Chapter 1 Introduction

1.1 Problem Statement

Information technology is deemed a necessity for an organization to compete in today's competitive world. Thus, organizations seek to use the most cost effective tools in information systems. Here in Malaysia as well, the managers would carefully decide on the most cost effective solutions to ensure that their information systems are being used efficiently so as to increase the competitive advantage of their organization in the market. The use of information systems, which Whitten, Bentley, and Dittman (2001) defined as "an arrangement of people, data, processes, communications, and information technology that interact to support and improve day-to-day operations in a business, as well as support the problem-solving and decision-making needs of management and users," is considered as one of the options for cost a effective solution. The open source software would be such an option for managers to consider when deciding the tools to be invested in. This research is focused on exploring the determining factors in deciding to implement the open source solutions for enterprise systems by collecting data from managers in organizations that have implemented OSS.

Studies have shown that the implementation of OSS can save cost and that the transition and migration from one platform to another requires significant investments as it involves training, data migration as well as hardware cost (Morgan & Finnegan, 2007; Ven & Verelst, 2006). The study by Hauge, Ayala, and Conradi (2010) study

showed “the complete calculations of the true costs and savings of (1) introducing OSS products into organizations, and (2) keeping the OSS products operational over a longer period of time" were considered the challenges to the organizations. Ven and Verelst (2008) also suggested that “that decision makers will not adopt OSSS because of its lower license cost. Instead, they also consider other costs involved in the migration.”. Thus, this study will focus on the managerial perspectives of the decision makers in implementing OSS in their organization.

A survey conducted by the Open Source Competency Center Malaysia in July, 2009 shows that more than 70% of Malaysian government offices were running on open source software ("OSS Adoption Statistics Malaysian Public Sector Open Source Software Programme," 2010).This number increased in the year 2010 where 97% of the adoption rate was reported in the public sector ("Open Source Competency Center (OSCC) Laporan Adoption Chart Tahun 2011," 2012). Looking at this number, it is can be fairly said that the implementation of the OSS in Malaysia is increasing. At present, there is still lack of studies about the OSS enterprise systems adoption, especially in Malaysia. Hence, this study will be valuable to Malaysian’s organizations as it evaluates on the factors determining the adoption of OSS in the context of Malaysia.

1.2 Purpose and Significance of the Study

This study will explore the adoption of the Open Source enterprise systems through sets of technological, organizational and environmental factors that could influence

the decision to adopt an OSS by a manager in an organization. Specifically in each of these contexts, this study will identify the factors which influence the adoption of OSS systems in the context of Malaysian organizations. This new data can be used to apply to recent changes in the technological, organizational and the surrounding environment where the adopters of the OSS have had a longer experience and greater deployment of their enterprise systems in their respective organization.

It would also be beneficial for the organizations especially in Malaysia to know the factors that contributes to the adoption of OSS besides the benefits of free software. This study too is also expected to reinforce the factors of previous studies as well as to offer more perspectives of the Malaysian organizational behavior on the adoption of OSS enterprise systems.

1.3 Research Objectives

In this research we attempt to identify the variables and factors that have a direct effect on the managers' decisions towards OSS enterprise systems adoption. The objectives of this study are:

1. To determine whether the technological factors are positively affecting the adoption of OSS enterprise systems in an organization.
2. To determine whether the organizational factors are positively related to the adoption of the OSS enterprise systems in an organization.

3. To determine whether the environmental factors are positively affecting the adoption of OSS enterprise systems in an organization.
4. To determine which factors are significant in influencing managers to adopt OSS enterprise systems.

1.4 Research Questions

The goal of this research is to give the managers some insights as to the possible factors that contributes to adopting the OSS enterprise systems in Malaysia. Since the managers are the ones who are taking the risk of implementing these systems in a company, they are the people being surveyed. In this study, we use the TOE framework to explore the factors that contributes to the adoption based on the technological, organizational and environmental contexts. The specific research questions are as follows:

Question 1

What is the level of adoption of OSS enterprise systems in Malaysia?

Question 2

What are the significant factors that influence a manager's adoption of OSS enterprise systems?

1.5 Organization of the study

This study is organized as the following Figure 1.1.

Figure 1-0-1: Organization of the Study

Chapter 1: Introduction

This chapter will discuss the rational, objectives and scope of this study.

Chapter 2: Literature Review

This is an analysis of current literature and theories on OSS adoption as introduced in the first chapter and the relevance and application to this study. Literatures which included the Technology-Organization-Environment (TOE) and Diffusion of Innovations (DOI) on the theories of technology adoption were also reviewed.

Chapter 3: Research Methodology

This chapter presents the development of my hypotheses; constructing a framework based on the previous chapter's discussion. It also discusses how the data was collected, analyzed and validated.

Chapter 4: Research Results

This chapter presents and review the findings from this research.

Chapter 5: Conclusion & Recommendation

This chapter discusses on the limitations and implications of the research as well as recommendations for future research. Research questions and research objectives are evaluated based on the results from previous chapter.

Chapter 2 Literature Review

2.1 Introduction

This chapter defines the overview history and background of the Open Source System (OSS), the movement in Malaysia, the overview of enterprise applications and the theory of technology adoption focusing on Technology, Organization and Environment (TOE model. This chapter also discusses the Diffusion of Innovation (DOI) theory. The literature reviewed here will be related to this study.

2.2 Open Source Software (OSS)

Coppola and Neelley (2004) defines OSS as "software programs that are distributed with the source code which allows users the freedom to run the program for any purpose, to study and modify the program, and to freely redistribute copies of the original or modified program". The improvements of the OSS are being contributed mainly by users or usually in a community who have fixed the problems or added new features to it. Several success stories show that a huge number of people worldwide using Apache, Linux, Firefox and mySQL (Chamili, Jusoh, H.Yahaya, & Pa, 2012).

The OSS may appear to be a software that is cost free but it also gives an opportunity for business, where the users may use the system as needed or the users may offer it

as a service to others. This means, the software can be commercialized (Coppola & Neelley, 2004) by:

- Offering services such as implementation, training, and support;
- Packaging and integrating open source software to make its installation and use easier for a wider market;
- Creating complementary, add-on, or enhanced software for sale

Open Source Initiatives (OSI) (2004) in its Open Source Definition (OSD) version 1.9, termed a software as an OSS if the distribution term of the software comply with the following criteria: free redistribution, accessible source code, allows any modification and derived works. The distribution of the modified software must also be the same as the original software. The license may restrict the modified software from being distributed only if the enhancement is through 'patch files' to ensure the integrity of the author's source code. The distribution of the modified OSS should not discriminate against persons or groups of persons, use of program in a specified field or endeavor, and redistribution of the OSS with the same rights. The license too must not be specific to a product or restrict other software and it must be technology-neutral.

