hypotheses of this research, the values used on the calculations were of a negative nature. Nevertheless, in this research the NPV method was adapted in order to compare negative values, as parameters to determine attractiveness. In addition to the NPV method, this research also included the use of the payback period in order to help identify how long the adoption of FLOSS will take to show economic benefits to XYZ Ltd., should they exist.

2.2.2 Resource-based view (RBV)

The resource-based approach to strategy analyses the internal resources and explores the organisation's capabilities and its important network of relationships as well as investigating what new capabilities and relationships may be needed over time (Fenton-O'Creevy et al. 2007). One of the principles of this theory is that organisations build their competitive advantage, by transforming resources into capabilities. In order to achieve this advantage, capabilities need to be inimitable, durable, relevant and appropriate, where to achieve these John Kay (1993) referred by Fenton-O'Creevy et al. (2007) suggests ***innovation***, architecture and reputation.

The resource-based analysis looks to identify key resources and capabilities and assess the extent to which these act as strengths or weaknesses of the organisation. Identifying these two elements, it enables the organisation to coordinate and exploit its attributes, thereby helping it to achieve its strategic goals as well as maximise its competitive advantage, which can be enhanced by understanding scarcity, relevance, durability, transferability and replicability. According to Bakhru and Gleadle (2010) competitiveness depends on an organisation's ability to develop a core competence around a key skill or set of interrelated skills. The authors also mention that the critical difference between organisations is the "bundle of assets that they possess and the way they make use of them" (Bakhru & Gleadle 2010, p.12).

The above can also be understood as an organisation's capabilities being what the firm can do through their resources, according to Grant (2010). The mentioned author defines three types: Tangible, Intangible, and Human Resources (Grant 2010), as incorporated in Figure 2 below.

Tangible resources are defined by the **financial** resources and **physical** assets of a firm. These elements can be identified and valued in the company's financial statement (Grant 2010). Some examples of these elements are plant equipment, ICT infrastructure, mineral reserves, bonds and securities among others.

Intangible resources, unlike tangible resources, are most times not visible in financial statements. However, Grant mentions that intangible resources are more valuable

than tangible resources. They are defined by Technology, Reputation and Culture (Grant 2010). Some examples of these are patents, systems, mining methods, mining licenses, brand value and relationships.

Human resources relates to the expertise and effort offered by employees (Grant 2010). Resources are measured through ongoing appraisal processes and established performance goals of employees' development plans. This leads to a comprehensive and quantitative assessment of skills and attributes of individual employees and appraisal criteria, Competency Modelling (Grant 2010). Some examples are skills/know-how, communication capabilities, motivation and job satisfaction amongst others.

The reason for using a resource audit of the company under analysis, based on the RBV model, is to assist in identifying key factors of the organisation capabilities that will impact FLOSS adoption. The more relevant aspects of this model to assist the ongoing research are two of the resources proposed by Grant (2010), intangible resources and human resources. While intangible resources explore the current technologies and systems in the company, the human factor explores skill sets and know-how. The combination and understanding of both of these factors will make clear the **acceptance** of the proposed technology and the company's capabilities to adapt to change. On this premise, the RBV model can safely be accepted as the basis for management to objectively support change when it enhances the company's capabilities.

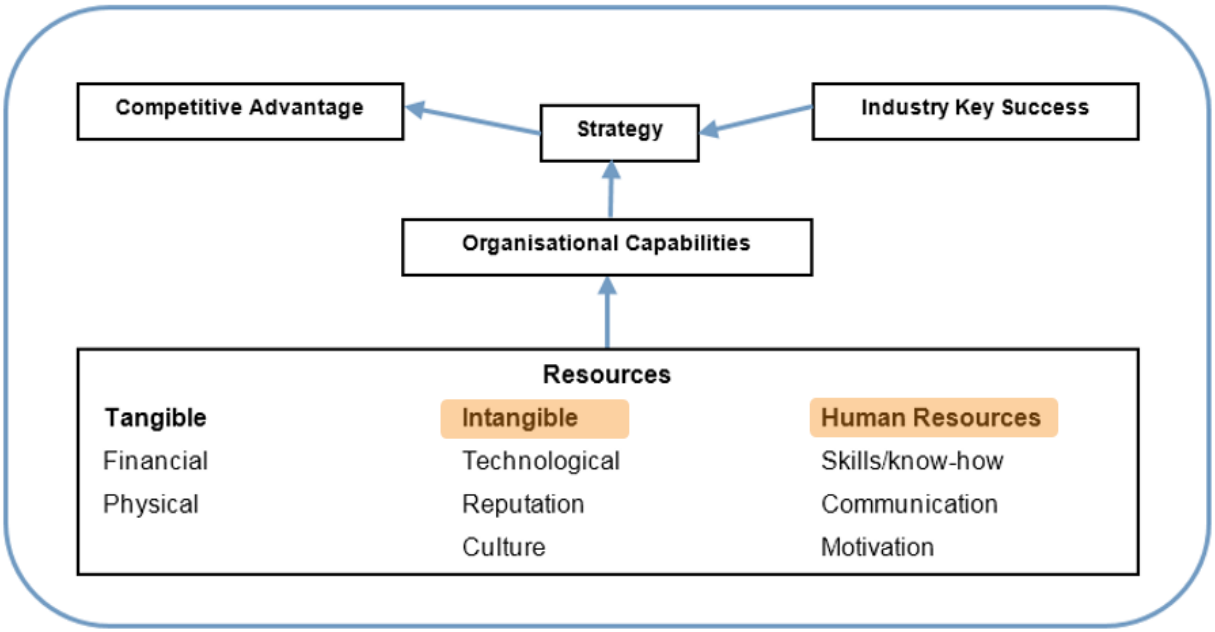


Figure 2 Links between resources, capabilities, and competitive advantage (Grant 2010)

2.2.3 The Cultural Web

Managing change involves delicate political manoeuvring, according to Jonson (1987). "Changing people's behaviour demands more than a plan, it requires to modify people's beliefs" (Boojihawon 2010). The cultural web is a model for mapping and managing change, a set of tools to enable managers to bring to the surface and explore the core assumptions underpinning their paradigms, and therefore, facilitate the implementation of change. It helps to identify the ***key levers for implementing strategic change within an organisation***.

- ***The paradigm***: a set of assumptions held in common and taken for granted about the organisation
- ***Power structures***: powerful managerial groupings supporting the organisation's existing core assumptions and beliefs
- ***Organisational structure***: formal structures and more informal systems and norms

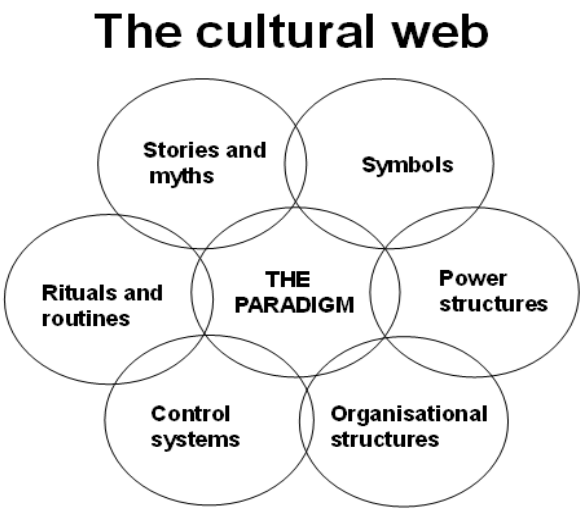


Figure 3 The Cultural Web (Johnson 2004)

- ***Control systems***: monitor and focus attention on the activities that the organisation values and considers important.
- ***Rituals and Routines***: how members behave toward each other, way things are done here.
- ***Stories***: they legitimise certain types of behaviour.
- ***Symbolic***: representation of the nature of the organisation, such as logos, office space, job titles, and language amongst others.

This model provides a view of the organisation's core identity "paradigm". The six elements described above enable managers to discover and understand the nature of each individual paradigm. These elements can be categorised into two areas: ***soft*** (intangible) symbols, stories, rituals and routines and ***hard*** (tangible) power structure, structure and control systems. Although more difficult to deal with, ***the only way to change an organisation is to address the soft area***s (Johnson 2004).

2.2.4 Readiness Assessment

The above theoretical considerations point out how important it is to focus on the intangible resources and cultural issues in the organisation; in the light of the company's recent strategic re-formulation forced on it by external forces, the following section explores the theoretical themes related to the company's openness and readiness to face change. It commences by investigating the different aspects affected

by the ***company's culture*** and the complexities of ***strategy implementation***, and concludes by proposing a force field analysis model that will help to identify which factors to look at when ***resistance to change generates a risk*** to the successful strategy (change) implementation.

2.2.5 Communication

One of the business models that help to ***successfully convey a message throughout an organisation*** is the communication model as mentioned by Cameron (2007a), based on the technical process of communication the author defines four components that describe the communication process: source, transmitter, receiver, and destination, all of these also negatively affected by noise created by not clear messages. In addition, Shannon and Weaver cited by Cameron (2007a) emphasized that one the principles of a clear and effective communication is only possible when individuals share a certain amount of common ground. Lastly, ***effective communication should look to help others to do their jobs*** (Cameron 2007a).

Finally, it is worth noting that the vision of the implemented change needs to be communicated, in order to ***create a common view across the different stakeholders*** to ensure that as many people as possible understand and accept the vision.

2.2.6 Strategy Implementation

According to Speculand (2006), one of the key points managers must take into consideration for strategy implementation is that most people are open to change when it is communicated in the right way; the response they make depends on what the change means for the individual. Additionally, the author argues that leaders, by failing to shift their beliefs, will develop the wrong policies for addressing staff members' reactions to the new strategy.

2.2.7 Financial Controls

The importance of forecasting a company's financial statements for its future will determine the success of the organisation. A good budget assists the organisation to achieve its goals methodically, minimising operational risks; it helps as a control mechanism (where it is possible to perform controlling and monitoring) as well as promoting communication and coordination in the different areas of a company. Additionally, it sets targets to achieve, defines activities to accomplish and relates the actions to take for achieving the organisation's long term objectives (Parkinson 2007, p.56).

2.2.8 Strategy Alignment

An organisation's culture defines "how things are done", through shaping work processes. Nevertheless, performance at the company depends on the extent to which its cultural values and norms can be aligned with its strategy (Ogbonna & Harris 2002, mentioned by Boojihawon 2010). ***Culture must support strategy*** in order to create organisational strength. Additionally, through aligning everybody in the organisation with the company's strategy by identifying well-defined priorities, creating a common understanding and stimulating learning orientation, the strategy becomes a ***shared value*** (Colarelli & Quinn 2007).

2.2.9 Force Field Analysis methodology

Force field analysis (see Figure 6), proposed by Kurt Lewis during 1940s, assists to identify those forces that are in favour or oppose to a specific change or initiative in the company, allowing the business to decide on whether or not to go ahead, or if the change has already been implemented, it will help to emphasise which areas require more attention in order to increase the success of such change (Connelly 2014). The principle behind this technic is to identify and list the pros and cons of a decision making process, knowing that each element of the list are of higher or lesser importance towards achieving the desired goal, or adoption of FLOSS in the case of the ongoing investigation. These elements are called forces, and need to be listed and represented by the weight it has towards the decision, thus allowing the decision maker to measure the level of impact such element will contribute in favour or against

the goal, and providing a more accurate assessment of the decision. The weight or importance can be measure by using a scale from 1 to 5, where 1 is of low importance, and 5 of high importance.

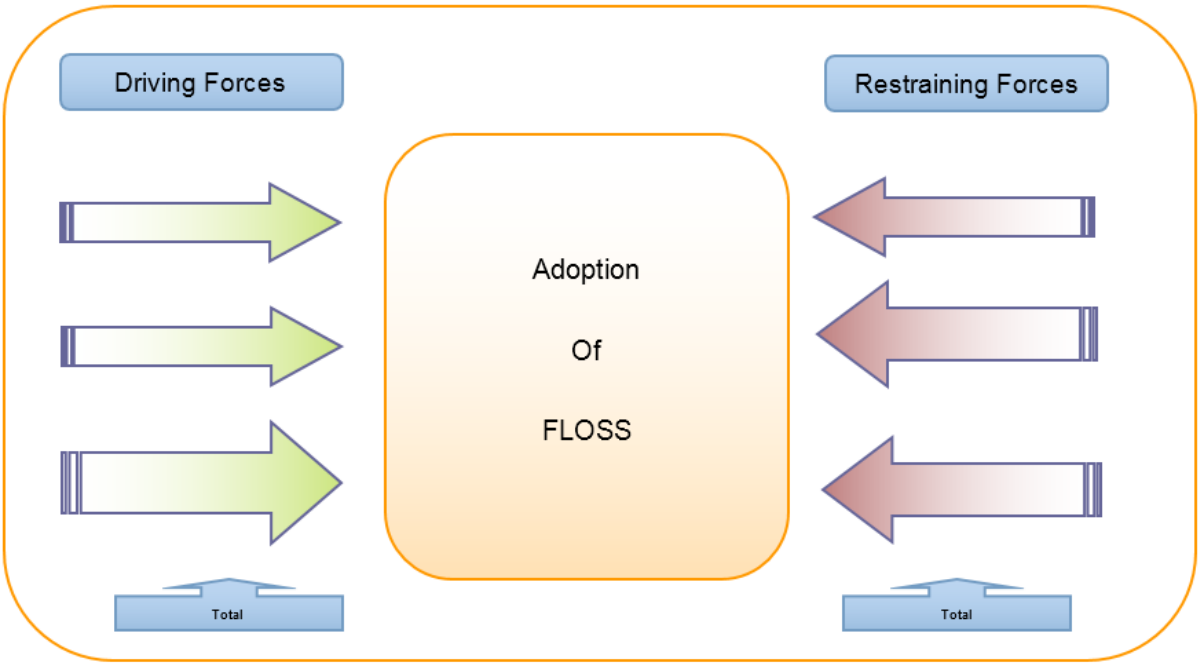


Figure 4 Force Field Analysis (Connelly 2014)

2.3 Literature Review

2.3.1 Introduction to FLOSS

Through reviewing more than sixty relevant and current journals and publications, it has been possible to perform an extensive literature review over the topic under investigation. This has enabled the researcher to identify four main themes relevant to the ongoing research and to pinpoint factors that may be regarded as important to take into account when considering adopting FLOSS. These are: economic, risk, security, and reliability, maturity and adoption factors.

- economic factors: focus on the different costs aspects behind open source adoption
- risk, security and reliability: examining factors that could jeopardise the proposed implementation

- maturity factors: refer to the current level of maturity FLOSS has reached in the last few years
- adoption factors: refer to exploring the dynamics behind implementation of FLOSS.

A ***computer application*** or a ***software program*** is foremost a sequence of orders and mathematical algorithms emerging from the mind of the innovator, hence creating a link with copyright laws as a prime source of intellectual property protection (Vuyst & Fairchild 2007, p.328).

Copyright protection shall extend to expression but not to ideas, procedures and methods of operation or mathematical concepts. As such, copyright protects the actual code of the computer program itself and the way the instructions have been drawn up, but not the underlying idea thereof (Vuyst & Fairchild 2007, p.329).

Remark: it is important to emphasise that in the following sections the words: Open Source Software, Open Source, FLOSS and OSS, are used interchangeably.

As already suggested by means of the short literature review in Chapter 1, FLOSS opens a set of different opportunities to reduce cost of ownership related to the use of software, such as licenses, support, and maintenance fees. This is achieved through the use of different license models, such as: GNU General Public License (GNU GPL) under which FLOSS has been distributed from its origins, designed to protect freedom for all users of a program, today at version 3 (GPL 3); Apache License and Eclipse Public License (EPL) amongst others (Mahony & Naughton 2004; Forge 2000; Stallman 2012). The General Public License (GPL), designed and published by the Free Software Foundation, strives to prevent private ownership of software, thus preventing any proprietorship of code, and is the most widely used license for FLOSS. Any software that uses and incorporates code subject to the GPL, is ***automatically subject to the GPL itself***; hence the software must be shared publicly. In contrast to ***copyright***, this concept is called ***copyleft*** (Mahony & Naughton 2004).

Miller et al. (2010) states that from its inception, OSS has been criticised by many, including Microsoft, which, in 2001, stated that: “open source is an intellectual property

destroyer". However, nowadays Microsoft has its own OSS portal CodePlex (www.codeplex.com).

It is worth clarifying that the term "open source software" has evolved since it was first defined. Therefore, for the purpose of this research, open source (OS), open source software (OSS), free and open source software (FOSS), libre software, free software (FS), and free/libre and open source software (FLOSS) are treated equally. In essence, currently all these different names refer to the same phenomenon: ***free/libre and open source software,*** utilised to describe software which allows users, individuals or companies to freely run it, to study and change its source code, and to redistribute copies with or without changes (Stallman 2012).

The evaluation criteria mainly consider elements such as: availability of technical support, future functional upgradability, open-standard compatibility, high reliability, budgetary and licensing and project scope, among others (Wang & Wang 2001).

2.3.2 Economic Factors

As Forge (2000, p5) states, mentioned earlier, "the term free software does not refer to price, but to the freedom of use, it implies no owners". Even though software is delivered free of charge, few companies had looked to create revenues out of the actions associated to the utilisation of FLOSS, such as customised versions of available open source software for which they offer maintenance and support. So proposing a more economical alternative also supports the premise that free downloads from the internet are a form of free distribution and hence are cost-free.

However, although the word "free" can also be considered to mean "free of charge", in reality, it does not constitute "no cost". In one way or another, FLOSS attracts indirect costs, including development, technical support and maintenance efforts (Wang & Wang 2001, p.91). Nonetheless, these authors' findings reveal that FLOSS is a competitive candidate for adoption of commercial software, due to the commercial-grade support provided for it.

Poba-Nzaou et al. (2014) mention that in recent times different organisations have deployed OSS mission critical as well as non-mission critical applications equally across different IT projects. As pointed out in the short review in Chapter 1, studies have shown that total cost of ownership (TCO) could be reduced between 20% to 60% when comparing commercial software versus open source software, regarding mission critical systems such as ERP (Torkar et al. 2011; Fitzgerald & Kenny 2003; Niemi et al. 2009; Klaiss 2008, cited in Poba-Nzaou et al. 2014, p.478).

The costs associated with internal support versus external support as mentioned by (Kenwood 2001) can also be identified as sources of the cost to maintain and support FLOSS in the organisation. Nevertheless, the author wishes to stress that it is imperative to evaluate staffing cost as it could increase or lower the total cost of ownership when dealing with open source software.

According to Ven et al. (2008) companies must be thoughtful when adopting FLOSS, as doing so for “the wrong reasons can harm the organisation, whereas not adopting FLOSS might leave considerable opportunities unused” (Ven et al. 2008). Through his research, Ven (2008) found that lower cost helps drive the use of FLOSS. Nonetheless, this perception might be misleading, as not all FLOSS is cost free, and it might not be less expensive than proprietary software. “However, if an organization develops an application that incorporates software licensed under the GPL and starts to distribute it (for example, an application that uses MySQL as a database), the organization must publish that application’s source code. Dual-licensing firms sell a commercial license for the same FLOSS product that doesn’t require the application’s source code to be licensed under the GNU GPL. The customer pays for the right to keep its intellectual property private” (Ven et al. 2008, p55). The author also argues that to estimate the costs involved in introducing FLOSS, an organisation could calculate the total cost of ownership. Various studies have compared the TCO of commercial software against that of FLOSS but many of these contradict each other. Shifting costs are an essential component of the TCO linked to software operations and occur when an organisation moves away from the current platform to the adoption of a new one.

According to Nagy et al. (2010), one of the barriers companies may encounter when intending to convert or move to open source, is the ***sunk cost***, due to substantial previous investment in proprietary software previous to the emergence of open source, as the adoption of FLOSS will require the write-off of such an invested amount. Since a company's executives demand cost justification for new technology investments, the sunk cost of currently owned software could make the adoption of FLOSS unjustifiable. Therefore, when assessing such technology replacements, companies should compare future cost streams of commercial software versus FLOSS (Nagy et al. 2010).

Morrissey (2010) is another author who argues that any software, FLOSS or commercial, will attract cost whether directly or indirectly in order to continue its production – to keep the product up to date. Hence careful assessment is required by the organisation considering its adoption. "FLOSS tools can provide considerable cost savings over proprietary tools. However, FLOSS is neither free to use, nor to create, nor to maintain. "The risks to sustainability of this network of resources must be assessed to determine what it will cost to keep them viable" (Morrissey 2010, p.211). As explained, any piece of software is linked to the cost of using it, such as maintenance and support cost, training, and implementation cost among others, all of this besides to the creating and development cost. However, one of the "freedoms attributed to FOSS is freedom from the costs of vendor lock-in" (Morrissey 2010, p.214). Although less critical, additional costs can also be attributed to license evaluation and compliance. "The Open Source Initiative provides a list of 65 licenses they have approved via their License Review process" (Morrissey 2010, p.215).

Other authors, Macredie and Mijinyawa (2011), have stated in their research that through the adoption of FLOSS, companies can to some degree, achieve notable economic benefits, as royalty-free licenses emphasise the commercial attractiveness to decision makers. Macredie & Mijinyawa (2011) also mentioned that for those organisations who have already adopted this technology, in the long term FLOSS will be an adequate candidate for multiple-and large-scale installations. As one of the outcomes of their research declares, "cost advantages generally occur when one needs to deploy many copies of a piece of software and the pricing structure of the

closed-source competition is not really good for that particular application" (Macredie & Mijinyawa 2011, p.244).

Free/Libre and Open Source Software presents a variety of cost advantages compared with commercial software. Nonetheless, organisations are advised to mitigate the hidden costs that FLOSS adoption might create. Allen and Geller (2012) look at three main elements that managements are required to observe when assessing the attractiveness of going to open source: budgetary, licensing and project scope. The first element refers to the indirect costs of it, such as development, technical support, and maintenance; the last two elements indicate the different restrictions software licenses place on the use of the selected application and how these affect projects, such as customisations or further development (Allen & Geller 2012).

Pruett and Choi (2013) argue that qualitative and quantitative economic studies of FLOSS support the adoption of open source. They also acknowledge open source software as an enabler to technological growth in developing countries. However, Ven et al. (2008) cited by Pruett and Choi (2013) discuss some barriers to the adoption, such as total cost, software maturity, and technical support. The most relevant point of contention raised is that the total cost of ownership, and the factors relevant to the adoption such as training and data migration, are difficult to measure.

Concurring with some of the above authors' ideas and findings, Rubens (2013) mentions the benefits of using open source software in the organisation. Moreover, he makes the point that if one pays a subscription fee for the product (some software houses build a commercial wrap around the open source code) an additional layer of attractiveness to the adoption of FLOSS is provided: "By paying a subscription you get the same experience as you do with proprietary software, only for far less money" (Rubens 2013).

Goode (2014) suggests that companies should adopt a more pragmatic approach when selecting software for the organisation. It is argued that, given that most FLOSS is not "resource hungry" (meaning that it requires excessive hardware specification to run – or not), organisations could also reduce their hardware costs or alternatively,

costs saved on software could be used to enhance hardware. An example would be the implementation of Linux, as it can be executed and effectively run on existing and old hardware (Goode 2014). Traditional commercial software houses release frequent upgrades or new versions of their products, as part of a long term revenue strategy, whereas open source software communities intend to improve the software quality by adding worthy contributions its source code, so that it reflects the users' real needs. In his research the author mentions that commercial software is used in the organisation being investigated only under exclusive situations, as latest products should be adopted only if they provide tangible benefits (Goode 2014).

When evaluating software adoption, Goode (2014) refers that firms have adopted financial methods in order to appraise the software acquisition process, such as NPV and IRR. As a result, organisations have been able to identify that firms using FLOSS "expend less on initially acquiring their software than firms that only use closed-source software products" (Goode 2014, p.71). However, although cost appeared to be an attractive option, it is not the only factor that decision makers should make use of when looking at FLOSS adoption. Finally, the author suggests that it is worth investigating how the organisation engages with the development community, as such a relationship will determine the future releases, as well as technical support to assist the end user.

2.3.3 Security, Risk, and Reliability

As previously discussed, FLOSS permits users and companies to access its source code, allowing organisations using or planning to use OSS to assess how the software has been built by analysing its code. Hoepman and Jacobs (2007) contend that open source plays an important role when building secure systems. Their main argument is that: "opening the source allows an independent assessment of the exposure of a system and the risk associated with using the system makes patching bugs easier and more likely and forces software developers to spend more effort on the quality of their code" (Hoepman & Jacobs 2007).

While some companies have saved up to USD 13 million annually due to migrations from commercial software to open source (Greenemeier 2005), the author argues that

companies adopting open source are exposed to high levels of risk, as: “the most popular open source projects are the product of thousands of contributors world wide” (Greenemeier 2005, p.42). Lastly, he makes the point that without access to qualified help, a company might lose the cost advantages that make OSS such an attractive option (Greenemeier 2005, p.44).

Kenwood (2001) raises his concerns around risk of fragmentation, phenomena that take place when different authors and IP holders are segregated throughout the world, as they belong to a virtual community of developers, instead of to structured organisations, as it is the case of commercial software houses. Nevertheless, despite the different risk aspects FLOSS adoption brings with it, Martens (2005) mentions that during 2005, owing to the fast growing open source utilisation across different institutions, three firms formed an organisation to offer open source software risk-mitigation consultancy services, and to provide insurance to those companies that wanted to embark on or already operating using this technology.

As mentioned in the short review, when considering risks associated to the adoption of OSS, Poba-Nzaou et al. (2014) highlights the importance of assessing the context in which the application will be adopted, taking into consideration the environmental and organisational context as well. In addition, contractual, financial and legal risks are also considered to be linked to relationship with partners, the capacity to pay for licensing fees, and the risk of losing competitive advantage as through the use of OSS companies might expose their IP (Poba-Nzaou et al. 2014).

Forge (2000) mentions that the open source software paradigm has been progressively developing since its origins, to the extent that it can be regarded as a new economic model, whereby cooperation is one of the main contributors to its success. Furthermore, Wang and Wang (2001) argue that, “for an OSS candidate to be considered operationally robust and highly reliable, it must have been operational in a large number of applications and its performance evaluated and reviewed, as well as for the most part, OSS is considered free in the sense that generally no or minimal costs (for example, shipping and handling) are involved” (Wang & Wang 2001, p.91). Amongst the main elements required to increase FLOSS’ robustness, three were

proposed by Wang and Wang (2001, p.91): open-standard compatibility, customisability and extensibility, and high reliability.

Researchers such as Zhao and Elbaum (2000) have studied the developmental quality control for open source software. Their research findings show that less than 20 percent of 200 FLOSS projects used software development test plans (Zhao & Elbaum 2000). In addition, these authors describe the differences, in the nature of product development and product testing between commercial software and open source software, as dramatic. While FLOSS relies on user criteria based on real-world needs as well as being limited to the features envisioned by the coders, commercial software is developed based on market trends and strategic targets defined by the software company in order to increase its revenues. Since quality is an essential component of the software life cycle, open source communities have started to adopt mechanisms to increase software quality such as making “documentation available, extremely modular code, rapid release cycles, and code review by people outside the project community” (Zhao & Elbaum 2000, p.33).

Authors such as Lee and Lee (2012) in their research refer to the open source software philosophy seeking to enhance the quality and reliability of software via peer reviews, as this is one of the principles of FLOSS (Lee & Lee 2012). It is also argued that open source implementation has to be addressed based on the merits of each business need, as well as to taking the following proposed threefold success factors that will assist with a FLOSS implementation into consideration: system quality at technical level; information quality at semantic level as well as use, user satisfaction, individual impact and organisational impact at the effectiveness level (Lee & Lee 2012).

With FLOSS being mainly supported by developer communities, managing quality across several groups demands effective approaches and commonality of objectives. It is relevant to draw attention to the fact that communities are the responsible entity for fixing software bugs (software errors), correcting weaknesses and vulnerabilities, as well as releasing updates and documentation relevant to such improvements (Goode 2014).

Poba-Nzaou et al. (2014) advise that to minimise the risk of adoption of FLOSS, organisations should explore the context in which the desired system is to be implemented; the environmental context, which includes elements such as industry type, external pressures and internal users, as well as examining the organisational context formed by company size, HR, organisation competences, and structure. The risks Poba-Nzaou et al. (2014) identifies in his research are of a technical, managerial, financial and legal nature. An example of being technical in nature would be the exposure to new technologies, while relationship with vendors is categorised as being of a managerial nature; financial capacity to pay licenses' fees is financial in nature whereas waiver of intellectual property rights is of a legal nature (Poba-Nzaou et al. 2014).

During 2004, when Oracle announced its bid to acquire PeopleSoft, a company that developed and provided HR Management Systems (HRMS) and Enterprise Performance Management (EPM) software amongst others (a direct competitor to SAP), it triggered Oracle's long-time partner, SAP, to start recommending MySQL database, an open source software, to its customers as an alternative to the Oracle database products (Mahony & Naughton 2004). In light of such an opportunity, and taking into consideration that software maintenance is one of the main pillars of risk elimination and reliability issues in software companies, as well as to provide an additional layer to the software offering, companies such as MySQL AB – today part of the Oracle Corporation – built a model called *dual licensing,* created in order to commercialise open-source software, whereby users requiring services or customisation of the software had to pay license fees for the utilised licenses (Mahony & Naughton 2004).

Although some authors argue that FLOSS is subject to errors, due to the high level of fragmentation across developers, Zhao and Elbaum (2000) believed that, "given enough eyes, all bugs are shallow, a stunning declaration that the software could become defect free" (Zhao & Elbaum 2000, p.54). Their research also mentions that FLOSS is easier to maintain, as the user has a greater influence on product direction, faster troubleshooting and bug fixes. Thus allowing organisations to use open source software for a range of situations from a few components to fully integrated enterprise

solutions. Lastly, these authors mention that by its open nature OSS enhances maintainability (Zhao & Elbaum 2000).

Most of the time software vendor lock-in can be seen as a risk, in that, not having the ability to choose between different suppliers, companies are exposed to the price determined by the vendor, leaving organisations without freedom to look for alternatives to suit their budget. Ven et al. (2008) argue that FLOSS is regularly adopted by companies wishing to eliminate or reduce vendor lock-in, so that they became less reliant on such vendors. Also worth mentioning is the caution that in most instances, switching vendors might attract substantial costs. Nevertheless, it is also argued that companies without previous experience, adopting FLOSS or lacking the necessary skills set within the organisation, choose to outsource the installation and maintenance of such solutions (Ven et al. 2008).

2.3.4 Maturity

According to Pauker (2000) in the last few years software development companies have adopted a hybrid model, by using open-source components that have already been developed, tested and debugged, and integrating them with their own intellectual property to develop new hybrid products (Pauker 2000).

Although, as mentioned in the short literature review, concerns about product quality and maturity due to the lack of monetary recompense have been raised, open source has reached impressive levels of usability on the World Wide Web (WWW), which comprises the software infrastructure supporting the internet software such Linux operating systems as well as, and Apache web servers. The mention to notion of exchanging trusted brand names, which are expensive, to the open source products will depend on readiness of people. Additionally, studies in the field of OSS has shown that the quality of open source components is some times greater than its commercial equivalent (Spirov 2007, cited in Pruett and Choi 2013, p. 436).

Open source use has gone well beyond infrastructure software onto the desktop and into specific applications in many different problematic domains. The business application layer has seen rapid growth with the availability of robust applications for

CRM, accounting, ERP, BI/KM, document management, content management, corporate email, PBXs, and Web 2.0. “Open source desktop environments and related end-user desktop applications have increased in both numbers and functionality” (Laplante et al. 2007, p.9).

Zhao and Elbaum (2000) mention that open source software’s unrestricted nature enhances software maintainability, which increases due to the various readiness standards available. Some examples of this are: the CapGemini’s Open Source Maturity Model (www.seriouslyopen.org); Navica’s Open Source Maturity Model (www.navicasoft.com/pages/osmm.htm) and The Business Readiness Rating (www.openbrr.com). They conclude that including FLOSS in the current utilised software will act as an enabler of software quality (Zhao & Elbaum 2000).

2.3.5 Adoption

Wang and Wang (2001) comment that there are many requirements to be considered when choosing a suitable software, whether or not the nominee is OSS or commercial, thus making the adoption of OSS a real challenge. They propose an evaluation framework to compare and analyse OSS in order to establish its suitability for the requirements of the company. It is also argued that personal motivation, organisational culture and age are some of the factors affecting the successful adoption of OSS in organisations (Spirov 2007, cited in Pruett & Choi 2013, p.436).

Forge (2006), cited in Pruett and Choi (2013, p.436), proposes open source as a solution for economic growth. Although the price is not the main variable, the author’s argument that unhappy customers of commercial software might look at OSS as an option was noted earlier. Whereas the lack of technical support is identified as the primary reason for rejecting OSS adoption, the economic factors have been found to make the organisations look at the benefits to be derived from such adoption, instead of evaluating their ability to adopt. Pruett and Choi (2013) proposes a threefold evaluation approach: “internal human capital, external human capital and community capital”. The latter refers to free support located primarily outside the institution, as opposed to purchased support (Goode 2005; Chau and Tam 1997; Li et al. 2005, cited in Pruett and Choi 2013, p.436-439).

Although Poba-Nzaou et al. (2014) point out that current studies regarding OSS adoption “are narrow and preliminary” (Poba-Nzaou et al. 2014, p. 478), their research concludes that one of the elements relevant to the adoption process is the internal and external knowledge of OSS, as well as the use of Diffusion of Innovation (DOI) theory to assess and explain the mission critical OSS adoption process (Poba-Nzaou et al. 2014, p.478).

Attention has been drawn by Paré et al. (2009, p.4-5) to the situation that some of the barriers present when adopting FLOSS, are lack of information and knowledge about open source software amongst IT managers; the absence of internal IT resources who have expertise of FLOSS; reliable information or documentation not available about open source products; the conservative nature of IT personnel; lack of responsible third party and hidden costs as well as a sense of exposure to risk.

Nagy et al. (2010) discuss five factors that act as barriers to the adoption of open source which would include knowledge barriers, legacy integration, sunk cost and technology immaturity (Nagy et al. 2010). Other authors propose a different set of factors that act as obstacles to FLOSS adoption, such as system interoperability and Microsoft-accustomed users (Hon et al. 2010).

When considering the company’s culture, Morrissey (2010) argues that success, when implementing FLOSS, varies considerably due to company cultural issues rather than for technical reasons (Morrissey 2010, p.215). He also indicates that it is necessary to secure a good relationship with the open source community responsible for application in use, as it is vital that good software support is provided (Morrissey 2010).

Allen and Geller (2012) propose that perception is an important factor in the adoption of open source software, such as the perceived freedom to deploy and experiment with FLOSS applications, as they are not subject to restrictions in the number of licenses or installations, thus permitting IT departments to increase their innovation drives, as well as deployment speed (Allen & Geller 2012).

2.3.6 Chapter Summary

From the above theoretical considerations it was possible to extract two main themes that assisted in understanding the matter under investigation. The first one refers to the financial elements of FLOSS, which can be better described as TCO. This theory highlights the importance of the time value of money as a means to evaluate the economic benefits of a new technology. The second theme is linked to the organisation's capabilities and its readiness to face change, through the assessment of intangible and tangible resources. These resources are associated with strategy implementation, in this case change, and the effect created by the company's culture.

Based on the literature review and the empirical evidence related to the range of benefits accompanying the implementation, adoption and evaluation of FLOSS, the following themes can be highlighted. The first is related to its economic aspects, since, as noted, FLOSS is not completely cost-free, and therefore an accurate TCO analysis will assist in determining whether or not its adoption is attractive. Security, Risk and Reliability, comprising the second theme, examine the technical viability and attractiveness of adoption, because some factors, such as lack of commercial-grade support and maintenance, can act as negative factors when undertaking such an initiative. The third and last theme is that of adoption or acceptance, which examines factors that are an enabler of FLOSS adoption, such as the company's culture, environmental factors and user perceptions.

Finally, it is worth citing Pruett and Choi (2013) that most of the times when companies assess open source software options they "tend to consider their ability to adopt rather than the benefits from adoption".

CHAPTER 3 - Research Design and Methodology

3.1 Introduction

The purpose of this research was to determine whether the adoption of FLOSS for non-mission critical applications at Corporate Office at XYZ Ltd. could contribute to the organisation's ability to reduce costs attributed to non-mission critical applications. Although it can be established that research has in the past been conducted in order

to assess cost factors related to mission critical applications, this research paper has concentrated specifically on the elements necessary for achieving cost reductions through the adoption of FLOSS in the organisation under study as well as on the different success factors that will allow the company to successfully achieve such an initiative. Different identifiers of design have been listed by Coldwell and Herbst (2004). These approaches assist in describing the type of strategy the researcher needs to take into account when developing the plan for the research project. They include: observation, interrogation/communication, exploratory, formalised, experimental, Ex post facto, descriptive, causal techniques as well as methodologies involving case studies, statistical studies in addition to field, laboratory and simulation data (Wiid & Diggines 2009; Coldwell & Herbst 2004).