2.3 OSS vs. Proprietary Software

In comparing the OSS with the proprietary software, there are a few factors that can be noted. Corrado (2005) in his study, evaluates the cost involved in implementing

the OSS. Generally, the cost of implementing the OSS is free or at a very minimal price while implementing the proprietary software is chargeable at very high fees due to the acquisition costs, implementation and support costs. In evaluating the software, the proprietary software often has a limited trial period as well as a limited version of the software (Corrado, 2005). Users will also have to deal with the vendor's sales personnel in order to get the proprietary software. In comparison, the OSS users are able to evaluate the software as long as it is available freely over the Internet. OSS users are also able to develop any enhancement to the OSS software without having to wait for the vendor to decide whether the enhancement is financially viable to develop (Fuchs, 2004). The OSS software can avoid vendor lock-in terms as the software can be supported by any vendor or by in-house support of the organization as compared to the proprietary software where the organization will have to purchase the support as according to the package and should the chosen package be inadequate, there will be additional costs to purchase for another tier of support (Corrado, 2005). The table below is a summary of the factors in comparing the OSS and the proprietary software.

Table 2-1: OSS vs. Proprietary

Factors	**OSS**	**Proprietary Software**
Cost	Generally free (or at a minimal cost), lower acquisition cost and lower implementation & support costs	High acquisition, implementation and support costs
Software Evaluation	Easier to evaluate as the software is freely available to download - without any license fees	Usually a very limited trial period, limited version of the software and have to deal with vendor's sales personnel

Software Enhancement	User can develop the enhancement themselves	Should there be any features to be enhanced, user must wait until the vendor decides it is financially viable to develop it (Fuchs, 2004)
Support Options	Allows for different vendor to compete for support contracts based on quality of service and on price	Often package service with the product - especially library-specific software. When the support is inadequate, there will be an additional expense to purchase another tier of support.
Vendor lock-in	Could provide self support or other vendors can come in and fill the voide left by the previous vendor.	Software can lead to a single point of failure. If the vendor goes out of business or decides not to support the software, there is often nothing a user can do.

Source: The Importance of Open Access, Open Source, and Open Standards for Libraries. (Corrado, 2005)

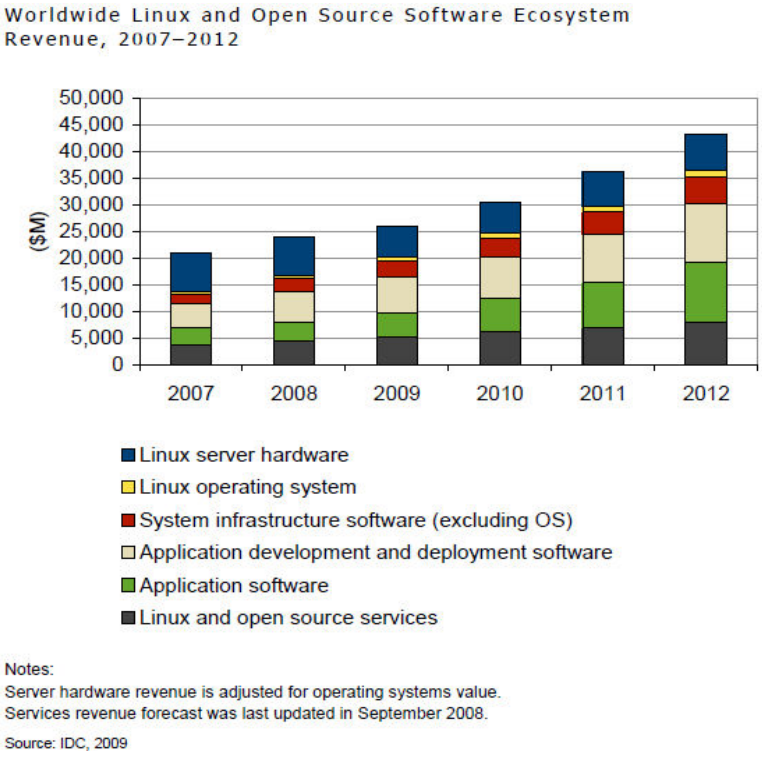
Over the years, the revenue from OSS has increased as reported in the *Worldwide Open Source Software 2009-2012 Forecast* (IDC, 2008). In the same report, it was revealed that worldwide revenue from OSS will grow at a 22.4% compound annual growth rate (CAGR) to reach $8.1 billion by 2013. This growth is expected due to the current economic crisis. Some of key findings from the report are:

- Large software vendors (e.g. IBM, Sun, Dell, HP and Oracle) are making significant amounts of indirect revenue from their activities with and support of OSS. This has aided the mainstream adoption and acceptance of OSS.
- Hybrid business models also seem to be increasing. It is likely that this will end up as the most prevalent business model, with on-premise vendors adding

Software as a Services (SaaS), SaaS vendors offering on premise, OSS vendors selling variants, and closed source vendors offering more OSS.

- The opportunity to leverage OSS in ways that increase competitive advantage, such as a part of Business Process Outsourcing (BPO) offerings or as a part of a software appliance, is on the rise and should help increase the adoption and growth for OSS vendors.

In another study done by IDC in 2009 for Linux Foundation ("The Opportunity for Linux in a New Economy ", 2009), showed that the application software is also growing as fast as according to the growth of the application development and deployment of OSS. The reported figures are detailed below.



Source: The Opportunity for Linux in a New Economy – IDC, 2009

Figure 2-1: Worldwide Linux and Open Source Software Ecosystem Revenue

2.4 OSS in Malaysia

In support of the OSS, two main organizations with government backing, i.e. Malaysian Institute of Microelectronic Systems (MIMOS) and the Malaysian Administration Modernization and Management Planning Unit (MAMPU) came up with their own roadmaps for open source systems for both the public and the private sectors. In the year 2002, MAMPU prepared a Memorandum entitled "Proposal on OSS Implementation in the Public Sector of Malaysia". This memorandum was then being endorsed by the government and was carried out in stages to ensure the least disruption of services offered by the Public Sector as well as to ensure the OSS was managed well.

The objectives of the implementation of the OSS in the public sector are as defined below:

1. Reduce total cost of ownership
2. Increase freedom of choice of software usage
3. Increase interoperability among systems
4. Increase growth of Information and Communication Technologies (ICT) industry
5. Increase growth of the OSS industry
6. Increase growth of the OSS user and developer community
7. Reduce digital divide

As a guidance, the OSS implementation in the public sector must be fit for its purpose, least disruptive to operations, can co-existence with other legacy proprietary system, must be leveraging on existing facilities, hardware, software and expertise and lastly, it must not be driven or controlled by hardware and software vendors. These initiatives are then transcended to the private sector by increasing the Information Communication Technology (ICT) industry growth (Open Source Competency Centre (OSCC), 2005).