3.2 Research Approach and Methodology

3.2.1 Research Approach

The research discussed up to this point has made use of two strategic approaches, descriptive and exploratory, as the subject under study benefitted by aspects provided by both styles. The first approach examined the answer to an ambiguous part of the problem linked to the second and third research objectives, whereas the second approach focused on the more defined part of the problem linked to the first and third research objectives. The ***Descriptive*** approach examined the problem from the personal points of view of the company's personnel in an attempt to answer questions such as *when*, *what*, and *who* with regard to the adoption of FLOSS and included their views on attractiveness, acceptance and viability, as these allowed the researcher to gain insight to what the company's employees feel about the subject under study. The ***Exploratory*** approach was necessary to develop a study that would lead to the development of a proposition based on the management model and actual findings, to answer questions relevant to how and what, thus helping to unravel and understand the existing literature supporting the body of knowledge (Coldwell & Herbst 2004; Wiid & Diggines 2009).

As suggested by Wiid and Diggines (2009), the research included the use of ***quantitative*** techniques and ***qualitative*** methods. In order to develop the study, this research made use of ***secondary data*** based on existing internal records that

explored the financial elements linked to non-mission critical applications purchased in recent years and ***primary data*** through the use of surveys to unravel the population trends and acceptance factors on the adoption of FLOSS.

3.2.2 Reliability and Validity

As previously stated, reliability refers to having a sample without errors or biases, in other words the data collected should be a trustworthy representation of the population. Reliability on the survey was achieved through the utilisation of different wording across questions aiming to examine the same answer. Therefore, by way of verification of the answers to similar questions, and based on answer repetition, the researcher was able to accomplish reliable outcomes. For illustration purposes, when a person answers the questionnaire, the results of only one question might mislead the findings, since there is not a method to ensure that respondents are being honest (Coldwell & Herbst 2004).

The concept of validity refers to being able to demonstrate that what is being measured by an instrument is that which is supposed to be measured. Validity is not possible without authentic data, since the evidence has to be consistent in order to be valid (Coldwell and Herbst, 2004). The elements below describe four known validity issues that were addressed in this research:

- Face validity is intended to ensure that measurement instruments, measure what they are supposed to (Coldwell & Herbst 2004, p.18). This was attained by using a combination of previously tested, utilised questionnaires concerning FLOSS, which were however adapted to suit the needs of this study.

- Content validity aims to illustrate the extent to which the items for a particular measuring instruments represent in full the area under study (Coldwell & Herbst 2004).

- Construct validity operates in terms of how well the items selected for the construct actually measure the construct itself. In other words it looks at how

well the factors that are included in a particular construct are supported by the available data (Coldwell & Herbst 2004).

- Criterion related validity. For the purpose of this research concurrent validity was used. This refers to the extent to which the measures taken by one instrument correlate with the measures taken at the same time by another instrument or measure of a given construct (Coldwell & Herbst 2004). This was achieved by assessing research where similar questionnaires have been used.

3.2.3 Primary Risk

The primary risks relevant to the ongoing research could be found in two main areas throughout the research. The first one relates to bias from the survey distribution, which was limited by using a non-probabilistic sampling method, specifically judgement sampling. The second primary risk, is related to unsatisfactory survey results, which were avoided with the help of the HR department, as the request for the selected employees to respond to the survey was issued through them.

3.2.4 Data Collecting Methods

For the purpose of this study the only method utilised in the collection of primary data was survey questionnaires. Such questionnaires were sent electronically, via a developed web based platform, to the selected individuals.

Secondary data were collected from existing documents, as historical and current information are essential to determine the associated costs for software licenses and maintenance.

3.2.5 Sampling

A representative sample means that the sample is capable to give an accurate picture of a larger population, where a sample is a group of observations taken from that population. Sample size is a characteristic of a sample that determines how representative the selected sample is of the population under study. The size will determine the accuracy of a survey, where the larger the sample size, the closer to

represent the population, therefore the more representative becomes. In essence, the use of a sample is to avoid using the entire population, which in most of the cases it is almost impossible, since the findings from the sample can be extrapolated to the entire population (Coldwell and Herbst 2004).

In this study, due to the topic being of such a technical and specific nature, a non-probability sampling was utilised, as sample elements were selected deliberately and subjectively; in other words, as mentioned, a "judgement sampling" (Wiid & Diggines 2009) was the chosen method. As the target population are all employees at Corporate Office, and the researcher had access to the entire population, the survey was sent just to a sample of 50 selected individuals which was sufficiently large to represent a total population of 250 employees.

3.2.6 Ethical considerations on the study

As mentioned by Coldwell and Herbst (2004), the areas of concern, in order to avoid ethical issues, are listed below:

- Privacy
- Confidentiality
- Professionalism.

3.2.7 Data analysis and measurement

The study aimed to identify trends, the use of percentages and possible correlations (Coldwell & Herbst 2004), across the different elements allocated on the survey questionnaire. It was expected that the findings would assist in determining the factors that contribute to the challenges of adoption of FLOSS at XYZ Ltd.

3.3 Summary

The importance of the information generated through the methodology described above was key to the success of this research, as the main topic under study has been partially researched while the knowledge gap related to non-mission critical

applications has been overlooked. The clarity and consistency of these results should prove to be useful and could potentially assist the organisation to secure a new and alternative set of tools that might harvest the benefits offered by FLOSS.

CHAPTER 4 - Data Analysis and Findings

4.1 Analysis and Findings of Theoretical Framework and Financial Data

4.1.1 Financial Theory and Data Analysis

Amongst the different economic factors assisting organisations and decision makers to choose between different projects or initiatives, as well as to measure the attractiveness of such options, one can find a set of financial apparatuses proposed in Financial theory (Firer et al. 2008) that are known as NPV, IRR, and Payback Period.

Based on this research's hypothesis concerning the reduction of cost of ownership of non-mission critical applications, it was fundamental to perform an assessment of what the current costs related to these type of applications are. It was also necessary that they were examined in a holistic and comprehensive way in order to provide a snapshot to understand the overall cost, and thus identify the economic factors that might act as leavers for cost reduction.

One way to determine the attractiveness of moving from commercially licensed software to FLOSS, is to assess the current cost that XYZ Ltd. Corporate Office incurs over one year, and forecast such expenditure for a 5 years period in order to have a concrete understanding of how the cash flows will look, to later compare them with those generated by a possible FLOSS alternative. However, it is imperative to highlight that the latter option will be used as a reference point so that allows the researcher to identify economic attractiveness, yet not necessarily a viable alternative.

When a company considers preparing a budget for software spend, there are three elements that need to be taken into account: license, maintenance and support cost. License cost makes reference to the fees paid to obtain the right to use the software, in most cases limiting the number of instances of use, whereas maintenance and

support cost is related to the fees paid to the vendor in order to receive basic support, also known as software assurance, should the software present defects, as well as the right to receive the latest software releases (upgrades and updates), these fees are paid per license, and is calculated as a percentage of the license fee, usually between 18% to 22%.

An exhaustive data analysis based on transactions recorded at Corporate Office during the 2014 year, was rendered through the investigation of more than 6000 purchasing transactions done in 2014 extracted from the company's ERP, by means of filtering and identifying those only relevant to software, such as software licenses, software maintenance and support and software subscriptions. This identified a group of 1440 transactions of a software nature, including some local to the Corporate Office, and others of global scope. Only those transactions relevant to Corporate Office were thoroughly reviewed so that non-mission critical applications could be identified and further examined. As a result, it was possible to identify 64 transactions, thus providing the following outcome:

- USD 71,815 new software licenses purchased during 2014
- USD 458,833 paid for software maintenance and support, as well as software subscription.

These two elements were identified in order to define a cost baseline to be forecast over a period of 5 years, as previously discussed. Also, it is important to note that for simplification reasons, software subscriptions were included in the maintenance and support cost. As far as this research is concerned, they were considered recurrent costs linked to software licenses.

Maintenance cost was calculated based on an average CPI escalation factor to calculate the future value of the recurrent software maintenance and support. Cash flows were calculated at the end of each year. In order to compare the current cost of commercial applications with the option to replace them by FLOSS, the following parameters were calculated, estimated and assumed:

- It was assumed that all identified non-mission critical applications had a FLOSS alternative
- Maintenance and support could be carried out by an insource or outsourced model, so that such resources would be able to provide the relevant services in order to render the maintenance and support tasks. Given the number of different applications to be supported, a total of 24, an estimate was made that two full time resource persons would suffice to perform the required tasks, one senior developer and one junior developer, with an annual cost to company equivalent to USD 53,950 and USD 35,967 respectively
- Transition cost was developed based on migration, implementation and training
- Maintenance already paid for in 2015 was equal to 2/3 of the full year maintenance cost
- The model does not make provision for additional licenses
- Weighted Average Cost of Capital (WACC) of 8.4% used in order to discount the cash flows and thus calculate NPV
- Due to the multi-country software sourcing, an average CPI was calculated equating to 1.034% and used to escalate annual costs of maintenance and support (see Appendix E).
- The current (at time of writing) South African CPI of 3.92% was used to escalate the services of support and maintenance to be internally rendered as an alternative to provide such services for FLOSS.

The following DCFs tables, Table 1 and Table 2, show the current situation forecast for the next four years, and the later comparison of the forecast costs, assuming a FLOSS adoption.

As may be observed, by comparing the NPV calculations, including the abovementioned parameters, the one related to FLOSS is 45.22% lower than the one calculated for its commercial equivalent, thus indicating it to be a more attractive option when comparing their associated costs in terms of today's value of money. In other words, FLOSS option's TCO for a period of 4 years is lower than the current TCO to which the company is exposed.

Commercial Software	2014	2015	2016	2017	2018
Maintenance & Support 2014	$ -458,833	$ -463,579	$ -468,374	$ -473,218	$ -478,113
Software License	$ -71,815				
Maintenance & Support 2015		$ -14,512	$ -14,662	$ -14,813	$ -14,967
Total	$ -530,648	$ -478,090	$ -483,035	$ -488,032	$ -493,080
PV		$ -443,498	$ -415,663	$ -389,576	$ -365,125
NPV		**$ -1,613,862**			

Table 1 NPV Commercial Software

FLOSS	2014	2015	2016	2017	2018
Commercial Maintenance & Support	$ -458,833	$ -159,363			
In/Outsource Maintenance & Support		$ -89,917	$ -90,847	$ -91,786	$ -92,736
Software License	$ -71,815				
Transition Cost		$ -318,727	$ -159,363		
Total	$ -530,648	$ -568,007	$ -250,210	$ -91,786	$ -92,736
PV		$ -526,908	$ -215,312	$ -73,269	$ -68,671
NPV		**$ -884,160**			

Table 2 NPV FLOSS

Additionally, the Payback Period method (see Table 3 below) was utilised in order to identify in which year the FLOSS related cash flows would become lower than those generated by its commercial equivalent, thus finding that although during the year 2015 the cost of FLOSS would be higher than the commercial software, in the year 2016 there is a turning point where FLOSS costs are lower, for the three following years. In Figure 5 it is possible to see the two projects' cash flow behaviours, and the reduction in cost starting at the end of the year 2015, purple trend line.

	2014	2015	2016	2017	2018
Annual Difference	0.00%	-18.81%	48.20%	81.19%	81.19%

Table 3 Payback Period

Figure 5 Commercial V/S FLOSS Compared

4.1.2 Resource-based view

As previously discussed, Grant (2010) explains that the RBV model looks into the capabilities within a company as sources for competitive advantage and proposes that by transformation of its resources an organisation can develop competencies that will increase its competitive advantage. Considering a more detailed approach into a resource audit focused at XYZ Ltd. Corporate Office, on the two proposed relevant selected elements, intangible and human, it was possible to evaluate the underlying factors that could contribute towards organisational performance when a new technology or change in technology is to be implemented.

Table 4, below, summarises the most relevant elements at XYZ Ltd., captured by observations that could be used to help in understanding the current status of the different factors forming part of the intangible and human resources.

Type of resource	Factors
Intangible	Centralised IT skills IT Department, Centrally managed systems, policies, and standards Interconnected systems New shaping culture
Human	Understanding of technology Skill sets Know-how Technical savvy Communication tools

Table 4 Resource Audit

Firstly, looking at the ***intangible*** resources and exploring the capabilities relevant to FLOSS technology adoption, it is important to mention that the company has developed an internal centre of excellence under the IT department, located at Corporate Office, formed by qualified professionals in the different branches of the ICT space, such as software applications, network architecture, cyber security, and business relationships amongst others. The strength created by this centralised group of professionals and the knowledge they share supports the organisation in making informed decisions and coordinating technological changes, thus creating a capability pillar for evaluating technology; therefore, they are able to successfully implement changes regarding the ICT initiatives.

On the one hand, from a cultural perspective it can be said that culture at the company is segregated and diverse, giving place for the establishment of different sub-cultures across departments. However, due to the changes the company has gone through; different departments have established ***their own ways of doing things***, which in some instances are contrary to the company's established strategy. Then again, because some of the main changes the company experienced were retrenchments, restructuring and cost reduction initiatives, these diverse and not yet completely rooted behaviours present an opportunity to shape people's beliefs and use these to the company's advantage if the adoption of FLOSS is found to attractive. This element plays an essential role in effective change implementation, and if not properly addressed could lead to failure when considering the adoption of FLOSS.

Secondly, based on the ***human*** element as a source for competitive advantage from the RBV model, after investigation and observation, it was found that over the last two years the company has developed capabilities that allow it to successfully implement different types of technological changes, as shown by the recent implementation of a globally implemented ERP system. These capabilities can be identified as know-how, a required skills set to face technological changes and understanding of technology, which can be extrapolated to the implementation of open source software in the organisation.

Finally, linked to the last resource analysed, was the communication factor. With the recent series of events and awareness of change that has been created, the

organisation has developed different mechanisms for communication across the business, such as monthly status reports on change progress sent to the business, high levels of engagement with employees from the company's executives driving the change and internally distributed brochures explaining the need for change, and the aspects to enable it, amongst other methods. These communication mechanisms have assisted XYZ Ltd. to face the required changes in order to adapt to new market conditions and demands in a rapid and successful manner. On this basis, it is possible to observe that the organisation has defined a set of effective channels that allows it to successfully implement strategic change and therefore has a platform to drive technological change.

4.1.3 Cultural web

The development of a cultural audit of the company under study, based on the Cultural Web model, helps to highlights the different aspects of the company's culture that need to be addressed in order to achieve the desired change. Table 5, below, lists the most relevant elements that XYZ Ltd. should take into consideration when planning to implement change.

Paradigm	Major gold producer in the world, attitude of "we have resources". This exposes the attitude behind an above average expenditure associated with the non-mission critical applications, which has been inherited from the last two years while gold was traded at a high price. This allowed individuals to purchase software based on their likes and dislikes instead of using a holistic approach, based on economic and sustainable drivers.
Power structures	Board of directors and CEO have the highest decision making power, and employees listen to and most of the time support their decisions. Discomfort created between various business units and Commercial and Finance departments, as the latter questions all transactions regarding software purchasing in order to enhance controls, and reduce unnecessary spend. Some top level managers believe they have authority over all departments.
Organisational structure	Well defined reporting lines. All departments have their own Vice-President. Top-down decision making. Previously, some departments had high levels of freedom for expenditure.
Control systems	Going through a transition period from a low level of cost controls, to a highly controlled environment. Relying on new systems and control mechanisms.

	Time sheet systems for shared services provided by hubs, in order to recover costs.
Rituals and Routines	Hire consultants to perform the work you do not know how to do. If there is not a planned budget, apply for it, it will be approved. Different departments act reactively to new business needs, thus requesting projects, purchasing, payments to supplier, etc., as a matter of urgency.
Stories	IT department has created high levels of unnecessary expenditure and system implementations. Past wealth allowed for high levels of investment and growth. Previous CEO created strong links with government bodies. High expenditure across different departments increased corporate cost.
Symbolic	Expensive laptops and peripherals. The bigger the budget, the more important you are. Desk size according to level. Corporate colours and posters with the company's strategy in the main areas.

Table 5 Cultural Audit

It is important to highlight that one of XYZ Ltd.'s main objectives within its strategic pillars, and currently under implementation, comprises the cost reduction initiatives. By means of these pillars the organisation intends to identify key points that will allow it to reduce its currently high levels of expenditure, whether at a global or local scale.

From the latter, together with the above elements related to the current cultural environment, specifically concerning cost reduction, it was possible to observe a ***legacy issue*** from the previous cash-flush era, where large capital expenditure was appraised before approval and spend, small expenditure was not thoroughly questioned or scrutinised, allowing different business units or individuals with an available budget to buy software or applications whenever required, without following a consultation process in order to perform an assessment of requirement suitability, duplication with existing software, and future cost associated with software upgrades and training amongst others. However, currently, even although the company has gone through different cost reduction initiatives, such as educating employees to avoid unnecessary expenditure, employees still tend to look for personal preferences instead of a holistic approach when selecting and purchasing software under the non-mission critical category, thus confirming that these individuals still operate under an older mind-set.

In essence, the ***soft*** areas above described expose and explain the primary reasons for a behaviour that has brought the Corporate Office high levels of expenditure

associated with non-mission critical applications, mainly based on symbolic, ritualistic and routine factors: the more difficult areas to deal with, when change is required (Johnson 2004). However, the ***hard*** areas on the other hand present a set of tools to enable change, as they have lately been modified in order to assist the organisation in effectively implementing strategic transformation.

4.1.4 Force Field Analysis

Examining the main aspects driving this study, as described in Chapter 1, and also based on key points encountered while carrying out the literature review in Chapter 3, it was possible to list the pros and cons surrounding the adoption of FLOSS, and utilise a force field analysis to understand the main challenges the organisation will require to address in order to implement a change from commercial to open source software.

Software TCO reduction: refers to the different components associated with the cost of licenses, implement, maintain and support the software.

Avoiding vendor lock-in: is the ability of the company not to be dependent on a specific vendor, so that it can avoid premium prices due to a monopoly, exposure to adverse foreign currencies' exchange rates and lack of available resources in the market to obtain training or services, amongst others.

Financial flexibility: describes the level of freedom the organisation has regarding the liability commitments that it might raise from contracts binding the company to future payments, or financial penalties, should the organisation desire to terminate the relationship with a specific vendor, thus preventing the organisation from exiting without spending money.

Reduce the number of currently used applications: refers to the significance of the opportunity to reduce a currently existing large number of non-mission critical applications used by the organisation, by finding a standard solution available in the FLOSS universe as an option to shrink and standardise such a portfolio.

User acceptance: is directly linked to the level of approval from the end user towards the adoption of FLOSS. In essence, the end user determines the level of success for such adoption, as the main source of resistance to change in organisations conducting technological modifications is to be found in the employees affected by this.

Maintenance and support requirements: this factor makes reference to the ability to access the latest version of the software, as well as to receive assistance should the applications present problems. The latter includes bug fixing as well as the right to use a support platform, as provided by the majority of software vendors.

Compatibility with existing systems: refers to the capability of an adopted application to interchange its outputs with the systems it is intended to replace. This is so that all existing work, documents, files, and archives could be moved or migrated into the new application or that previously existing information can be accessed.

Security and reliability: looks to ensure that that any application entering the environment is secure, robust and stable, as well as free of security risks such as software backdoors, malicious code and any unpredictable behaviour that could expose the organisation to lose or leak information unexpectedly.

Driving Forces			**Restraining Forces**	
Software TCO reduction	5	*FLOSS adoption*	User acceptance	5
Avoid vendor lock-in	3		Need for Maintenance and Support	5
Financial flexibility	5		Compatibility with existing solutions	4
Reduction on the number of currently used applications	4		Security and reliability.	5
Total	17		Total	19

Table 6 Field Force Analysis of FLOSS Adoption

The above model suggests that one should focus effort mainly on exploring the factors relevant to user acceptance, security, and need for software maintenance and support. The latter two are fundamental and non-negotiable elements that require attention, should the organisation find FLOSS an option to replace one or more commercially licensed non-mission critical applications. However, the first identified element, user acceptance, although also important, can be addressed by looking at the cultural factor, as it is linked to the organisation's behaviour.

4.2 Analysis and Findings of Literature Review

4.2.1 Economic factors

One of the most attractive factors companies have found in Open Source Software, is the low cost or in some scenarios, zero-cost, when intending to deploy an Open Source application across the business. One key characteristic of FLOSS is its freedom of use, as mentioned earlier. However, this cost is only linked to the right to use the software, and not necessarily to the total cost of ownership associated with it as referred to by Forge (2000): support, maintenance, customisations, and implementation. Also, although not all but most Open Source Software does not offer paid support and maintenance, software companies have seen an opportunity in this market space by offering commercial-grade maintenance and support for FLOSS.

A few additional economic factors that should be taken into consideration when assessing FLOSS adoption are discussed by Nagy et al (2010), Ven et al (2008), and Morrissey (2010), including sunk cost, shifting or transition cost, and vendor lock-in. When proposing to replace commercial software by a FLOSS alternative, decision makers might encounter a barrier produced by the level of previously invested capital that will have to be written-off as a consequence of the replacement, also known as sunk cost. However, the complexity of this barrier will depend on how the organisation treats software in its balance sheets, CAPEX or OPEX. The other important factor to take into account when migrating from commercial to Open Source Software is the possible transition cost of moving from a current application to a new one, as this might generate costs associated with converting all existing work, documents, files and archives to the new software, as well as implementation, training and documentation costs. The last element referred to by the above authors is the vendor lock-in factor, which creates dependency and lack of freedom that can be attributed to premium prices due to monopoly, exposure to adverse foreign currencies exchange rate, and lack of available resources in the market to obtain training or services that can only be provided by a specific vendor.

Exploratory studies have discovered that through the adoption of FLOSS organisations can achieve cost reductions up to 60% of their current cost in commercially licensed software. Nonetheless, it is imperative to reiterate that one of

the main themes identified through the literature review is the fact that Free/Libre and Open Source Software is not totally cost-free, as there are associated costs in order to implement, migrate, maintain and support the software, either of internal or external origin (Kenwood 2001), as companies have to be able to provide assistance to their employees should they experience problems with an application supplied by the organisation. The assistance could be obtained through various channels, with its primary channel being the IT department in most organisations.

In addition to the aforementioned, it is also worth taking into consideration that some software companies have built their own products using Open Source Software, thus offering a non-free product, although at less expense than proprietary software and inclusive of maintenance and support.

It is important to emphasise that most of the authors in the literature reviewed highlight the importance of understanding the reasons behind the adoption of FLOSS and thus of thoroughly assessing all possible hidden costs, since elements such as maintainability and continuity, project scope, requirement for customisation, data migrations, and software maturity might be critical for the business operation. Therefore TCO could potentially exceed the cost of the commercial software to be replaced.

Lastly, one additional economic factor argued by Goode (2014) is that FLOSS is not resource intensive, which means that it can be installed, and executed in old hardware, without the need to upgrade the server or desktops in order to enable employees to enhance their user experience, thus creating an extra opportunity for cost reduction. Nevertheless, the associated risks of running old hardware could have a negative effect on the TCO in the long run, as old hardware will run out of warranties and it exhibits an increasing tendency to failure over time.

In summary, one can say that there are various economic benefits that can be obtained by the use of FLOSS within an organisation, from avoiding vendor lock-in to the reduction of cost of ownership for the use of a specific application, thus presenting an attractive case. However, it is relevant to highlight that the words Free or Open Source could be misleading if the decision maker is not familiar with such terms, as taking a

decision to go the “FLOSS route” without thoroughly assessing the economic impact to the business, not just in today's terms but with a long-term vision, could deteriorate damage and destroy existing values that have been built over time, could create problems for the future.

4.2.2 Security, Risk, and Reliability factors

On the one hand, it has been mentioned by various researchers that Open Source Software exposes companies to a high level of risk due to the multiple contributors to its code, as well as to the level of IP fragmentation and non-structure development process, to the extent that they may even lose control over their IP. Additionally, the openness of its code, could potentially create opportunities for exposure to vulnerabilities that can rapidly be exploited by *black hat hackers* who may thus gain unauthorised access to a company's confidential information, if not properly monitored. Lastly, non-technical factors regarding the business context, including industry type, company size, organisational competencies, and structures, where FLOSS is planned to be implemented, can potentially attract additional risks of a financial and legal nature.

On the other hand, Hoepman and Jacobs (2007) mention that accessing the source code in order to analyse how the software has been built, allows companies to create more secure systems given that, by being able to scrutinise how software has been developed from its code, they can run their independent assessments and ensure that the software is free of malicious code. Moreover, it encourages open source developers to produce error-free software. However, not having access to technical assistance, as opposed to commercial software assistance, generates an additional level of risk which could be seen as a negative factor that weakens the economic benefits of adopting FLOSS.

When discussing the level of reliability offered by FLOSS, different authors argue that Open Source Software is a highly reliable product, due to the multiple developers’ reviews as well as to its high level of transparency that allows for rapid fault finding and correction to its source code. Also, although researchers have found that only a low percentage of Open Source Software projects use product testing methodologies,

thus reducing the software quality, nowadays communities of FLOSS developers have commenced to rapidly adopt different mechanisms and methodologies that assist them in enhancing the quality of their products; amongst the most notable strategies are external peer reviews, well defined and standardised documentation and the use of open standards, such as XML, in order to enhance interoperability across different systems.

It is also worth noting that in order to overcome issues of reliability and security, so as to eliminate software vulnerabilities, fast patch development and rapid troubleshooting and bug fixes, Open Source Communities projects have implemented specialised communication channels in order to enable users to report, request and track software fixes, releases and improvements. Alternatively, some software houses, in order to provide an additional layer to their service offering, have created support programs to selected FLOSS projects, such as MySQL, Apache, and Libre Office amongst others.

4.2.3 Maturity

Maturity plays an important role when choosing an application, as this defines how good the quality of software or its components is. The perception that FLOSS is of low quality is largely related to the market's concept of value for money. Nonetheless, this premise has been disproved by the fact that more than 70% of Internet software infrastructure is supported by Open Source Software, therefore showing a higher level of maturity than some commercial software products.

However, it is important to highlight that the main reason for the preconceived idea of FLOSS being of low quality is due to factors such as a lack of trust in non-branded products, commercial software sales agents' negative messages about FLOSS and lack of marketing communications in order to promote Open Source. This exposes the underlying factor regarding people's readiness to accept alternatives to software they currently use.

Lastly, it is important to emphasise that with the fast development of the FLOSS offering, and commercial software utilising Open Source components as part of their products, since 2000 the Open Source communities have adopted various standards

and methodologies in order to support the software life cycle. An example is Navica's Open Source Maturity Model, thus increasing the software quality and maturity levels. As a consequence of this, it is possible today to find that some Open Source components are of equal or better quality than their commercial equivalent.

4.2.4 Adoption

The major organisational challenge when implementing change is considered to be people's adoption of new ways, methods, or systems as resistance to change can be the cause of failure of any change initiative, or more specifically FLOSS adoption.

In order to overcome the different barriers to the adoption of FLOSS in the organisation, Wang and Wang (2001) argue that age and organisational culture are factors that require special attention and understanding to achieve a successful adoption. As age is a factor that determines the willingness to accept change, with the younger generations being more adaptable to new software applications compared to more senior employees who are more reluctant to change, while culture determines the way things are done in the organisation, and can therefore be the main reason for implementation failure. Also, linked to organisational culture, it is important to understand future users' needs, likes, and dislikes when looking to introduce OSS, as the people factor is essential to the success in the adoption of new technology.

Another key element mentioned in the literature review was that in order to support FLOSS adoption in the organisation, identifying and securing sources to support and maintain the Open Source Software should be implemented. If this expertise does not exist within the organisation it will need to be obtained through the communities currently developing such applications. Consequently it is proposed that organisations intending to adopt FLOSS secure a good relationship with the open source community responsible for the application to be used.

Finally, it has been highlighted that knowledge about Free/Libre and Open Source Software plays a key role in the adoption process. It has been found, as indicated, that the lack of information and understanding of FLOSS from IT management, as well as the conservative nature of IT personnel together with fear of change and moving out

of their comfort zone, act as a strong barrier to the adoption process. Lastly, and worth noting, is the fact that users accustomed to Microsoft-like applications are also seen as a challenge and can potentially present resistance to change. On the other hand, the advantages of Open Source Software can also be perceived as an opportunity to test new technologies and increase the innovation drives, without the need of contracts, licenses, or engagement with vendors, this which eventually can ultimately act as an enabler factor to the adoption process.

4.3 Analysis and Findings of Research Data

The objective of the survey questionnaire used to retrieve information from Corporate Office at XYZ Ltd., was to explore and understand the underlying complexities associated with the adoption of FLOSS as an alternative for non-mission critical applications as well as assisting in the process of unravelling how employees perceive Open Source Software. This was achieved by utilising a set of closed questions through the use of an online survey developed for the purposes of this study (see Appendix A).

The survey was sent to a total sample of 50 individuals, selected from a population of approximately 250 employees. As explained previously, the selection was done using judgement sampling (Wiid & Diggines 2009), as the research is of a specific technical and economic nature; hence it was essential to aim at individuals with understanding in the technical, economic, or business space. Furthermore, in order to obtain a non-skewed set of results and to avoid clustered responses, the subjects were selected from different departments across the Corporate Office, including Supply Chain, Legal, IT, Internal Audit, Business Improvement, Finance, Capital Evaluation, and Marketing, amongst others. Additionally, within the selected departments three main groups of individuals were targeted: economic buyers, technical users and end users (see Appendix A).

The survey was strategically divided into two topic areas. The first one explored the level of knowledge and understanding that subjects have towards Open Source Software, whereas the second one focused on the three research hypotheses of this investigation: key factors that determine attractiveness, user acceptance factors and

viability factors. One important point to mention about the survey developed is the fact that it was prepared and configured to be responded to anonymously in order to avoid bias from the respondent and researcher. For this reason the first question was designed to determine the category under which the respondent was considered to belong: technical user, economic buyer or end user.

Once the questionnaires were returned and analysed, the different datasets were coded and categorised in order to extract the desired information. From a total of 50 targeted individuals, 30 completed the questionnaire, thus achieving a response rate of 60%.

The first dataset reveals the category distribution of the respondents, see Figure 6 below, indicating that 47% claim to have some level of IT technical knowledge, while 53% can be considered to be merely consumers of technology.

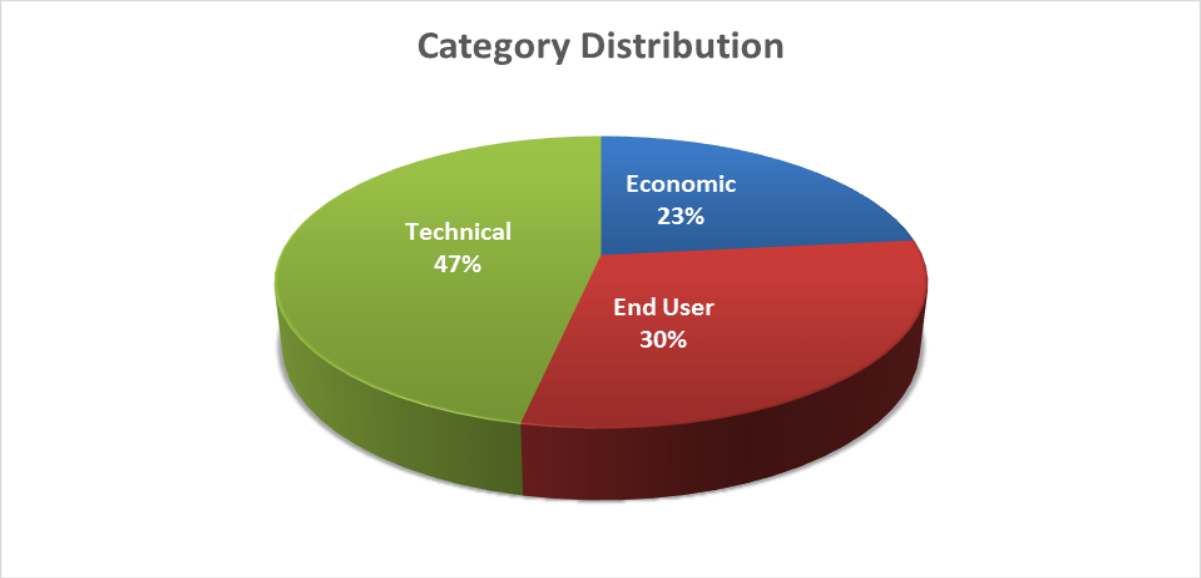


Figure 6 Respondents Distribution

The data analysis searching to measure the portion of samples knowing, or have some understanding of Open Source Software or FLOSS, as shown on Figure 7 below. Strongly indicates that only half of the subjects with technical background know something about the topic, the other half indicated not to know or understand it. Nevertheless, the study reveals that 50% of the subjects to some extent, understand

the matter under discussion, while the other 50% does not understand or do not know about it.

Additionally, based on the category distribution, one could have expected the portion of sample subjects understanding FLOSS to be part of the technical group in its totality. However, the information hereto displayed reveals that 50% of the subjects with some level of knowledge about FLOSS are part of the non-technical group.

It is worth noting that as the results regarding knowledge showed an exact split between respondents understanding or knowing about FLOSS, and those that do not. It was necessary to rectify the survey responses in order to ensure that no errors occurred in the data counting.

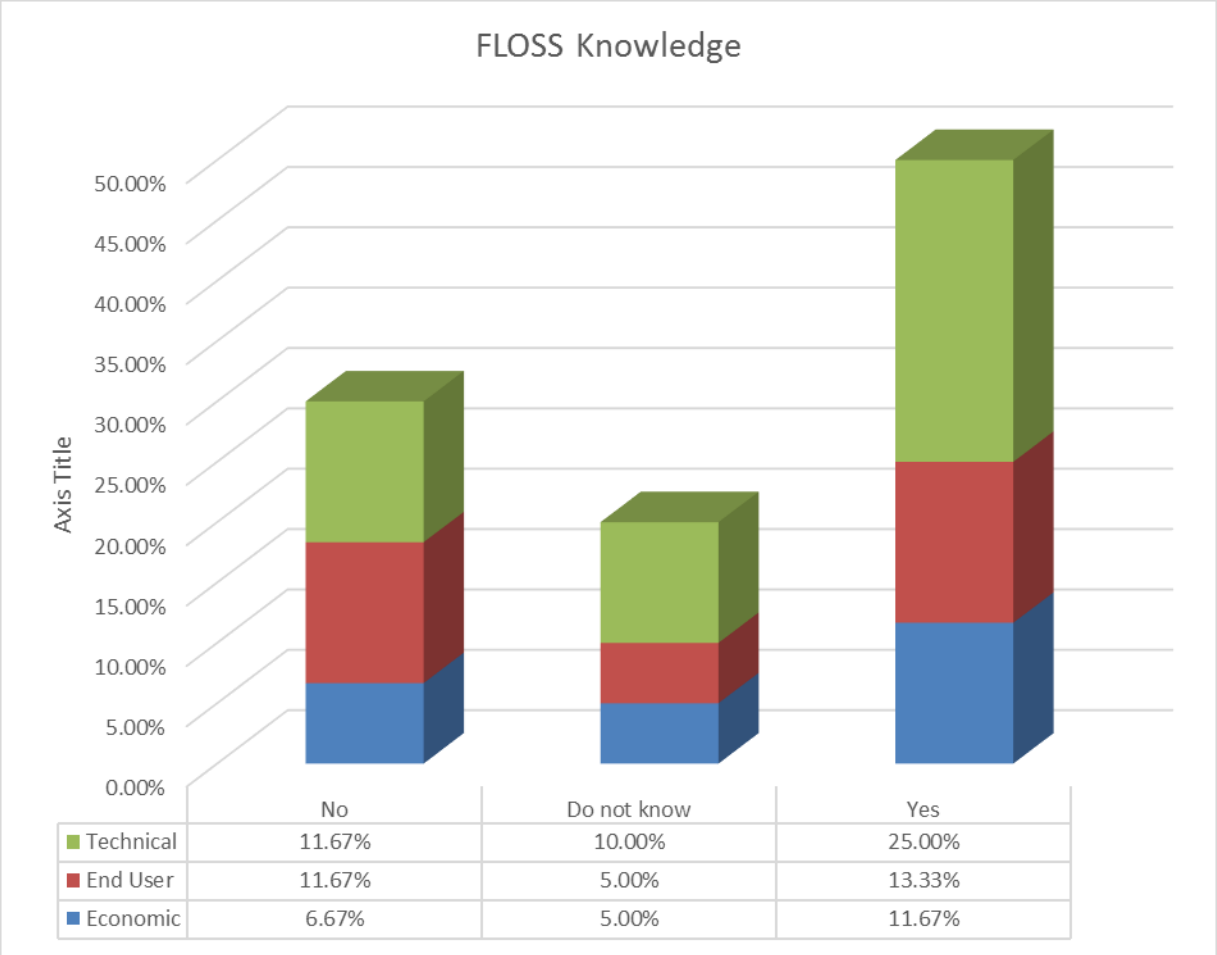


Figure 7 FLOSS Knowledge

The following section focuses on the perception which employees have towards FLOSS, through the use of a set of questions aimed at determining how the subjects behave under certain circumstances. The data set analysed here covers four main areas that allowed the researcher to form an idea of the key points determining attractiveness, viability, and acceptability in adopting FLOSS at the Corporate Office. The main areas covered by this section of the survey, target answers on how the following themes are perceived by the respondents, with the focus on a non-mission critical application of their choice:

- Economic benefits of FLOSS as a positive factor pro adoption
- Need for support when using a non-mission critical application
- Maturity level of Open Source Software
- Willingness to accept the change of a non-mission critical software.