In the recent reports produced by MAMPU on the adoption of the OSS by public sector agencies, there have been a tremendous increase in the adoption ("Open Source Competency Center (OSCC) *Laporan* Adoption Chart Tahun 2011," 2012). Compared to 2006, there has been about a 200% increase of the adoption the OSS by the agencies in 2011. And in the back-end infrastructure alone, it is reported about 80% of agencies are adopting the OSS back-end infrastructure. The high increase can be credited to the strong initiatives committed by MAMPU such as producing the framework, policies and guidelines of the implementation to the public sectors ("Malaysian Public Sector Open Source Software Initiative," 2005).

Source: OSCC Laporan Adoption Chart Tahun 2011 (2012)

Figure 2-2: 2011 OSS Adoption Chart in Malaysian Public Sector

2.5 OSS for Enterprise Applications

A survey done of Western European companies by IDC, 2009 found that nearly 10% were using open source enterprise software and this number increased by 20 percent or more each year. Some of the top OSS enterprise application (Harvey, 2012) is shown in the table:

Table 2-2: 101 Open Source Apps for Enterprise

Categories	Open Source Software	Categories	Open Source Software
Accounting	Edoceo Imperium FrontAccounting GnuCash TurboCASH XIWA	Business Intelligence (BI)	Jaspersoft Pentaho JedoxPalo BI Openl Palo BI Suite RapidMiner OpenReports Mondrian Jmagallanes

Business Process Management (BPM)	ProcessMaker Intalio BPMS uEngine Adaptive Planning	Business Suites	Adempiere ERP Business Suite Compierre ERP + CRM Business Solution opentaps Plazma ERP + CRM JAlllnOne ERP/CRM GNU Enterprise Dolibarr ERP/CRM Jfire allocPSA TNT Concept Ohioedge Value ERP
Collaboration/ Groupware	Group-Office cyn.in Collabtive OpenGoo/ Feng Office phpGroupWare IGSuite TUTOS	Content Management Systems (CMS) and Wikis	Magnolia Alfresco Liferay Joomla Drupal TikiWiki Daisy CMS MindTouch Twiki FOSWiki TYPO3 BIGACE Bitweaver Devproof Portal
Customer Relationship Management (CRM)	hipergate CRM SugarCRM openCRX SplendidCRM Concourse Suite XRMS Open Source CRM vtiger CRM Orange Leap Daffodil CRM CitrusDB SellWinCRM SourceTap phplist OpenEMM	Database	MySQL PostgreSQL Firebird Kexi

Data Warehouse (DW)	Talend Open Studio LucidDB Apatar DataCleaner MailArchiva KETL	Document Management Systems (DMS)	Knowledge Tree Epiware Inforama OpenKM
E-Commerce	Magento Zen Cart PrestaShop Order Portal	Enterprise Resource Planning (ERP)	Postbooks/xTuple ERP Openbravo ERP Open ERP Project-open webERP EdgeERP Neogia
Human Resource Management (HRM)	Orange HRM Latrix WaypointHR	Miscallaneous	GlobalSight (translation management system)
Point-of-Sale (POS)	Openbravo POS Posterita SymmetricDS Barcode4J	Project Management	OpenProj GanttProject Open Workbench Dotproject Achievo openXprocess Onepoint Project Plandora Double Choco Latte BORG Calendar

Source: Harvey, C. 2009. 101 Open Source Apps for Enterprises. ITBusinessEdge & Harvey, C. 2012 80 Open Source Replacements for Really Expensive Applications

2.6 OSS Studies in Malaysia

Chamili et al. (2012) identified the selection criteria to assist in selecting the adoption of an OSS in Malaysia. The criteria comprise three dimensions: system quality, information quality and service quality. These criteria are tailored based on the

literature study, standard for software quality and guidelines from MAMPU that were proposed in order to build the user's confidence in implementing the software. The proposal will be using DeLone & McLean (Delone & McLean, 2003) IS Success Model as the framework to evaluate the OSS adoption with the other two criteria (user satisfaction and net benefit) excluded as the study focused on the adoption of OSS.

Rahim, Alias, and Carroll (2010) in their study, identified the various criteria influencing the OSS appropriation process from multiple perspectives in a Malaysian public university. The study combines and extends the Multiple Perspectives approach by Mitroff and Linstone (1993) and the Model of Technology Appropriation by Carroll et al., (2002a) by proposing an integrated framework named Multiple Perspective Appropriation (MPOSSA). The model represents three levels of which level 1 represents the users' first encounter with the technology, level 2 involves the users' evaluation of the technologies through use and level 3 where it captures the users' persistent act to maintain the use of the technology when it is considered stabilized. It was a cross case study of the Engineering and Technology University (ETU)'s implementation of the OSS.

The multiple perspectives in this study comprised three perspectives: technical perspective (T), organizational perspective (O) and personal perspective (P). An external context was also being identified to understand the external factors which would influence the appropriation process of OSS application. This study is limited to

organizations in Malaysia. Thus, the result does not generalize the adoption of the OSS in the context of the Malaysian organization.

2.7 Adoption Theories

2.7.1 Diffusion of Innovation (DOI)

Over the years, the Diffusion of Innovation (DOI) has become the basis for current adoption theory studies which was written by Rogers in 1962. Rogers' works elaborate on the concept of innovation and the factors that affect the innovation's adoption rate. His model outlines five stages of the adoption process:

1. knowledge of the innovation
2. persuasion by influencing factors or entities
3. a decision to adopt
4. implementation of the innovation
5. confirmation of the decision to adopt

The criterion for categorizing an adopter is innovativeness and this criterion is considered 'relative' in that an individual has either more or less of it than others in a social system (Rogers, 2003). Adopters generally fall into categories defined as innovators, early adopters, early majority, late majority and laggards. Innovators are those who are eager to try new ideas and who are willing to accept the occasional setback when new ideas proven unsuccessful (Rogers, 2003). Early adopters are a second wave of adopters of innovations, and take some risks in exchange for the

benefits of newer innovations. They are also usually respected by his or her peers and have a reputation for successful and discrete use of new ideas (Rogers, 2003). Early majority are the ones who adopt more slowly, balancing risk with perceived benefit. They would deliberate for some time before completely adopting the new idea. Late majority only adopts after the majority of the population has already adopted, sacrificing any benefits of the innovation related to an early adoption. They will also need strong pressure from their peers to adopt. Laggards are those who do not adopt innovation until long after the rest of the population has adopted. Figure 2.3 below show Rogers' categorization of adopters

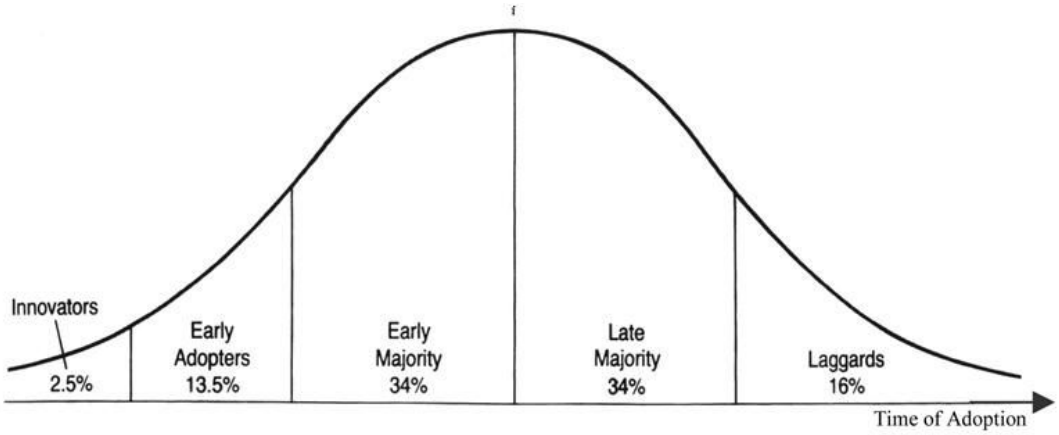


Figure 2-3: Categorization of adopters (Rogers, 2003)

Rogers' (2003) Diffusion of Innovation theory lists five characteristics of innovations. Relative advantage is the degree to which an innovation is perceived as better than the idea, which it supersedes. Compatibility is the degree to which an innovation fits with the existing values, past experience, and needs of the potential adopter. Complexity is the degree to which an innovation is perceived as difficult to understand and use. Trialability is whether an innovation may be experimented with

on a limited basis. Observability is the degree to which the results of an innovation are visible to others.

Rogers' framework has some limitation when applied to organizational innovations. It focuses on the diffusion of mass-produced items which is through individuals in the population (Chau & Tam, 1997). Therefore, a more relevant model is needed to take into account the factors that can affect the propensity of adoption within the specific context of the technological, organizational and the environmental circumstances.

2.7.2 Technology-Organization-Environment (TOE)

In their study of technological innovation adoption, Tornatzky and Fleischer (1990) developed the technology-organization-environment (TOE) framework. This framework allowed the structure of various adoption factors from different contexts into a coherent framework (Ven & Verelst, 2012). The three contexts described here which would influence the adoption decision are the technological context, the organizational context and the environmental context. A number of literatures have analyzed and used the TOE framework as a foundation for the adoption of OSS in an organization (Chau & Tam, 1997; Dedrick & West, 2003, 2004; Ellis & Belle, 2009; Morgan & Finnegan, 2007, 2010; Ven & Verelst, 2006, 2012)

In 2004, Dedrick & West developed a grounded theory on Open Source Platform adoption by interviewing Management Information System (MIS) managers and contrasting it with prior academic reports about the adoption of open source. The study was focused on computing platform standards and the decision process of the

organizations in selecting the server platforms specifically Linux. In their study, they too agrees that TOE is a useful analytical tool for distinguishing between inherent qualities of an innovation itself and the motivations, capabilities, and the broader environmental context of the adopting organizations (Dedrick & West, 2004).

In this study we used the Technology–Organization–Environment (TOE) framework as the theoretical framework as the TOE framework is often used to describe the contexts in which the adoption takes place. Figure 2.4 represents the TOE framework that is being used as the basis of this study.

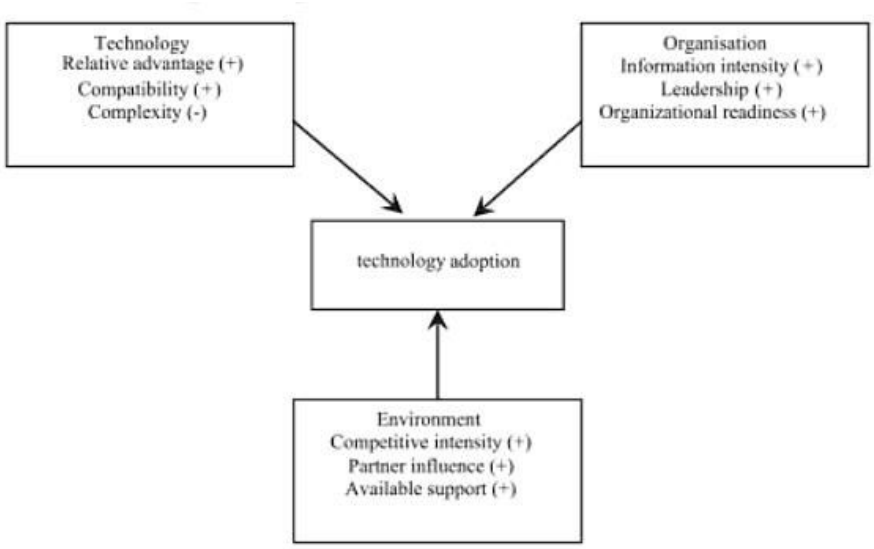


Figure 2-4: The Technology, Organization, Environment (TOE) model (Tornatzky & Fleischer, 1990)

2.7.3 The Technology Context

The technological component describes the importance of both internal and external technological factors that would improve the organizational as a whole (Chau & Tam,

1997; Tornatzky & Klein, 1982). Factors like existing available technologies, new technologies to be adopted as well as business processes surrounding it are factors being described in most of the literatures (Chau & Tam, 1997; Zhu, Kraemer, & Xu, 2002). Consistent with the studies by Rogers (2003) and Tornatzky and Klein (1982) there are a few factors that would influence the adoption decision. They are relative advantage, compatibility, complexity and trialability and observability. This is then supported in the studies by (Dedrick & West, 2003, 2004; Morgan & Finnegan, 2007). They have identified in their studies four technological characteristics which were evident in their studies as influencing the adoption decision, namely relative advantage, compatibility, complexity and trialability. "Observability was not seen as relevant" (Morgan & Finnegan, 2010). Thus, in this study, we will focus on relative advantage, compatibility, complexity and trialability which are relevant to the adoption of Open Source Systems in Malaysia.

2.7.4 The Organizational Context

The organizational component describes the resources available in the organization to support the technologies. Rogers (2003) has identified that the organizational characteristic such as formalization, centralization, system openness, interconnectedness, organizational slack and size are related to the adoption of innovation. In Tornatzky and Fleischer (1990), the organizational context looks at the structure and the processes of an organization that influence the adoption and thus, the implementation.

The organizational factors are often cited by previous studies as factors behind the managerial decision to adopt the OSS (Goode, 2005; Morgan & Finnegan, 2010; Varian & Shapiro, 2003). Factors such as management support and the internal knowledge and expertise are also identified as the important factor in considering the adoption of the OSS (Glynn, Fitzgerald, & Exton, 2005; Goode, 2005; Morgan & Finnegan, 2010). The lack of internal knowledge and expertise would impede a decision to work with the open source software. Another factor to consider is the IT innovativeness, i.e., where the adoption of the new technology is based on the timing of when it is adopted into the organization (Ellis & Belle, 2009). In this study, we will focus on the management support and the internal knowledge and expertise factors.