In order to set the context for the set of questions below (Table 6), the respondents were given the following short instruction before commencing the questionnaire: *The following questions are based on your experience with any non-mission critical application you have used, or currently use within your organization. Please keep such application in mind when answering the rest of this survey.* Additionally, it is also relevant to mention that a brief definition of *non-mission critical application* was provided to the respondents through the survey introduction, as well as the communication sent via email (see Appendix A).

Group	Question	Disagree	Neutral	Agree
Economic Factors	If you find an Open Source Software alternative for a current application you use. How likely is it that you would consider such alternative to be adopted?	6	6	18
	Most of the Open Source Software available in the web is free of charge. Would you consider the adoption of open source software beneficial for the organisation?	7	4	19
	How likely is it that you would consider Open Source Software in order to avoid vendor lock-in?	4	9	17
	Would you consider Open Source Software as an option for cost reduction?	7	1	22
Likelihood to Seek for Support	Do you often report or provide feedback to software companies on their new releases, so that they can improve or fix their products?	15	5	10

	How likely will it be for you to report a software bug/issue to the software developer company?	10	6	14
	You frequently seek for support (example via email, telephonic, online) when using the non-mission critical application under discussion.	16	8	6
	If the application under discussion presents issues/bugs, how likely is that you will try and resolve such problem yourself?	15	7	8
Maturity Factors	Based on latest technology researches, more that 70% of the Internet runs on Open Source Software. Would you say that Open Source Software could be considered a reliable option for non-mission critical applications?	0	8	22
	Open Source Software can be seen as a low quality software compared with commercial software.	12	7	11
Acceptance Factors	You are presented with the opportunity of choosing between two applications that generate the same type results, both look similar, one is Open Source Software and the other is a known commercial package. How likely is it that you would consider to choose the Open Source Software option?	5	11	14
	You often browse Internet in order to access online tutorials or documentation so that you can learn how to use software.	9	2	19

Table 7 Coded Summaries of the OSS Survey Results

After consolidating and coding the results captured through the survey, a set of three main categories for analysis were prepared. Such classifications are explained and analysed as follows:

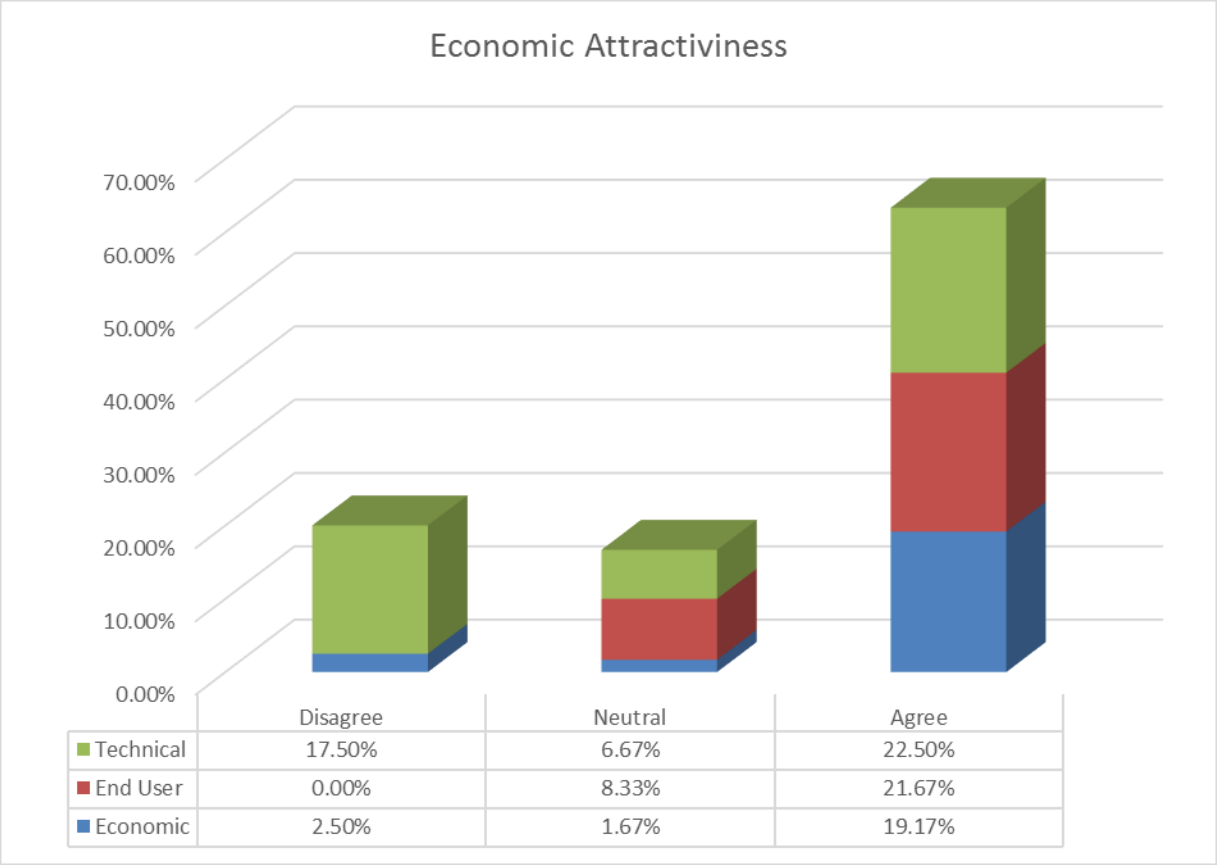


Figure 8 Economic Attractiveness

Economic attractiveness would be provided by replacing commercial licensed software with Free/Libre and Open Source Software. The results shown in Figure 8 indicate that a majority (a total of 63.3%) of employees perceive the option to adopt FLOSS, as an attractive alternative for cost reduction. This figure was uniformly distributed across the three categories of respondents. Twenty percent (20%) of the respondents, of which a majority possess technical knowledge, see this option as less attractive and possibly not as an option for cost reduction. This could be supported by factors such as respondents perceiving that there are associated shifting costs when migrating from one application to another, or simply looking at the different known risks associated with FLOSS. Lastly, it is possible to infer that end users and economic buyers are less concerned about possible transition costs, as they are mainly the budget controllers.

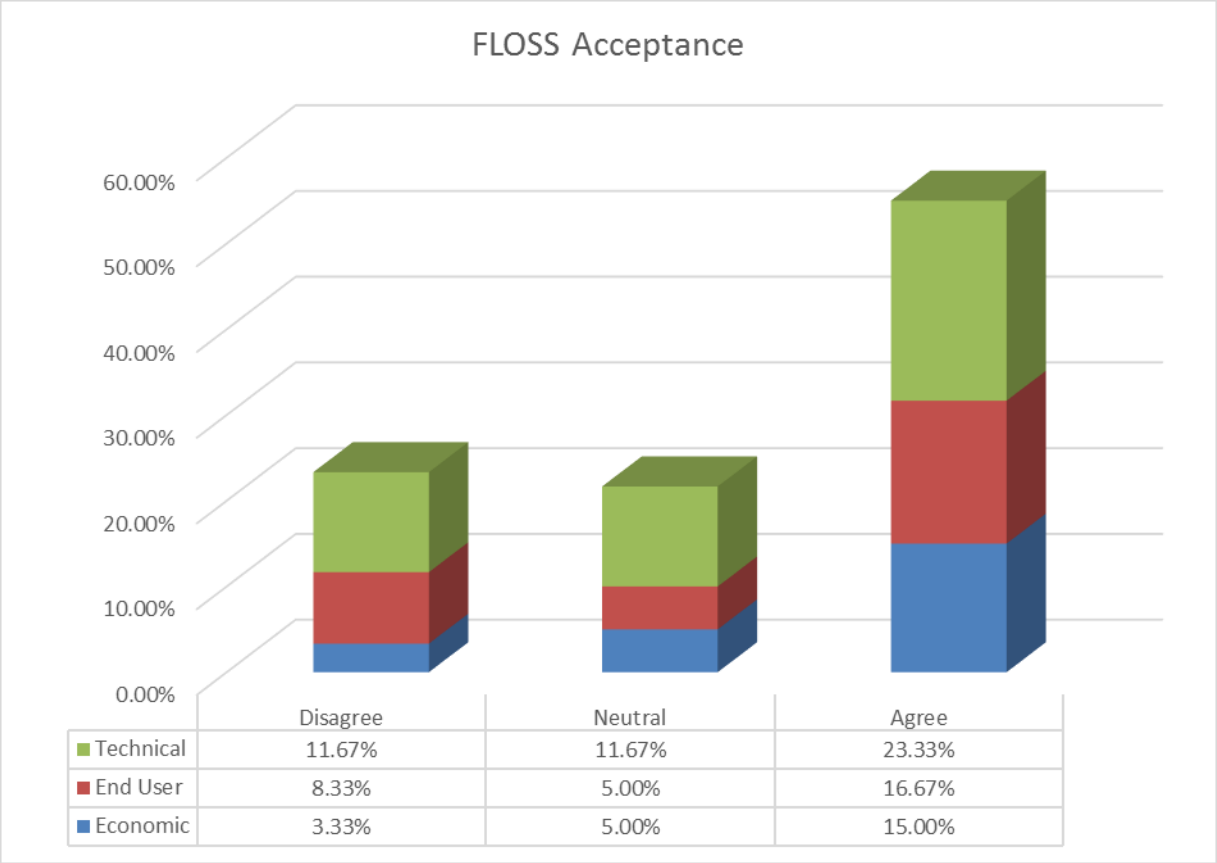


Figure 9 FLOSS Acceptance

The consolidated results, focused on the questions intended to assess acceptance of FLOSS adoption as displayed in Figure 9 above, recorded that more than half of the respondents (55%) would be willing to adopt FLOSS, as well as to adjust themselves to a new non-mission critical application, as an option to commercially licensed software. The other 23.3% might present resistance to the change, should the organisation decide to implement this FLOSS adoption, because they perceive the change as not suitable. Lastly, the additional 21.6% seem to be indifferent to the adoption, hence not presenting any positive or negative indication towards the adoption under discussion.

The last set of questions addresses the theme of viability of adoption, through the understanding of the need for support and level of perceived maturity regarding non-mission critical applications and FLOSS respectively. The first theme, (Figure 10), seeks to understand the associated risk and impact of not having commercial grade support available. The results clearly indicate that close to 41% of the respondents do not usually request support, nor look for information about the non-mission critical

application under discussion. However, the remainder of the respondents, 59%, can be perceived as the percentage of the population that will be affected by not having access to commercial grade support, thus creating a potential risk to the adoption of FLOSS.

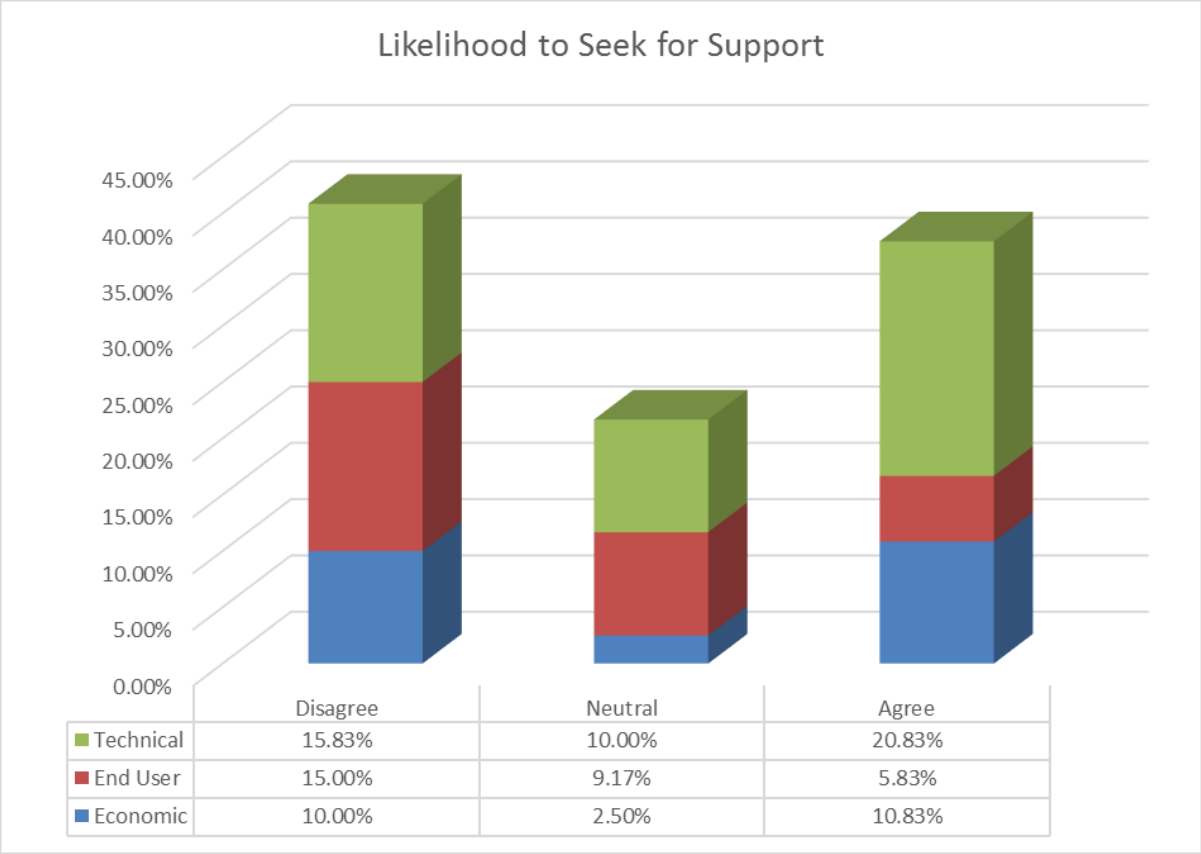


Figure 10 Likelihood to Seek for Support

The second theme, which seeks to understand the perceived maturity of FLOSS, as illustrated below in Figure 11, strongly indicates that more than 50% perceive Open Source Software to be acceptably mature while 18.3% perceive FLOSS as being not reliable or not mature-enough technology to be adopted by the organisation. However, it is important to highlight that a significant 25% is neutral in this position, which might be seen as lack of understanding or knowledge of FLOSS.

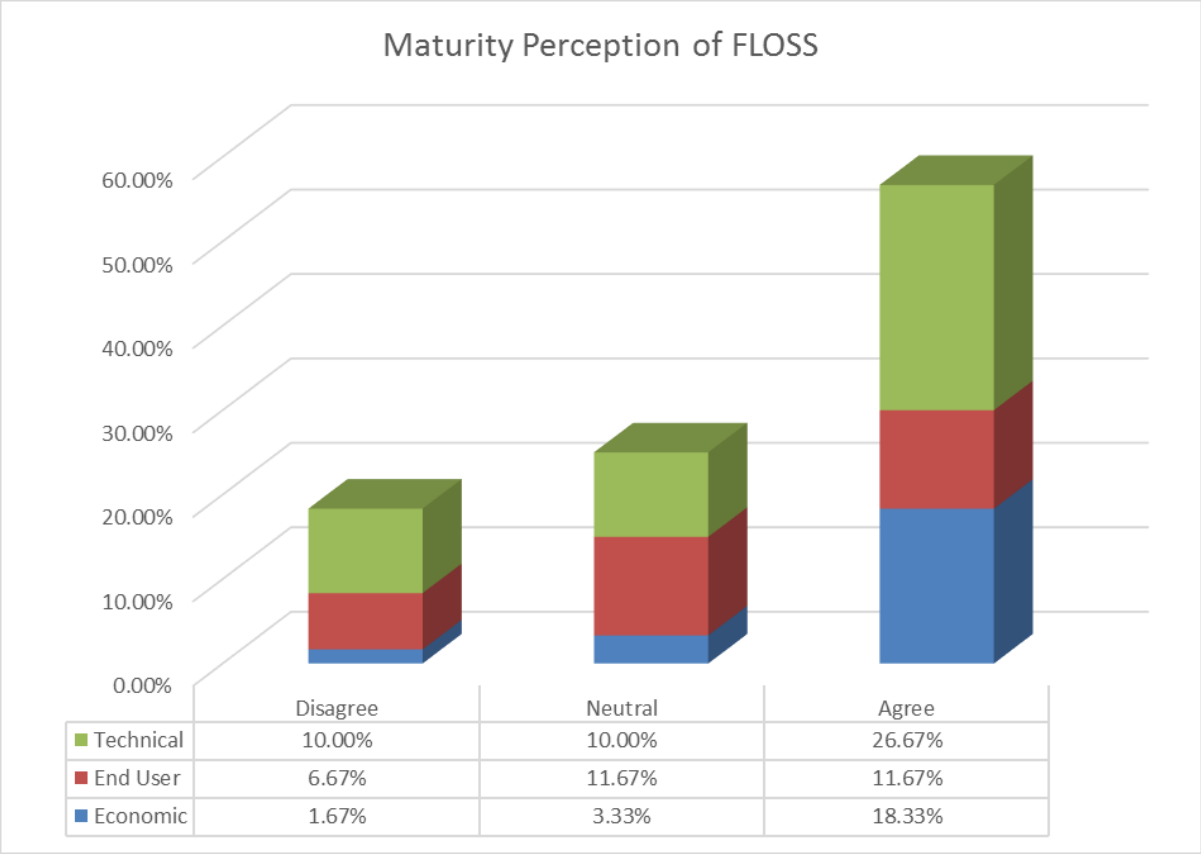


Figure 11 Perceived Maturity of FLOSS

In summary, looking at the above discussed results from a holistic perspective, this survey serves as a basis for generating an idea of how FLOSS adoption of a non-mission critical application could be perceived across the different departments at XYZ Ltd. Corporate Office, and of the associated possible barriers or risks to take into account when introducing such adoption. In conclusion, by selecting and regrouping the survey data with its focus just on those questions directly intended to answer perceived acceptance and benefits of FLOSS adoption, as shown in Figure 12, in orange, it is possible to observe that most of the respondents to the survey perceive the proposed adoption as favourable to the organisation.