2.7.5 Environment Context

The environmental component is the platform the organization to conducts its business. The environmental components of the organization include the industry in which the business is conducted, its competitors, and the regulations affecting the organization and its relationship with the government (Chau & Tam, 1997). It represents the constraints and opportunity for the technologies adopted. Rogers (1995) also identified adopter characteristics as the environmental attributes. Factors such as the availability of external supports and skills, avoidance of vendor lock-in are often cited (Dedrick & West, 2004; Goode, 2005; Morgan & Finnegan, 2007).The lack of those factors and ownership are among the drawbacks – which encourage the companies to search for available skills and support. This differs with the proprietary

software where there is a legal comfort from a signed guaranteed maintenance contract signed.

2.8 Chapter Summary

This chapter had presented the related studies on the Opens Source System ("OSS Adoption Statistics Malaysian Public Sector Open Source Software Programme,") as well as the technology adoption theories. The background of OSS and the initiatives in Malaysia are also elaborated in this chapter. This study adopt the Tornatzky and Fleischer (1990) TOE framework. The underlying theory of Innovation Diffusion (DOI) was also being discussed in this chapter.

Chapter 3 Research Methodology

3.1 Introduction

The previous chapter discussed about theories that are related to technology adoption. This chapter presents the proposed research model, development of the hypotheses as well as the selection of measures and the questionnaire design. The sampling design and data collection procedure, as well as the analysis technique used in this study are also explained.

3.2 Development of Hypotheses

Relative Advantage

Rogers (2003) defines *relative advantage* as the degree to which innovation is perceived as better than the idea it supersedes. A number of rigorous studies (Dedrick & West, 2003, 2004; Morgan & Finnegan, 2007, 2010) also indicate that relative advantage is one of the factors that influence the decision in the adoption decision. Dedrick and West (2003) in their study of Linux adoption states that the relative advantage of OSS as compared to proprietary systems is perceived in terms of cost and reliability. Cost consists of the hardware and software cost which were deemed as important relative to the advantage of OSS. Switching cost for the labor and human to adopt the new technology which includes the cost of training and evaluation depend largely on the availability of IT skills in the organization (Dedrick & West, 2003).

This is supported by recent studies where these factors has a negative impact on the adoption of OSS (Morgan & Finnegan, 2007; Ven & Verelst, 2012).

OSS is also reliable enough for most tasks but it is still lacking of it for critical applications. Those studies were done by interviewing the MIS managers. However, this study is more interested in finding out the level of OSS adoption based on the managerial perspectives of the organizations in Malaysia. Therefore, Hypothesis 1 reflects the relationship described here:

> H1. *Perceived higher relative advantage of OSS is positively affecting the adoption of OSS.*

Compatibility

The adoption of open source systems is greatly influenced by the compatibility of the new technology with current technology, skills and tasks (Dedrick & West, 2003; Gurusamy & Campbell, 2012). Adoption is greatly influenced by the compatibility of the new technology with the current infrastructures, skills and tasks (Dedrick & West, 2004; Glynn et al., 2005). The compatibility of the new technology with the current systems is a major factor as mentioned in Dedrick and West's study. The respondents prefer the platform with the largest variety of applications. Skill sets of the IT staff in the organization also plays as a determinant role in the adoption as it would ensure a smooth and manageable adaptation of the new technology (Dedrick & West, 2004).

Therefore, in this study the aspects of technology and skills are explored to see whether they could influence the adoption. Thus, we reflect on the second hypothesis:

> H2: *Perceived higher compatibility of OSS is positively related to the adoption of OSS.*

Complexity

Complexity is the level to which an innovation is perceived as difficult to understand and use (Rogers, 2003). Lack of the IT skills as well as knowledge on OSS would be a resulted in complexity issue causing it to be a technical drawback (Ellis & Belle, 2009; Morgan & Finnegan, 2007). The organization will find it difficult to find the right expertise and to develop the right skills (Morgan & Finnegan, 2007). It would be a high investment for the organization to train the existing resources and thus this becomes a barrier in adopting the software. Hypothesis 3 is then developed as below:

> H3: *Perceived complexity of OSS is negatively affecting the adoption of OSS.*

Trialability

Trialability can be defined as the ability to try out the software at a very low cost as it could be downloaded for free from various sources or run on the existing hardware (Dedrick and West, 2004). As supported by Rogers (2003), the organization would be more likely to adopt the OSS in which the innovation can be tried and assimilated in small chunks over time. It is then proposed that hypothesis 4 is to be constructed as below:

H4: *Perceived Trialability of OSS is positively related to the adoption of OSS.*

Top Management Support

According to Glynn et al. (2005), in OSS development, it is critical for the support from the top management as this contravenes the traditional model where support is legally guaranteed by a vendor. Morgan and Finnegan (2007) in their study also revealed the necessity of having top management support for OSS adoption. Both the benefits and drawbacks of an OSS influenced the decision to adopt OSS in organizations. Hence, Hypothesis 5 is derived:

H5: *Greater top management support of OSS is positively affecting the adoption of OSS.*

Knowledge and Expertise

Quality of the organization's human capital is being discussed by numerous study in different perspectives such as skilled personnel (Glynn et al., 2005), boundary spanners (Morgan & Finnegan, 2007; Ven & Verelst, 2006) and source code availability (Ven, Verelst, & Mannaert, 2008). Unlike proprietary software which has the vendor to turn to for support, OSS has none and relies on the organization's own skills and online OSS community (Dedrick & West, 2004). Gurusamy and Campbell (2012) stated that the lack of knowledge and experience with OSS in the organization made it harder for the organization to adopt OSS. This shows the relevance of having

knowledge and expertise of OSS in the organization in order for the organization to adopt OSS. The Hypothesis 6 is derived as below:

> H6: *Higher knowledge and expertise of OSS is positively related to the adoption of OSS.*

Technological Skills and Services

In the context of external environment, most literatures stressed the importance of the availability of external support and services and also the lack of it would be the reason for certain management rejections as well as business drawbacks. (Goode, 2005; Morgan & Finnegan, 2007). OSS users have to rely on the collaborative support from the online community, whose services are not guaranteed to be available (Dedrick & West, 2003). This affects large corporations who have the necessary resources to pay for formal support agreements and has less of an effect on small businesses that often rely on in-house skills and community support. Vendor lock-in was also often being cited as one of the difficulties to extend the use of the software (Dedrick & West, 2003; Miralles, Sieber, & Valor, 2005; Ven & Verelst, 2012). The following hypothesis can therefore be established:

> H7: *Higher availability of technological skills and services is positively related to the adoption of OSS.*

Platform Long term viability

It is an important factor to ensure that the OSS product is viable for a long term. Many organizations prefer platforms which are perceived to be the winning standard (Dedrick & West, 2003). Broadly accepted technology standards will have a greater investment as well as vendor support. This is also supported by most of the OSS adoption studies (Chau and Tam's 1997; Dedrick and West 2003) where high perceived performance for multivendor standards would be a characteristic of the open systems innovation. Based on this, hypothesis 8 is proposed as below:

H8: *Greater platform long term viability is positively affecting the adoption of OSS.*

Below Table 3-1 summarized the literatures reviewed in developing the hypotheses:

Table 3-1: Summary of Literatures Reviewed in Hypotheses Development

Technological Factors	
Relative Advantage	The level to which an advantage is perceived as better than the idea it supersedes (Rogers, 2003). The relative advantage of OSS as compared to proprietary systems is perceived in terms of cost and reliability.(Dedrick and West, 2004)
Compatibility	The degree to which an innovation is perceived as being consistent with the existing values, past experiences and needs of potential adopters (Rogers, 2003). Adoption is greatly influenced by the compatibility of the new technology with the current infrastructure, skills and tasks (Dedrick and West, 2004, Glynn et al., 2005).

Complexity	The level to which an innovation is perceived as difficult to understand and use (Rogers, 2003). Lack of the IT skills as well as knowledge on OSS (Ellis & Belle, 2009; Morgan & Finnegan, 2007)
Trialability	The degree to which the innovation can be tried and assimilated in small chunks over time (Rogers, 2003). The ability to try out the software at a very low cost as it could be downloaded for free or run on the existing hardware (Dedrick & West, 2004; Morgan & Finnegan, 2010).
	Organizational Factors
Top Management Support	Senior management supports the adoption of the innovation (Morisio, 2000; Glynn et al., 2005).
Knowledge & Expertise	Quality of human capital (Glynn et al., 2005) Boundary spanners (Morgan & Finnegan, 2007; Ven & Verelst, 2006) Source code availability (Ven, Verelst, & Mannaert, 2008) Dependency on their own skills and online OSS community (Dedrick & West, 2004)
	Environmental Factors
Technological Skills & Services	The availability of external skills and services that are required to utilize OSS (Dedrick and West, 2003,2004). Lack of available application support was a critical barrier (Goode, 2005) Avoidance of vendor lock-in (Dedrick & West, 2003; Miralles et al., 2005; Ven & Verelst, 2012)
Platform long term viability	Platforms which are perceived to be the winning standard (Dedrick & West) High perceived performance for multivendor standards would be a characteristic of the open systems innovation (Chau and Tam's 1997; Dedrick and West 2003)

Table 3-2 below is a summary of the hypotheses development. Altogether, there are eight hypotheses:

Table 3-2: Summary of Hypothesis

No	Hypothesis
	Technological Context
H1	Perceived higher relative advantage of OSS is positively affecting the adoption of OSS.
H2	Perceived higher compatibility of OSS is positively related to the adoption of OSS.
H3	Perceived complexity of OSS is negatively affecting the adoption of OSS.
H4	Perceived trialability of OSS is positively related to the adoption of OSS.
	Organizational Context
H5	Greater top management support of OSS is positively affecting the adoption of OSS.
H6	Higher knowledge and expertise of OSS is positively related to the adoption of OSS.
	Environmental Context
H7	Higher availability of technological skills and services is positively related to the adoption of OSS.
H8	Greater platform long term viability is positively related to the adoption of OSS.

3.3 Theoretical Framework

After much deliberation on the related literatures and generating the hypotheses generation for this study, the proposed framework is illustrated in Figure 3.1 below. The framework consists of 8 independent variables, which is postulated to affect the dependent variable which is the OSS adoption.

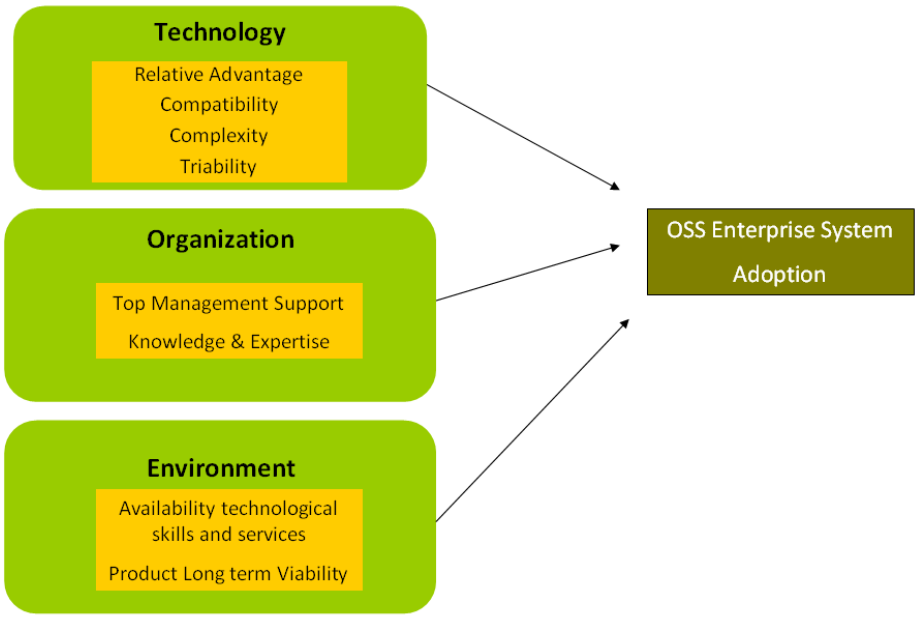


Figure 3-1: Theoretical Framework

3.4 Development of questionnaires

In order to gather the data, a questionnaire was developed and designed to measure the perceptions on each of the hypothesis that has been developed. Questionnaire survey have been commonly used in previous organizational technological innovation adoption (Chau & Tam, 1997).

One of the advantages of using the questionnaire method is that the administration of these questionnaires to large numbers of individuals is less expensive and the time taken to do that is less consuming than interviewing individuals (Sekaran & Bougie, 2010). At the same time, the respondent can complete the questionnaires at their convenience (Sekaran & Bougie, 2010; Zikmund, Babin, Carr, & Griffin, 2012).

The development of the questionnaires is based on the measurements adopted from previous studies that used Tornatzky and Fleischer (1990) TOE model. The measurements of the variables is an essential part of research and a significant aspect of quantitative research design (Cavana, Delahaye, & Sekeran, 2001). The following sections will be discussed in detail on how each variable is measured.

3.4.1 Dependent Variable

The dependent variable that was used to confirm the validity of the hypotheses are summarized and categorized in Table 3-3 below. Instruments of this dependent variable are taken from prior researches. However, these instruments were being rephrased as no exact instruments could be found for OSS.

Table 3-3: Dependent Variable Measurements of OSS Adoption

Factor	Item	Source
Dependent Variables		
OSS Adoption	OSS implementation in the organization	Srinivasan, Lilien, and Rangaswamy (2002)
	Impact on business performance	Srinivasan et al. (2002)
	Capability to support business process	Scupola (2003)
	Change of business process	Scupola (2003)

3.4.2 Independent Variable

Table 3-4 below represents the independent variables that were used to measure the hypothesis developed in item 3.2. Similar to dependent variables, the instruments are adopted directly from the previous studies as listed in the column source in the table below or should the instrument not be found, it will then be rephrased to adopt the OSS implementation.