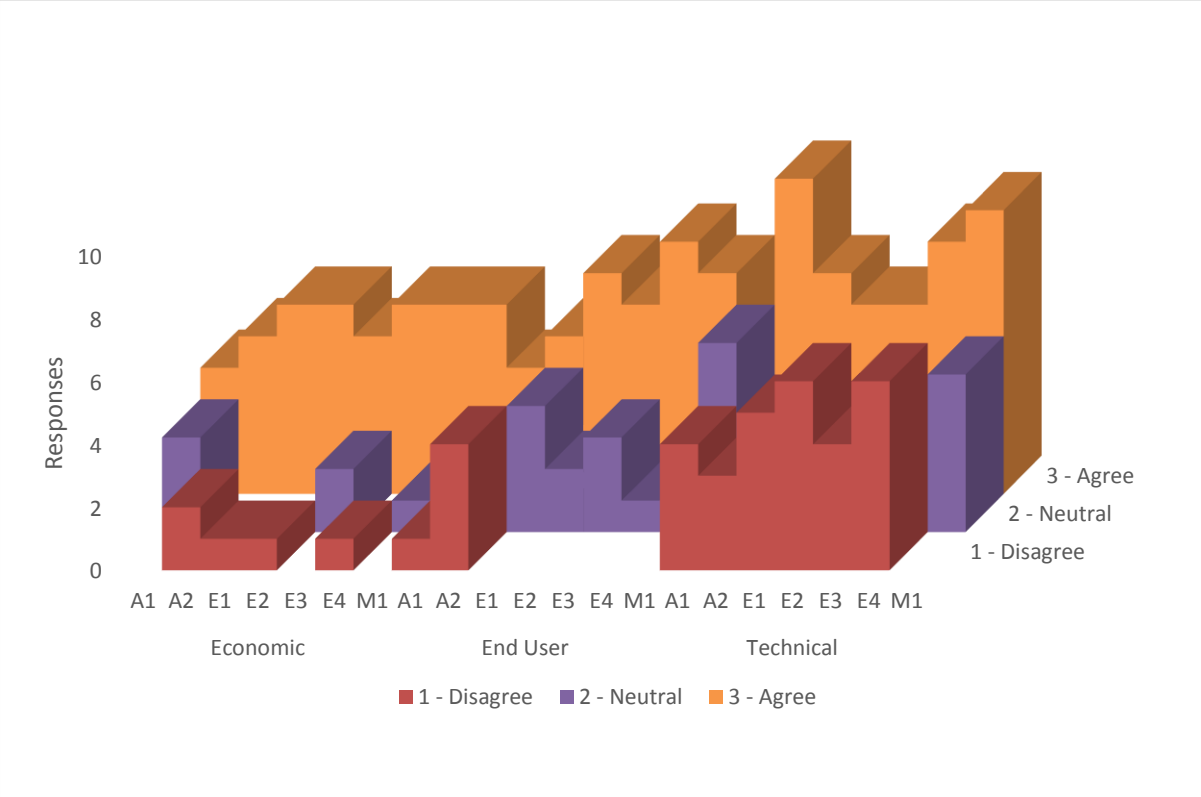


Figure 12 OSS Survey Holistic View

CHAPTER 5 - Conclusions and Recommendations

5.1 Introduction

This research investigated the different aspects that make Free/Libre and Open Source Software an attractive, acceptable and viable option for adoption in XYZ Ltd., as an alternative to commercially licensed, non-mission critical applications, so as to serve as a remedy to the identified high level of expenditure on the latter type of applications within the Corporate Office.

The research hypotheses were answered by the use of a threefold approach, in order to consistently and methodically unravel the various complexities beyond what is immediately evident. The first hypothesis was answered by the use of management theory, thus providing insight as to the underlying matters associated with the adoption of the FLOSS paradigm; the second hypothesis was answered by the use of a literature review to identify the different advances around the topic under study and the third hypothesis was answered by empirical research within XYZ Ltd.

5.1.1 Conclusions of the Theoretical Framework

The different theoretical frameworks utilised to understand FLOSS adoption helped to unravel the underlying complexities accompanying the adoption of open source as an alternative to commercial software. In this manner, the various analyses developed in this regard revealed a threefold set of themes that were used as foundations to respond the research hypothesises of this investigation: economic, cultural and change factors.

The ***economic*** factors, supported by the financial theory used to identify the attractiveness of FLOSS adoption, served to provide understanding of the benefits of moving from commercially licensed software to Free/Libre and Open Source Software, since the attractiveness of a project lies in its merits to generate positive cash flows or in this case, to reduce the negative cash flows. As calculated by the use of the NPV and Payback Period methods, moving from commercial software to FLOSS will unlock value only after the first year of commencing the transition. However, it will reduce expenditure by up to 45% in a period of 4 years of projected cash flows. Thus, from a financial perspective, it may be regarded as an attractive project to undertake.

With regard to the ***cultural*** factor, as established by Grant (2010), the human component is in fact what actually determines the success or failure of change implementation. As discovered through the use of different management models, such as the RBV resource audit and cultural web, the company has gone through several changes in a short period of time, due to various adverse market conditions, as discussed. In other words, XYZ has developed the capability to modify its culture in order to adjust the majority of its employee's behaviours towards a cost conscious organisation. These changes have created a *mouldable culture*, which could be used as an advantage for the company when implementing FLOSS. In addition, as evident from the Field Force analysis, there is extra factor that needs to be taken into consideration for the FLOSS adoption process: *user acceptance* of a new application.

Concerning the ***change*** component, it was determined that the firm's main competitive advantage could be its readiness for change. Due to the nature of the business, the company cannot modify the market or the price of the metal. However, it can adapt its

internal resources in order to reduce costs, eliminate redundancies and adopt new technology. This study shows that XYZ's main competitive advantage lies in its capability to adapt to rapidly changing conditions, which acts as a core factor for strategy or change implementation. However, resistance to change is an unavoidable barrier and it has to be treated carefully, with its main elements having been identified through the cultural web as symbols and routines.

These two factors that have been pinpointed will need to be addressed in order for XYZ to adopt FLOSS. They concern the available budget being spent and if there are unplanned requirements beyond the budget, whether these are approved. These two elements are of relevance given that they are contrary to the financial attractiveness of the above findings. However, the nature of this situation is also intrinsically linked to the need of supporters to drive these initiatives within the different teams in the organisation.

5.1.2 Conclusions of the Literature Review

Free/Libre and Open Source Software is considered by most authors to be a viable option for ***cost reduction***, due to its freedom of use and low cost of ownership. Although in the short term it attracts hidden costs associated with maintenance and support, as well as shifting costs, in the long term it reduces TCO and frees the organisation from vendor lock-in. However, it is necessary to perform a thorough assessment of the economic impact on the business before commencing with the adoption process, as sunk and shifting costs need to be exhaustively evaluated and defined, as well as to understand the reasons behind adopting FLOSS.

Various authors have referred to elements of ***risks*** and ***maturity*** associated with the adoption of FLOSS when comparing it with commercially licensed software, such as the lack of maintenance and support provided by dedicated teams, SLAs, and its exposure to vulnerabilities due to the multiple contributors to its code. Nevertheless, the Open Source community has developed counter measures in order to overcome these issues, such as specialised communication channels in order to enable users to report, request, and track software fixes, releases, and improvements.

Fast development of the FLOSS offering, and of commercial software utilising Open Source components as part of the product, weakens the preconceived idea of FLOSS being a low quality product. Some of the main sources creating this type of perceptions can be attributed to a lack of trust in non-branded products, or commercial software sales agents speaking negatively about FLOSS, as their revenues are mainly based on license and maintenance fees. In addition, it is important to highlight that more than 70% of Internet software infrastructure is supported by Open Source Software.

When discussing the ***acceptance*** factor, several authors have mentioned that the key elements that could compromise adoption of FLOSS are the lack of information and understanding about FLOSS amongst IT departmental managers, the conservative nature of IT personnel, and lastly the fear to move out of their comfort zone experienced by people accustomed to a familiar software look and feel. It is also argued that people's age is a factor that determines the willingness to accept change: the younger they are, the more adaptable.

Lastly, identifying and linking the organisational culture to software adoption patterns, is an important factor to understand future users' needs, likes, and dislikes, as well as to be aware of how their business unit strategy and plans fit into the FLOSS adoption model. Consequently, it is essential to identify and secure sources to support and maintain Open Source Software in the organisation, so that end-user experience is not compromised.

5.1.3 Research Conclusions

There is a limited understanding of FLOSS across the technical teams. The study reveals that 50% of the subjects possess some level of knowledge of FLOSS, while the other 50% does not. Even though, to a large extent, FLOSS is perceived as an attractive option to adopt as alternative software to unlock cost reduction, it seems that employees with technical knowledge find this option less attractive, or not an option to do so. This paradox could be attributed to their understanding of the complexities linked to software support and maintenance in general, but not specifically to FLOSS.

The majority of employees will be willing to adopt FLOSS. However, the main resistance to change will come from employees with technical knowledge, as not having access to commercial grade support will create a risk for the organisation adopting FLOSS.

More than 50% of employees perceive Open Source Software to be acceptably mature. Furthermore, from a holistic perspective, most of the respondents to the survey perceive the proposed adoption as favourable to the organisation.

In general, it is evident that from a knowledge perspective, the organisation does not possess enough understanding of FLOSS; therefore some groups perceive such initiatives as risky, and of no value to the organisation.

5.2 Conclusions

In terms of the three hypotheses in the research objectives, it is possible to conclude that the success factors to enable FLOSS adoption are as follows:

Key factors that determine attractiveness when replacing commercial licensed software with FLOSS for non-mission critical applications:

- FLOSS adoption presents an attractive business case, and it has been demonstrated to bring financial sustainable benefits to the organisation.

- Adopting open source software lowers the cost of the project and positively increases the NPV of a project. It also helps to reduce negative cash flows by lowering the up-front investment costs (shifting capital expenses to operating expenses) and lowers the barriers to actually kicking-off the revenue generating projects.

- The increase in project portfolio value results in higher profitability and provides the Economic Buyers with the ability to invest funds in additional projects and growth for the organisations.

- Hidden cost of operations can be reduced and monitored better with FLOSS than with commercially licensed software.

User acceptance factors the company needs to take into consideration to successfully implement FLOSS:

- The opportunity created by shaping a culture, discussed in the theoretical analysis, could be seized by changing behaviour towards FLOSS, as the main benefit of adopting such type of applications is economic in nature.

- The integration of the various elements proposed by the above findings, into one model, can be used to understand how adaptable the organisation will be in order to overcome barriers to change created by the adoption of FLOSS.

- Although the company is partially prepared for change, there are several aspects that could potentially slowdown the change implementation, such as the lack of commitment and understanding of the need for change from the heads of some departments in the present study.

- FLOSS adoption requires one to prepare technical teams to support it, and to learn to utilise the community based support.

Viability factors that will influence the IT department to adopt FLOSS for non-mission critical applications:

- The findings yield results of potential savings, and further investigation into identifying which applications are available under the FLOSS category. Hence current applications could be replaced, based on the factors described above.

In summary, on the one hand, although FLOSS adoption for non-mission critical applications has been proven to be an economically attractive option, knowledge about Open Source Software as well as the different methodologies behind its development, have to be explored and learned by the technical teams, as they are a key component for successful adoption and will eventually be responsible to support

and maintain such applications. On the other hand, support for end users and economic buyers needs to be made available, as if they are not provided with it, there is a potential risk of failure in the proposed implementation.

5.3 Recommendations

Based on the findings and conclusions of this research paper, the following recommendations are presented for consideration:

- Develop an implementation plan for FLOSS adoption at Corporate Office, through the use of a pilot project, selecting one or two non-mission critical applications as candidates for adoption in order to empirically validate the benefits of FLOSS. This plan should include three strategic points to be mitigated: cost, risk, and resistance to change.

- Technical teams need to explore, study and understand the pros and cons of the available FLOSS options for non-mission critical applications, in order to analyse the various unknown risks that Open Source Software might attract, and develop an action plan to address them, so that the economic benefits of adopting FLOSS could be unlocked.

- Investigate the OSS development methodology in order to identify how this process could be used to identify the strategic levers that will allow the organisation to know *how and when* to liaise with the community of Open Source Software developers. This will help to establish the necessary communication channels to obtain software support from the said community, influence the future of the software development, as well as to be informed of any plans that could disrupt the availability of non-mission critical FLOSS applications used within the organisation.

- Conduct a comprehensive analysis of the non-mission critical applications desired to be replaced by Open Source Software, in order to identify the technical aspects that will confirm FLOSS as a suitable candidate for adoption of the selected group of applications. In order to develop a holistic understanding of this option, as well as to increase the support from the

business, such an exercise needs to be performed in consultation with end-user and economic buyers.

- Lastly, as a further recommendation, it will be beneficial for the organisation to establish a graduated development programme in order to grow young ICT professionals in the Open Source Software methodologies, and at the same time use their skills set as internal resources to support FLOSS within the organisation.

References

Abdelkafi, N., Blecker, T. & Raasch, C., 2009. From open source in the digital to the physical world: a smooth transfer? *Management Decision*, 47(10), pp.1610–1632. Available at: http://www.emeraldinsight.com/doi/abs/10.1108/00251740911004718 [Accessed May 16, 2015].

Aberdour, M., 2007. Achieving Quality in Open Source Software. *IEEE Computer Society*, 7.

Allen, J.P. & Geller, D., 2012. Open source deployment in local government: Rapid innovation as an occasion for revitalizing organizational IT. *Information Technology & People*, 25(2), pp.136–155. Available at: http://www.emeraldinsight.com/doi/abs/10.1108/09593841211232631 [Accessed May 17, 2015].

Ayala, C. et al., 2011. Five Facts on the Adoption of Open Source Software. *IEEE Software*, 11.

Bakhru, A. & Gleadle, P., 2010. *B820 Strategy, Unit 3, Competing with capabilities*, Milton Keynes: Open University.

Balas, J., 2004. Considering Open Source Software. *ProQuest Computing*, 24(8).

Benlian, A., 2011. Is traditional, open-source, or on-demand first choice? Developing an AHP-based framework for the comparison of different software models in office suites selection. *European Journal of Information Systems*, 20.

Boojihawon, K., 2010. *Unit 6 - Strategic Implementation: Structure, Systems, Culture and Change*, Milton Keynes: Open University Business School.

Brydon, M. & Vining, A., 2008. Adoption, Improvement, and Disruption: Predicting the Impact of Open Source Applications in Enterprise Software Markets. *Journal of Database Management*, 19(2).

BusinessDictionary.com, 2015. What is mission critical? definition and meaning. *BusinessDictionary.com*. Available at: http://www.businessdictionary.com/definition/mission-critical.html [Accessed February 28, 2015].

Cameron, S., 2010a. Session 2. In *Block 2 - The Practice of Management*. Open University Business School.

Cameron, S., 2010b. Session 7. In *Block 2 - The Practice of Management*. Open University Business School.

Chan, J. & Husted, K., 2010. Dual Allegiance and Knowledge Sharing in Open Source Software Firms: DUAL ALLEGIANCE AND KNOWLEDGE SHARING IN OPEN SOURCE SOFTWARE FIRMS. *Creativity and Innovation Management*, 19(3),

pp.314–326. Available at: http://doi.wiley.com/10.1111/j.1467-8691.2010.00566.x [Accessed May 16, 2015].

Chuttur, M., 2009. Overview of the Technology Acceptance Model: Origins, Developments and Future Directions. *Sprouts: Working Papers on Information Systems*, 9(37). Available at: http://sprouts.aisnet.org/9-37 [Accessed December 1, 2014].

Coldwell, D. & Herbst, F.J., 2004. *Business research*, New York: Juta Academic.

Collet, S., 2011. OPEN SOURCE UNCHECKED. *Computerworld*, 45(9).

Connelly, M., 2014. Kurt Lewin's Force Field Analysis. *Chance Management Coach*. Available at: http://www.change-management-coach.com/force-field-analysis.html [Accessed November 12, 2014].

Crowston, K. & Scozzi, B., 2008. Bug Fixing Practices within Free/Libre Open Source Software Development Teams. *Journal of Database Management,*, 19(2).

Curtis, P., 2011. *Maintaining Mission Critical Systems in a 24/7 Environment* 2nd ed., John Wiley & Sons, Inc.

Davis, 1993. User acceptance of information technology: system characteristics, user perceptions and behavioral impacts. *International Journal Man-Machine Studies*, 38.

Dictionary.com, 2015. open source. *The American Heritage® Science Dictionary*. Available at: http://dictionary.reference.com/browse/open source [Accessed March 16, 2015].

Donnelly, F.P., 2010. Evaluating open source GIS for libraries. *Library Hi Tech*, 28(1), pp.131–151. Available at: http://www.emeraldinsight.com/doi/abs/10.1108/07378831011026742 [Accessed December 1, 2014].

Ebert, 2008. Open Source Software in Industry. *IEEE Computer Society*, (8).

Elliott, M.S. & Scacchi, W., 2008. Mobilization of software developers: the free software movement. *Information Technology & People*, 21(1), pp.4–33. Available at: http://www.emeraldinsight.com/doi/abs/10.1108/09593840810860315 [Accessed May 16, 2015].

Fenton-O'Creevy, M. et al., 2007. *B713 Fundamentals of Senior Management, Block 3 Improving performance*, Milton Keynes: Open University.

Firer, C. et al., 2008. *Fundamentals of Corporate Finance* 4th South African Edition., London: McGraw-Hill Education.

Fitzgerald, B. & Kenny, T., 2004. Developing an Information Systems Infrastructure with Open Source Software. *IEEE Computer Society*.

Forge, S., 2000. Open source: the economics of giving away stuff, and software as a political statement. *info*, 2(1), pp.5–7. Available at: http://www.emeraldinsight.com/doi/abs/10.1108/14636690010801267 [Accessed December 1, 2014].

Freeman, S., 2012. User freedom or user control?: The discursive struggle in choosing among Free/Libre Open Source tools in the Finnish public sector. *Information Technology & People*, 25(1), pp.103–128. Available at: http://www.emeraldinsight.com/doi/abs/10.1108/09593841211204362 [Accessed December 1, 2014].

FSF, 2015. What is free software? *GNU Project - Free Software Foundation*. Available at: https://www.gnu.org/philosophy/free-sw.html [Accessed February 28, 2015].

Goode, S., 2014. Exploring Organizational Information Sharing in Adopters and Non-Adopters of Open Source Software: Evidence from Six Case Studies: Information Sharing and Open Source Software. *Knowledge and Process Management*, 21(1), pp.78–89. Available at: http://doi.wiley.com/10.1002/kpm.1430 [Accessed February 23, 2015].

Grant, R., 2010. *Contemporary strategy analysis* 7th ed., Hoboken, NJ: John Wiley & Sons.

Greenemeier, L., 2005. Open Source Goes CORPORATE. *ProQuest Computing*, (1057).

Harvey, C., 2009. 101 Open Source Apps for Enterprises: Page 2 - Datamation. Available at: http://www.datamation.com/osrc/article.php/12068_3828671_2/101-Open-Source-Apps-for-Enterprises.htm [Accessed March 28, 2015].

Hecker, F., 1999. Setting up shop: The business of open-source software. *IEEE Software*, 16(1), pp.45–51. Available at: http://ieeexplore.ieee.org/lpdocs/epic03/wrapper.htm?arnumber=744568 [Accessed March 28, 2015].

Hoepman, J.-H. & Jacobs, B., 2007. Increased security through open source. *Communications of the ACM*, 50(1), pp.79–83. Available at: http://portal.acm.org/citation.cfm?doid=1188913.1188921 [Accessed December 10, 2014].

Hon, M.-W., Russell, G. & Welch, M., 2010. Open Source Software Considerations for Law Enforcement. *IT Professional*, 12(6), pp.18–23. Available at: http://ieeexplore.ieee.org/lpdocs/epic03/wrapper.htm?arnumber=5560623 [Accessed December 1, 2014].