Table 3-4: Independent Variable Measurements of OSS adoption

Factor	Item	Source
Independent Variables		
Perceived Relative Advantage	Hardware Cost	Dedrick & West (2004), Ellis & Van Belle (2009), Ven & Verelst (2012)
	Software Cost	Dedrick & West (2004), Ellis & Van Belle (2009),Ven & Verelst (2012)
	Switching Cost	Dedrick & West (2003),Ven & Verelst (2012)
	Software license	Gurusamy & Campbell (2012)
Perceived Compatibility	OSS system's features as per proprietary	Gurusamy & Campbell (2012)
	Co-existence with current key applications.	Glynn et al (2005)
	Good fit with current IT architecture	Dedrick & West (2004),Glynn et al (2005) , Gurusamy & Campbell (2012)
	Organizational fit as per business needs	Dedrick & West (2004),Gurusamy & Campbell (2012)
	Matches well with the organization's need	Gurusamy & Campbell (2012)
Perceived Complexity	Difficult to use	Scupola (2003), Ellis & Belle (2009)
	Learning to operate is hard	Scupola (2003)
	Interaction is confusing	Scupola (2003)
	Takes a long time to use successfully	Scupola (2003)

Perceived Trialability	Ability to test the software	Gurusamy & Campbell (2012)
	Less difficult to try out	Morgan & Finnegan (2010)
	It is useful to try out the software	Morgan & Finnegan (2010)
Management Support	Enthusiastic on adoption	Goode (2005)
	Top management's willingness to invest	Goode (2005)
	Support OSS initiatives	Gurusamy & Campbell (2012)
	Resource allocation	Goode (2005)
	OSS relevance to business	Goode (2005)
Knowledge & Expertise	Right expertise for OSS implementation	Gurusamy & Campbell (2012)
	Sufficient training / awareness	Ellis & Van Belle (2009)
	Understanding on OSS systems / product knowledge	Ellis & Van Belle (2009)
	Right expertise for OSS support	Dedrick & West (2004), Gurusamy & Campbell (2012)
Technology Skills & Services	There are enough skilled OSS Support (Online Community) available to support our organization's OSS enterprise systems	Ellis & Van Belle (2009), Macredie & Mijinyawa (2011)
	External support services (vendors)	Dedrick & West (2003), Ellis & Van Belle (2009), Ven & Verelst (2012)
	Technical information availability	Glynn et al (2005)
	Availability of IT-skilled worker	Dedrick & West (2003),
	Avoid vendor lock-in	West & Dedrick (2003,2004), Ven & Verelest (2012)
Platform Long Term Viability	Software features	Gurusamy & Campbell (2012)
	OSS Security	Gurusamy & Campbell (2012)
	Winning standards platform	Ellis & Van Belle (2009)

3.5 Sampling Design

The target population was the Malaysian organizations that were using OSS as their key application. A sample size of 300 was expected. The targeted respondents were

the IT and non IT managers who were involved in adopting the OSS systems. Designation od the IT managers and non IT managers for the target population may include IT Manager, Team leader, Project manager and middle management.

3.6 Data Collection Procedure

3.6.1 Questionnaire

This study used quantitative survey to collect the primary data, and this was done by using a structured, closed item questionnaire. The questionnaire was divided into four sections:

- Section A: Demographic Profile
- Section B: Company Profile
- Section C: Open Source Adoption
- Section D: Open Source Adoption Factors

Section A: Demographic Profile

This section is intended to collect the respondents' demographics data including gender, age, education level and current role in the organization. This section is used to filter out the respondents whose current position is not managerial level.

Section B: Company Profile

This section requested the respondents' organization's profile such as the organization name, the type of industry, size of the company and also what are the

OSS system used in the company. By indicating the organization's name, duplicate answers can be filtered out. This is to ensure that the analysis is based on the organization and not the individuals.

Section C: Open Source Adoption

This section determined whether or not the organization adopts OSS and measured the impact of the OSS on business performance and business process.

Section D: Open Source Adoption Factors

The final section then represents the OSS determinants factors based on the hypothesis developed in item 3.2.

The measurements of Section C and Section D were using the seven-point Likert scale, where a 'seven point' score meant that the item was the most agreeable and a 'one point' score meant that it was the most disagreeable item.

Data was collected in two phases namely in a pilot study and in the final survey questionnaires.

3.6.2 Pilot Test

In order to get feedback on the questionnaires that was developed, they were sent to a subset of the population sample. The objective of the pilot testing was to test out the

complexity of the questionnaires and the time it would take to complete the questionnaires.

Thirty respondents from various organization participated in this pilot test. Surveys were sent using email to the respondents requesting them to answer it online through Google Docs. The results of the pilot study indicated that the respondents had no difficulty with the questionnaires and were able to answer them in an average time of 5-10 minutes. Only two respondents commented on the questionnaires structure. Based on the feedback, a small modification was made to the final survey. The rest of the respondents did not give any feedback. It can be safely said that the questionnaires were clear and comprehensible.

The results were being tested for reliability using the Cronbach's alpha coefficient. The alpha coefficient results are as per Table 3-5 below, where the variable factor of the OSS adoption resulted at 0.905. For independent variables, Table 3-6 shows alpha coefficient for technological instruments, which resulted at 0.812, organizational at 0.966 and environmental at 0.903. The closer Cronbach's alpha is to 1, the higher the internal consistency reliability (Sekaran & Bougie, 2010). Therefore, these figures indicate acceptable reliability levels for valid research.

Table 3-5: Reliability Analysis Result for Pilot Study – Dependent Variable

Variable Factor Reliability Statistics

Factor	Cronbach's Alpha	Cronbach's Alpha Based on Standardized Items	N of Items
OSS Adoption	.905	.907	4

Table 3-6: Reliability Analysis Result for Pilot Study – Independent Variable

Independent Factor Reliability Statistics

Factor	Cronbach's Alpha	Cronbach's Alpha Based on Standardized Items	N of Items
Technological	.812	.827	16
Organizational	.966	.967	9
Environmental	.903	.904	8

3.6.3 Data Collection

In the final phase of the data collection, the survey was made available to both public and private organizations. The mode of data collection is via an online survey. This mode was selected as it easy to administer, inexpensive, can reach globally, ensure fast delivery and the respondents can answer the questionnaire at their convenience (Sekaran & Bougie, 2010). Sekaran & Bougie (2010) also indicated the disadvantage of this mode is where the respondents must have access to the internet in order to answer it as well as the respondents' computer literacy and that the willingness to answer the survey were dependent on the respondents. Thus, since the target respondents are managerial levels, it was assumed that the respondents do have access to the internet and was computer literate.

The questionnaires were updated to the online survey and its URL was sent to each of the respondent via online OSS communities and to the shortlisted public organizations derived from the 2012 OSS Initiative reports by MAMPU. For each of the organization, at least three addresses were being selected based on their designation in the listed staff directory available on their websites. Selection of the

designations are IT officers and above. This is to ensure that they are the managerial level.