IBM, 2006. Integrating Open Source into your business.

Iivari, N., 2009. “Constructing the users” in open source software development: An interpretive case study of user participation. *Information Technology & People*, 22(2), pp.132–156. Available at:

http://www.emeraldinsight.com/doi/abs/10.1108/09593840910962203 [Accessed May 16, 2015].

Investopedia, 2015. Mission Critical. *Investopedia*. Available at: http://www.investopedia.com/terms/m/missioncritical. asp [Accessed February 28, 2015].

Johnson, G., 2004. Managing Strategic Change: Staregy, Culture and Action. In *The strategy reader*.

Kenwood, C., 2001. A Business Case Study of Open Source Software.

Kerm, H., 2001. IT Infrastructure Support and Development Organization Structures for Supporting RAS. *informIT*. Available at: http://www.informit.com/articles/article.aspx?p=23460&seqNum=3 [Accessed February 28, 2015].

Kirby, S., 2000. Free to choose: the real power of Linux. *Library Hi Tech*, 18(1), pp.85–88. Available at: http://www.emeraldinsight.com/doi/abs/10.1108/07378830010314519 [Accessed March 28, 2015].

Laplante, P., Gold, A. & Costello, T., 2007. Open Source Software: Is It Worth Converting? *IT Professional*, 9(4), pp.28–33. Available at: http://ieeexplore.ieee.org/lpdocs/epic03/wrapper.htm?arnumber=4287372 [Accessed April 8, 2015].

Lee, S.M. & Lee, S., 2012b. Success factors of open-source enterprise information systems development. *Industrial Management & Data Systems*, 112(7), pp.1065–1084. Available at: http://www.emeraldinsight.com/doi/abs/10.1108/02635571211255023 [Accessed December 1, 2014].

Lerner, J. & Tirole, J., 2004. ECONOMIC PERSPECTIVES ON OPEN SOURCE. In *Advances in the Study of Entrepreneurship, Innovation & Economic Growth*. Bingley: Emerald (MCB UP), pp. 33–69. Available at: http://www.emeraldinsight.com/10.1016/S1048-4736(04)01502-4 [Accessed May 16, 2015].

Levi, S. & Woodard, A., 2004. Open Source Software: How to Use It and Control It in the Corporate Environment. *ProQuest Computing*, 8(21).

Lindman, J., Rossi, M. & Puustell, A., 2011. Matching Open Source Software Licenses with Corresponding Business Models. *IEEE Software*, (11).

Louw, L. & Venter, P., 2006. *Strategic Management: Winning in the Southern African Workplace*, Cape Town, South Africa: Oxford University Press.

Mabey, C., 2008. Session 10. In *Block 4 – Managing Projects and Change*. Open University Business School.

Macredie, R. & Mijinyawa, K., 2011. A theory-grounded framework of Open Source Software adoption in SMEs. *European Journal of Information Systems*, 20(2), pp.237–250. Available at: http://www.palgrave-journals.com/doifinder/10.1057/ejis.2010.60 [Accessed April 8, 2015].

Mahony, I. & Naughton, E., 2004. Open source software monetized: out of the bazaar and into big business. *The Computer & Internet Lawyer*, 21(10). Available at: http://go.galegroup.com/ps/i.do?id=GALE%7CA123322132&v=2.1&u=usa_itw&it=r&p=AONE&sw=w&asid=11f1a5e98f41983faebbcffbbf4036c2 [Accessed December 1, 2014].

Martens, C., 2005. Insurance comes to open source. *ProQuest Computing*, 22(44).

Martin, V., 2008c. Session 1/2/3/5. In *Block 4 – Managing Projects and Change*. Open University Business School.

McLaren, S., 2000. Linux: a viable alternative or desert mirage? *Library Hi Tech*, 18(1), pp.82–84. Available at: http://www.emeraldinsight.com/doi/abs/10.1108/07378830010314500 [Accessed March 28, 2015].

Mears, J., 2004. Open source products grab Corporate attention. *ProQuest Computing*, 21(42).

Messmer, E., 2013. Security of open source software again being scrutinized: Researchers discuss relative risks and potential remedies. *Network World Inc.* Available at: http://0search. proquest.com.oasis.unisa.ac.za/docview/1317443052? accountid=14648.

Miller, K.W., Voas, J. & Costello, T., 2010. Free and Open Source Software. *IT Professional*, 12(6), pp.14–16. Available at: http://ieeexplore.ieee.org/lpdocs/epic03/wrapper.htm?arnumber=5662568 [Accessed December 1, 2014].

Miscione, G. & Johnston, K., 2010. Free and Open Source Software in developing contexts: From open in principle to open in the consequences K. Kimppa, ed. *Journal of Information, Communication and Ethics in Society*, 8(1), pp.42–56. Available at: http://www.emeraldinsight.com/doi/abs/10.1108/14779961011024800 [Accessed December 1, 2014].

Morrissey, S., 2010. The economy of free and open source software in the preservation of digital artefacts. *Library Hi Tech*, 28(2), pp.211–223. Available at: http://www.emeraldinsight.com/doi/abs/10.1108/07378831011047622 [Accessed April 8, 2015].

Msweli-Mbanga, P., 2011. *Writing a research proposal: practical guidelines for business students*, Cape Town, South Africa: Juta.

Nagy, D., Yassin, A.M. & Bhattacherjee, A., 2010. Organizational adoption of open source software: barriers and remedies. *Communications of the ACM*, 53(3),

p.148. Available at: http://portal.acm.org/citation.cfm?doid=1666420.1666457 [Accessed April 8, 2015].

Norris, J., 2004. Mission-Critical Development with Open Source Software: Lessons Learned. *IEEE Software*, 4.

Oxford Dictionary, 2015. mission-critical. *Oxford Dictionary*. Available at: http://www.oxforddictionaries.com/definition/english/missioncritical [Accessed February 28, 2015].

Paré, G., Wybo, M.D. & Delannoy, C., 2009. Barriers to Open Source Software Adoption in Quebec's Health Care Organizations. *Journal of Medical Systems*, 33(1), pp.1–7. Available at: http://link.springer.com/10.1007/s10916-008-9158-4 [Accessed December 1, 2014].

Parkinson, A., 2007. Session 6. In *Block 2 – The Practice of Management*. Open University Business School.

Pauker, A., 2000. Combining open source and traditional software in a new hybrid model. *ProQuest Computing*, p.5.

Poba-Nzaou, P., Raymond, L. & Fabi, B., 2014. Risk of adopting mission-critical OSS applications: an interpretive case study. *International Journal of Operations & Production Management*, 34(4), pp.477–512. Available at: http://www.emeraldinsight.com/doi/abs/10.1108/IJOPM-03-2012-0117 [Accessed February 28, 2015].

Pruett, J. & Choi, N., 2013. A comparison between select open source and proprietary integrated library systems. *Library Hi Tech*, 31(3), pp.435–454. Available at: http://www.emeraldinsight.com/doi/abs/10.1108/LHT-01-2013-0003 [Accessed December 1, 2014].

Rajala, R., Westerlund, M. & Möller, K., 2012. Strategic flexibility in open innovation – designing business models for open source software I. Combe, ed. *European Journal of Marketing*, 46(10), pp.1368–1388. Available at: http://www.emeraldinsight.com/doi/abs/10.1108/03090561211248071 [Accessed December 1, 2014].

Rossi, B., Russo, B. & Succi, G., 2012. Adoption of free/libre open source software in public organizations: factors of impact. *Information Technology & People*, 25(2), pp.156–187. Available at: http://www.emeraldinsight.com/doi/abs/10.1108/09593841211232677 [Accessed May 17, 2015].

Rossi, B., Russo, B. & Succi, G., 2007. Evaluation of a Migration to Open Source Software. In *Handbook OF Research on OSS*.

Rubens, P., 2013. 6 Reasons to Pay for Open Source Software | CIO. *CIO*. Available at: http://www.cio.com/article/2388344/open-source-tools/6-reasons-to-pay-for-open-source-software.html [Accessed December 1, 2014].

Schießle, B., 2012. Free Software, Open Source, FOSS, FLOSS - same same but different. *Free Software Foundation Europe*. Available at: https://fsfe.org/freesoftware/basics/comparison.en.html [Accessed February 2, 2015].

Segal-Horn, S. ed., 2004. *The strategy reader* 2nd ed., Malden, MA: Blackwell Pub. in association with the Open University.

Segal-Horn, S., 2010. *Unit 7 - International and Cross-Cultural Strategy*, Milton Keynes: Open University.

Shaikh, M. & Cornford, T., 2011. *Total cost of ownership of open source software: a report for the UK Cabinet Office supported by OpenForum Europe*, UK Cabinet Office. Available at: http://eprints.lse.ac.uk/39826/ [Accessed April 4, 2015].

Speculand, R., 2009. Six necessary mind shifts for implementing strategy. *Human Resource Management International Digest*, 10(3).

Spinello, R.A., 2003. The future of ppen source software: Let the market decide. *Journal of Information, Communication and Ethics in Society*, 1(4), pp.217–233. Available at: http://www.emeraldinsight.com/doi/abs/10.1108/14779960380000237 [Accessed April 8, 2015].

Stallman, R., 2012. Why Open Source Misses the Point of Free Software - GNU Project - Free Software Foundation. *GNU Project*. Available at: https://www.gnu.org/philosophy/open-source-misses-the-point.html [Accessed February 28, 2015].

St. Amant, K. & Still, B. eds., 2007. *Handbook of research on open source software: technological, economic, and social perspectives*, Hershey, PA: Information Science Reference. Available at: http://books.google.co.za/books?id=75KT6GdcWbYC&lpg=PP2&pg=PP1#v=onepage&q&f=false.

Steven, J., 2015. It's an open-source world: 78 percent of companies run open-source software. *ZDNet*. Available at: http://www.zdnet.com/article/its-an-open-source-world-78-percent-of-companies-run-open-source-software/ [Accessed April 19, 2015].

Sturges, J., 2008. Session 4. In *Block 4 – Managing Projects and Change*. Open University Business School.

Toth, K., 2006. Experiences with Open Source Software Engineering Tools. *IEEE Computer Society*, (6).

University of Twente, 2010. Diffusion of Innovations Theory. *Diffusion of Innovations Theory*. Available at: http://www.utwente.nl/cw/theorieenoverzicht/Theory%20Clusters/Communication%20and%20Information%20Technology/Diffusion_of_Innovations_Theory/ [Accessed March 28, 2015].

Vainio, N. & Vadén, T., 2007. Free Software Philosophy and Open Source. In *Handbook OF Research on OSS*.

Venkatesh et al., 2003. User Acceptance of Information Technology: Toward a Unified View. *Management Information Systems Research Center, University of Minnesota*, 27(3), pp.425–478. Available at: http://www.jstor.org/stable/30036540.

Ven, K., Verelst, J. & Mannaert, H., 2008. Should You Adopt Open Source Software? *IEEE Software*, 25(3), pp.54–59. Available at: http://ieeexplore.ieee.org/lpdocs/epic03/wrapper.htm?arnumber=4497765 [Accessed December 1, 2014].

Ven, K. & Verlst, J., 2008. The Impact of Ideology on the Organizational Adoption of Open Source Software. *Journal of Database Management,*, 19(2).

Vishal, M. et al., 2010. IMPROVING OPEN SOURCE SOFTWARE MAINTENANCE. *ProQuest Computing*, 50(3).

Vuyst, B. & Fairchild, A., 2007. Legal and Economic Justifi cation for Software Protection. In *Handbook OF Research on OSS*.

Wahyudin, D. et al., 2007. Monitoring the “health” status of open source web-engineering projects. *International Journal of Web Information Systems*, 3(1/2), pp.116–139. Available at: http://www.emeraldinsight.com/doi/abs/10.1108/17440080710829252 [Accessed May 16, 2015].

Wang, H. & Wang, C., 2001. Open source software adoption: a status report. *IEEE Software*, 18(2), pp.90–95. Available at: http://ieeexplore.ieee.org/lpdocs/epic03/wrapper.htm?arnumber=914753 [Accessed March 28, 2015].

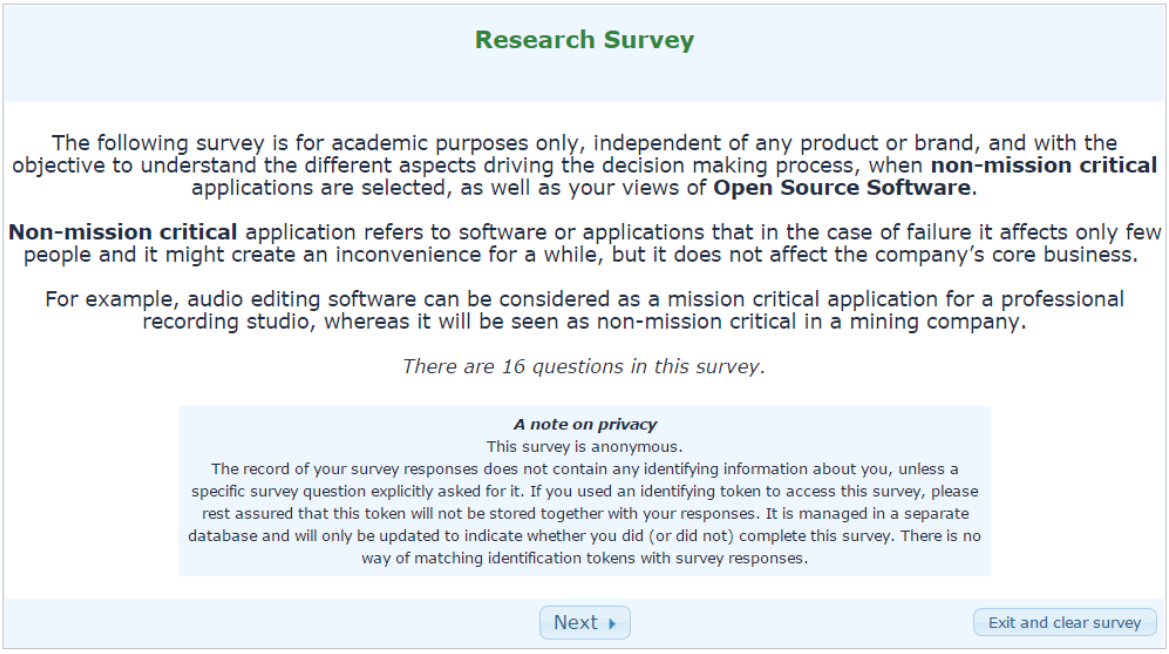
Wiid, J. & Diggines, C., 2009. *Marketing research*, Lansdowne, Cape Town: Juta.

Yan, N., Leip, D. & Gupta, K., 2005. The use of open-source software in the IBM corporate portal. *ProQuest Computing*, 44(2).

Zhao, L. & Elbaum, S., 2000. A survey on quality related activities in open source. *ACM SIGSOFT Software Engineering Notes*, 25(3), p.54. Available at: http://portal.acm.org/citation.cfm?doid=505863.505878 [Accessed April 13, 2015].

Appendices

Appendix A – Online Questionnaire



Research Survey

The following survey is for academic purposes only, independent of any product or brand, and with the objective to understand the different aspects driving the decision making process, when **non-mission critical** applications are selected, as well as your views of **Open Source Software**.

Non-mission critical application refers to software or applications that in the case of failure it affects only few people and it might create an inconvenience for a while, but it does not affect the company's core business.

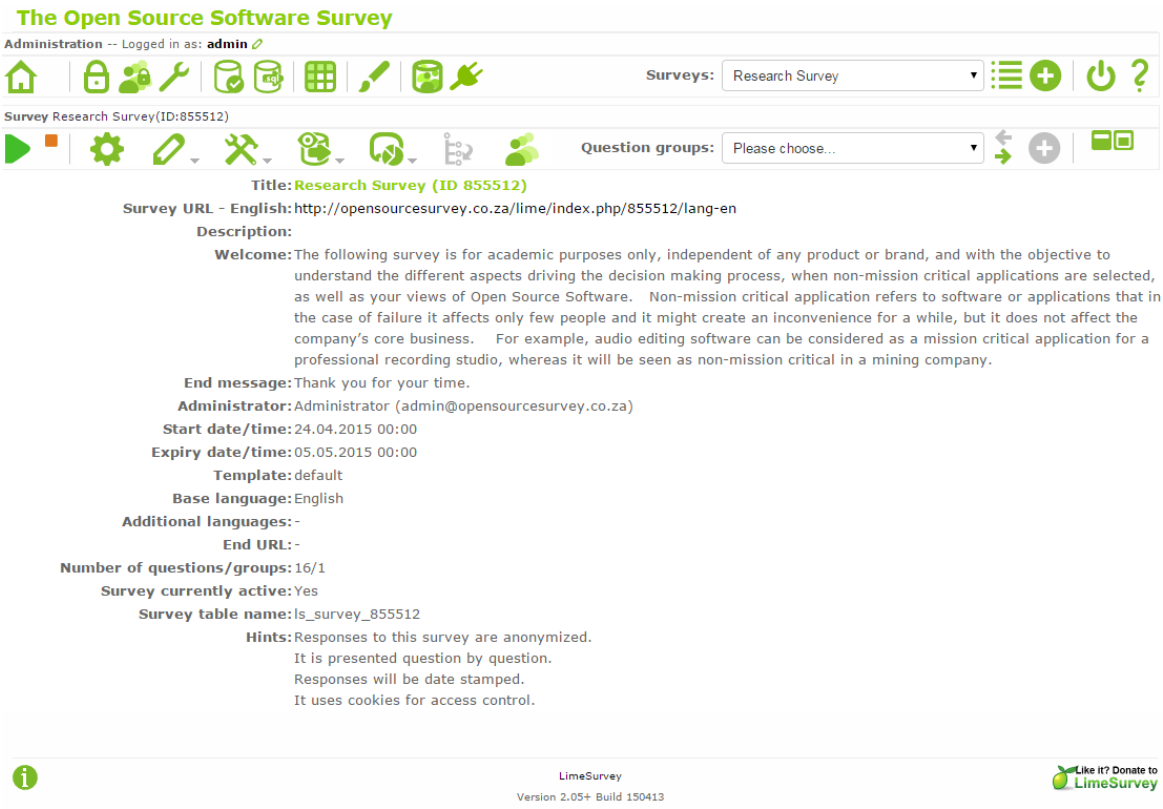
For example, audio editing software can be considered as a mission critical application for a professional recording studio, whereas it will be seen as non-mission critical in a mining company.

There are 16 questions in this survey.

A note on privacy
This survey is anonymous.
The record of your survey responses does not contain any identifying information about you, unless a specific survey question explicitly asked for it. If you used an identifying token to access this survey, please rest assured that this token will not be stored together with your responses. It is managed in a separate database and will only be updated to indicate whether you did (or did not) complete this survey. There is no way of matching identification tokens with survey responses.

Next ▸ | Exit and clear survey

Source: http://www.opensourcesurvey.co.za/lime/index.php/survey/index/sid/855512



The Open Source Software Survey

Administration -- Logged in as: **admin**

Surveys: Research Survey

Survey Research Survey(ID:855512)

Question groups: Please choose...

Title:	Research Survey (ID 855512)
Survey URL - English:	http://opensourcesurvey.co.za/lime/index.php/855512/lang-en
Description:	
Welcome:	The following survey is for academic purposes only, independent of any product or brand, and with the objective to understand the different aspects driving the decision making process, when non-mission critical applications are selected, as well as your views of Open Source Software. Non-mission critical application refers to software or applications that in the case of failure it affects only few people and it might create an inconvenience for a while, but it does not affect the company's core business. For example, audio editing software can be considered as a mission critical application for a professional recording studio, whereas it will be seen as non-mission critical in a mining company.
End message:	Thank you for your time.
Administrator:	Administrator (admin@opensourcesurvey.co.za)
Start date/time:	24.04.2015 00:00
Expiry date/time:	05.05.2015 00:00
Template:	default
Base language:	English
Additional languages:	-
End URL:	-
Number of questions/groups:	16/1
Survey currently active:	Yes
Survey table name:	ls_survey_855512
Hints:	Responses to this survey are anonymized. It is presented question by question. Responses will be date stamped. It uses cookies for access control.

LimeSurvey
Version 2.05+ Build 150413

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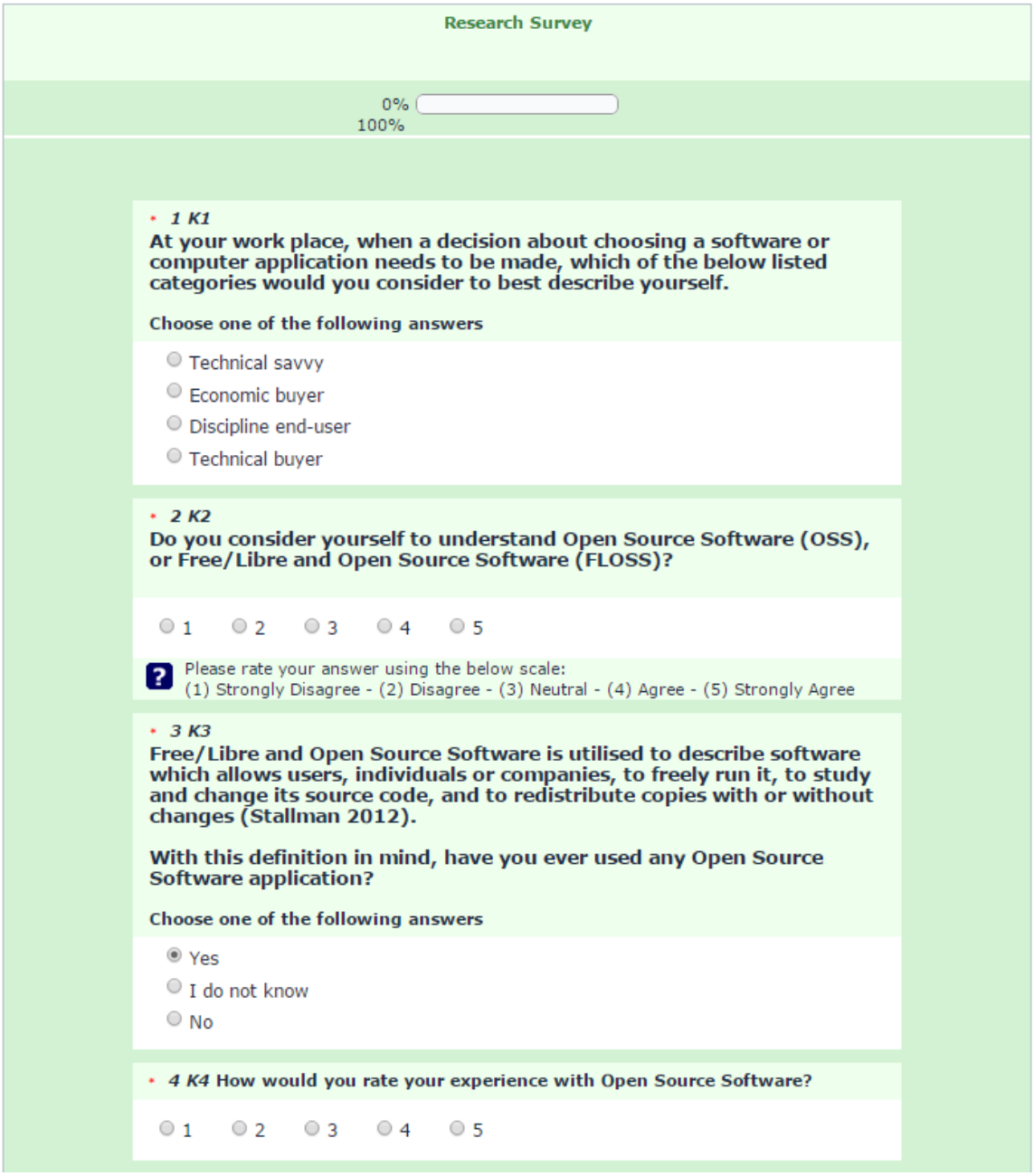
Knowledge factors



Economic factors

• *5 E1*

The following questions are based on your experience with any non-mission critical application you have used, or currently use within your organization. Please keep such application in mind when answering the rest of this survey.

If you find an Open Source Software alternative for a current application you use.
How likely is it that you would consider such alternative to be adopted?

○ 1 ○ 2 ○ 3 ○ 4 ○ 5

? Please rate your answer using the below scale:
(1) Strongly Disagree - (2) Disagree - (3) Neutral - (4) Agree - (5) Strongly Agree

• *6 E2*

Most of the Open Source Software available in the web is free of charge. Would you consider the adoption of open source software beneficial for the organisation?

○ 1 ○ 2 ○ 3 ○ 4 ○ 5

? Please rate your answer using the below scale:
(1) Strongly Disagree - (2) Disagree - (3) Neutral - (4) Agree - (5) Strongly Agree

• *7 E3*

How likely is it that you would consider Open Source Software in order to avoid vendor lock-in?

○ 1 ○ 2 ○ 3 ○ 4 ○ 5

? Please rate your answer using the below scale:

(1) Strongly Disagree - (2) Disagree - (3) Neutral - (4) Agree - (5) Strongly Agree

• *8 E4* **Would you consider Open Source Software as an option for cost reduction?**

○ 1 ○ 2 ○ 3 ○ 4 ○ 5

? Please rate your answer using the below scale:

(1) Strongly Disagree - (2) Disagree - (3) Neutral - (4) Agree - (5) Strongly Agree

Support, and Maturity factors

9 R1

Do you often report or provide feedback to software companies on their new releases, so that they can improve or fix their products?

1 2 3 4 5

Please rate your answer using the below scale:

(1) Strongly Disagree - (2) Disagree - (3) Neutral - (4) Agree - (5) Strongly Agree

10 R2

How likely will it be for you to report a software bug/issue to the software developer company?

1 2 3 4 5

Please rate your answer using the below scale:

(1) Strongly Disagree - (2) Disagree - (3) Neutral - (4) Agree - (5) Strongly Agree

11 R3

You frequently seek for support (example via email, telephonic, online) when using the non-mission critical application under discussion.

1 2 3 4 5

Please rate your answer using the below scale:

(1) Strongly Disagree - (2) Disagree - (3) Neutral - (4) Agree - (5) Strongly Agree

12 M1

Based on latest technology researches, more that 70% of the Internet runs on Open Source Software. Would you say that Open Source Software could be considered a reliable option for non-mission critical applications?

1 2 3 4 5

Please rate your answer using the below scale:

(1) Strongly Disagree - (2) Disagree - (3) Neutral - (4) Agree - (5) Strongly Agree

13 M2

Open Source Software can be seen as a low quality software compared with commercial software.

1 2 3 4 5

Please rate your answer using the below scale:

(1) Strongly Disagree - (2) Disagree - (3) Neutral - (4) Agree - (5) Strongly Agree

14 M3

If the application under discussion presents issues/bugs, how likely is that you will try and resolve such problem yourself?

1 2 3 4 5

Please rate your answer using the below scale:

(1) Strongly Disagree - (2) Disagree - (3) Neutral - (4) Agree - (5) Strongly Agree

Acceptance factors

* ***15 A1*** **You are presented with the opportunity of choosing between two applications that generate the same type results, both look similar, one is Open Source Software and the other is a known commercial package. How likely is it that you would consider to choose the Open Source Software option?**

○ 1 ○ 2 ○ 3 ○ 4 ○ 5

? Please rate your answer using the below scale:

(1) Strongly Disagree - (2) Disagree - (3) Neutral - (4) Agree - (5) Strongly Agree

* ***16 A2***

You often browse Internet in order to access online tutorials or documentation so that you can learn how to use software.

○ 1 ○ 2 ○ 3 ○ 4 ○ 5

? Please rate your answer using the below scale:

(1) Strongly Disagree - (2) Disagree - (3) Neutral - (4) Agree - (5) Strongly Agree

Appendix B – Data Analysis, Grouping, and Coding

		No	Do not know	Yes
K2	**Economic**	3	2	2
	End User	5	2	2
	Technical	1	3	10
K3	**Economic**	1	1	5
	End User	2	1	6
	Technical	6	3	5

	No	Do not know	Yes
Economic	2	1.5	3.5
End User	3.5	1.5	4
Technical	3.5	3	7.5

	No	**Do not know**	**Yes**
Economic	6.67%	5.00%	11.67%
End User	11.67%	5.00%	13.33%
Technical	11.67%	10.00%	25.00%

	No	**Yes**	
Economic	11.67%	11.67%	
End User	16.67%	13.33%	
Technical	21.67%	25.00%	

	Disagree	**Neutral**	**Agree**
		E1	
Economic	1		6
End User		4	5
Technical	5	2	7
		E2	
Economic	1		6
End User		2	7
Technical	6	2	6
		E3	
Economic		2	5
End User		3	6
Technical	4	4	6
		E4	
Economic	1		6
End User		1	8

Technical	6		8

	Disagree	Neutral	Agree
Economic	0.75	0.50	5.75
End User	0.00	2.50	6.50
Technical	5.25	2.00	6.75

	Disagree	Neutral	Agree
Economic	2.50%	1.67%	19.17%
End User	0.00%	8.33%	21.67%
Technical	17.50%	6.67%	22.50%

Original			
	Disagree	**Neutral**	**Agree**
M1			
Economic		1	6
End User		2	7
Technical		5	9
M2			
Economic	5	1	1
End User		5	4
Technical	7	1	6
M3			
Economic	6		1
End User	5	3	1
Technical	4	4	6
R1			
Economic	5		2
End User	8	1	
Technical	2	4	8
R2			
Economic	3		4
End User	5	2	2
Technical	2	4	8
R3			
Economic	3	3	1
End User	4	5	
Technical	9		5

Adjusted			
	Disagree	**Neutral**	**Agree**
M1			
Economic		1	6
End User		2	7

Technical		5	9
M2			
Economic	1	1	5
End User	4	5	
Technical	6	1	7
R4			
Economic	1		6
End User	1	3	5
Technical	6	4	4
R1			
Economic	5		2
End User	8	1	
Technical	2	4	8
R2			
Economic	3		4
End User	5	2	2
Technical	2	4	8
R3			
Economic	3	3	1
End User	4	5	
Technical	9		5

M1+M2	**Disagree**	**Neutral**	**Agree**
Economic	0.50	1.00	5.50
End User	2.00	3.50	3.50
Technical	3.00	3.00	8.00

R1+..+R4	**Disagree**	**Neutral**	**Agree**
Economic	3.00	0.75	3.25
End User	4.50	2.75	1.75
Technical	4.75	3.00	6.25

M1+M2	**Disagree**	**Neutral**	**Agree**
Economic	1.67%	3.33%	18.33%
End User	6.67%	11.67%	11.67%
Technical	10.00%	10.00%	26.67%

R1+..+R4	**Disagree**	**Neutral**	**Agree**
Economic	10.00%	2.50%	10.83%
End User	15.00%	9.17%	5.83%
Technical	15.83%	10.00%	20.83%

	Disagree	Neutral	Agree
A1			
Economic		3	4
End User	1	2	6
Technical	4	6	4
A2			
Economic	2		5
End User	4	1	4
Technical	3	1	10

	Disagree	Neutral	Agree
Economic	1	1.5	4.5
End User	2.5	1.5	5
Technical	3.5	3.5	7

	Disagree	Neutral	Agree
Economic	3.33%	5.00%	15.00%
End User	8.33%	5.00%	16.67%
Technical	11.67%	11.67%	23.33%

Appendix C – List of Questions

Code	Question
K1	At your work place, when a decision about choosing a software or computer application needs to be made, which of the below listed categories would you consider to best describe yourself.
K2	Do you consider yourself to understand Open Source Software (OSS), or Free/Libre and Open Source Software (FLOSS)?
K3	Free/Libre and Open Source Software is utilised to describe software which allows users, individuals or companies, to freely run it, to study and change its source code, and to redistribute copies with or without changes (Stallman 2012). With this definition in mind, have you ever used any Open Source Software application?
K4	How would you rate your experience with Open Source Software?
E1	The following questions are based on your experience with any non-mission critical application you have used, or currently use within your organization. Please keep such application in mind when answering the rest of this survey. If you find an Open Source Software alternative for a current application you use. How likely is it that you would consider such alternative to be adopted?
E2	Most of the Open Source Software available in the web is free of charge. Would you consider the adoption of open source software beneficial for the organisation?
E3	How likely is it that you would consider Open Source Software in order to avoid vendor lock-in?
E4	Would you consider Open Source Software as an option for cost reduction?
R1	Do you often report or provide feedback to software companies on their new releases, so that they can improve or fix their products?
R2	How likely will it be for you to report a software bug/issue to the software developer company?
R3	You frequently seek for support (example via email, telephonic, online) when using the non-mission critical application under discussion.
M1	Based on latest technology researches, more that 70% of the Internet runs on Open Source Software. Would you say that Open Source Software could be considered a reliable option for non-mission critical applications?
M2	Open Source Software can be seen as a low quality software compared with commercial software.
M3	If the application under discussion presents issues/bugs, how likely is that you will try and resolve such problem yourself?
A1	You are presented with the opportunity of choosing between two applications that generate the same type results, both look similar, one is Open Source Software and the other is a known commercial package. How likely is it that you would consider to choose the Open Source Software option?
A2	You often browse Internet in order to access online tutorials or documentation so that you can learn how to use software.

Appendix D – Raw Data

Respondent	K1	K2	K3	K4	E1	E2	E3	E4	R1	R2	R3	M1	M2	M3	A1	A2
1	Technical savvy	3	I do not know		3	3	4	2	4	4	4	3	3	4	3	4
2	Technical savvy	2	I do not know		2	2	2	4	2	2	2	3	2	3	3	3
3	Technical savvy	4	No		1	1	1	2	5	3	2	3	5	3	2	1
4	Economic buyer	2	I do not know		4	4	3	4	2	4	3	4	3	2	3	2
5	Economic buyer	2	Yes	2	5	5	5	5	1	1	1	4	2	1	3	4
6	Economic buyer	4	No		5	5	5	5	5	5	4	5	1	2	4	5
7	Technical savvy	5	Yes	5	5	5	4	4	3	4	2	5	2	2	4	4
8	Technical buyer	3	No		4	5	5	4	4	4	4	5	1	4	5	5
9	Economic buyer	3	Yes	3	4	5	4	5	1	5	3	5	1	1	5	5
10	Discipline end-user	2	Yes	3	4	4	4	4	1	2	2	4	3	1	4	1
11	Technical savvy	5	Yes	5	5	5	4	5	3	3	4	5	1	4	5	5
12	Discipline end-user	2	No		3	4	4	4	2	2	3	4	4	1	4	1
13	Technical savvy	4	I do not know		2	4	3	4	2	2	2	4	4	4	2	4
14	Technical buyer	4	No		4	4	2	4	4	4	2	4	4	2	3	4
15	Technical savvy	4	Yes	4	3	3	4	4	4	4	4	4	2	3	3	5
16	Discipline end-user	2	Yes	3	3	3	3	4	2	2	3	4	4	2	3	4
17	Discipline end-user	1	I do not know		4	4	3	4	2	4	2	3	3	1	4	4
18	Economic buyer	3	Yes	4	4	4	4	4	2	2	3	4	2	2	4	2
19	Technical buyer	5	Yes	4	2	2	2	1	4	4	1	3	2	5	2	4
20	Discipline end-user	4	Yes	4	3	4	5	5	1	2	1	4	4	1	4	3
21	Economic buyer	2	Yes	4	4	5	5	5	2	2	2	5	4	4	5	5
22	Discipline end-user	3	Yes	2	4	4	4	5	3	4	2	4	3	3	4	4
23	Technical savvy	4	Yes	3	5	4	4	5	3	4	3	4	4	4	4	4
24	Economic buyer	5	Yes	2	2	2	3	2	4	4	2	3	2	2	3	4
25	Technical savvy	4	Yes	3	4	4	4	5	3	3	2	4	4	3	4	4
26	Discipline end-user	3	Yes	3	4	4	5	5	1	1	3	4	3	3	2	2
27	Technical buyer	5	No		2	2	3	2	3	3	4	3	2	4	2	4
28	Discipline end-user	2	Yes	3	4	4	4	4	2	3	3	5	4	4	5	4
29	Discipline end-user	4	No		3	3	3	3	1	3	3	3	3	3	3	2
30	Technical savvy	3	No		4	2	3	2	4	4	2	4	4	2	3	2

Appendix E – CPI Calculations

Currency	USD	CPI	Source
AUD	$ 0.780	1.300%	http://www.abs.gov.au/ausstats/abs@.nsf/mf/6401.0
CAD	$ 0.820	1.200%	http://www.statcan.gc.ca/tables-tableaux/sum-som/l01/cst01/cpis01a-eng.htm
EUR	$ 1.090	-0.102%	http://www.global-rates.com/economic-indicators/inflation/consumer-prices/hicp/eurozone.aspx
GBP	$ 1.520	-0.078%	http://www.global-rates.com/economic-indicators/inflation/consumer-prices/cpi/great-britain.aspx
USD	$ 1.000	-0.074%	http://www.global-rates.com/economic-indicators/inflation/consumer-prices/cpi/united-states.aspx
ZAR	$ 0.083	3.960%	http://www.global-rates.com/economic-indicators/inflation/consumer-prices/cpi/south-africa.aspx
Average		**1.034%**	

[Accessed 15 May 2015]

Note: Yearly basis inflation rate quantified through the use of country or regional CPI.