For the private sector, social networks were being used. Request to participate the online survey was being posted in the OSDC.my's Facebook page as well as other online OSS community forum. The administrator of the page also promoted the posting to attract the participation of the survey.

The questionnaires contained a cover letter and the questionnaires form. The cover letter explained the purpose and objective of the survey. The respondents were assured of the confidentiality of their responses. It was requested that the survey was being completed within a week from the date the respondent received the questionnaire.

It was expected that the response to the online survey would be low, and so it would be difficult for the online survey to represent the sample. Therefore, follow up requests were sent to the recipients after three days.

3.7 Data Analysis Technique

3.7.1 Descriptive Analysis

Descriptive statistics were used to analyze the demographic profile of the respondents and the mean for each of the factors. To measure the dispersion of the interval scale,

variance and standard deviation was being used (Sekaran & Bougie, 2010). Descriptive statistics have a number of benefits:

I. Provides a description of characteristics of the sample

II. Checks the variables for any violation of the assumptions underlining the statistical techniques that is used

III. Assists in addressing specific research objectives.

In addressing the primary information relating to the characteristics of the OSS respondents in Malaysia, using descriptive statistics was considered suitable.

3.7.2 Normality Analysis

The rationale behind the hypothesis testing is based on normally distributed data (Field, 2009). Therefore, it is important to check the distribution to avoid flawed assumption. Both skewness and kurtosis values will quantify the aspect of distribution. Positive skewness will indicate there are too many low values in the distribution and negative skewness will indicate a flat and light tailed distribution. Positive kurtosis indicates a pointy and heavy tailed distribution while negative kurtosis will indicate a flat and light tailed distribution (Field, 2009).

3.7.3 Reliability Analysis

Zikmund et al. (2012) defined reliability as "the degree to which measures are free from random error and therefore yield consistent results". In other words, it offers consistent measurement by having measurements that are without bias (error free). Cronbach's alpha is an adequate test of internal consistency reliability in most cases (Sekaran & Bougie, 2010). The Cronbach's alpha indicates how highly the items in the questionnaire are interrelated in order to determine the instrument's reliability.

3.7.4 Correlation Analysis

The correlation is derived by assessing the variations in one variable as another variable also varies in other words, it is used to examine the association between each factors and the extent of it in relation to the OSS adoption. A Pearson correlation matrix will indicate the direction, strength and significance of the relationships among the variables that were measured at an interval (Sekaran & Bougie, 2010).

Correlation analysis indicates if a linear relationship exists between two variables. The correlation coefficient indicates whether the relationship is significant or not. By having a coefficient of 1.0, it is indicated that it has a perfect positive correlation and a negative correlation has coefficient of -1.0 (Coakes, Steed, & Ong, 2010). The cause of the relationship is unknown but from the correlation analysis, we know that the variables are associated with one another.

3.7.5 Factor Analysis

Factor analysis is a procedure to reduce the number of variables which are being used "to reduce a data set to a more manageable size while retaining as much of the original information" (Field, 2009). The reduction of data can be achieved by looking at the variables that correlate highly with a group of other variables. It also does not correlate for other than the group's variables. This is also used to identify which variables show the relationship. The variables should represent indicator of some common underlying dimension or concept (Field, 2009), which in this study are the factors that represent the 3 contexts, technological, organizational and environmental.

3.7.6 Multiple Regression Analysis

Regression analysis is used in a situation where one independent variable is hypothesized to affect one dependent variable (Sekaran & Bougie, 2010). Simple regression uses a single predictor of the dependent variable and multiple regression uses two or more predictors of the dependent variable (Field, 2009). There are three major regression models: standard or simultaneous, hierarchical and stepwise regression. In standard or simultaneous method, the independent variables are entered in the equation all at once to examine the relationship between the whole set of predictors and the dependent variable. In the hierarchical multiple regression, the determinants of the order of independent variable entry is based on theoretical knowledge (Coakes et al., 2010).

In stepwise regression, the number of independent variables entered and the order of entry are based on purely mathematical criteria. The method of entry can be forwards, backwards or a combination of both. Stepwise regression is a popular approach to variable selection as it assesses the contribution of each predictors to the regression model, based on the greatest contribution (Hair, Anderson, Tatham, & Black, 2006). The method preferred is the backward method due to the suppressor effects, which occur when a predictor has a significant effect but only when another variable is held constant (Field, 2009).

3.8 Chapter Summary

This chapter presented the research methodology and the framework used. The hypotheses are being constructed are based on the research variables. The framework will be the basis of this study on determinants of the OSS adoption in Malaysia. The list of tests done on the data was also discussed. These include descriptive statistics, normality, reliability, correlation, factor and regression analysis.

Chapter 4 Research Results

4.1 Introduction

This chapter presents the results of the study based on the analysis performed on the data that was collected through the survey. The analysis covers a summary of the statistics, descriptive analysis and the reliability and validity analysis. The results are discussed at the end of the chapter.

4.2 Data Overview

A total of 365 emails with the survey URL were sent out to shortlisted respondents based on 130 public sector organizations, and 264 emails turned out to be valid addresses. As mentioned in the data collection, for each of the organization, at least 3 email addresses were sent to each of organization. The email addresses were identified based on the listed directory of the respective organization's website. Out of 130 organizations, 64 replied via the online survey as well as 10 emailed the softcopy of the survey. This makes up a return response rate of 57%.

The social media was used to distribute the questionnaires to the private sector. This includes the OSS communities available over the Internet, such as OSDC.my discussion group on Facebook, Lowyat.Net forum, Bincang.Net forum, Putera.Net forum, Cari.Com Forum and ITTutor.Net forum. The response received from this media recorded about 52 responses where only 2 responses were invalid as they did not state the respondents' designation or their organization name and contained redundant data. Overall, the valid responses used in this study data were 124.

Table 4-1: Survey Collection Method and Response Rate

Data Collection Method	Respondent Targeted (org)	Response	Response Rate	Useable Response
Email	130 (129 valid)	74	57%	74
Social Media	Nil	52	Nil	50
		Total Useable Response		124

For the responses using the online survey, the questionnaires were being set as mandatory in section C and D. Therefore, there were no missing data recorded. For the responses via softcopy, there were no missing data recorded too. Thus, all responses were valid to be used for further analysis.

4.3 Descriptive Statistic

4.3.1 Company Profile Analysis

The respondents' company profile is summarized as per table 4-3 below:

Table 4-2: Demographic Profile of the Companies

Characteristics	Frequency	Percentage(%)
Type of Industry		
Computers / IT	20	16.1
Education	10	8.1
Government	73	58.9
Manufacturing	1	0.8
Services	1	0.8
Telecommunication	5	4.0
Others	9	7.3
Company Size		
<150 Employees	21	16.9
150 - 250 Employees	4	3.2
250 - 5000 Employees	1	0.8
500 - 1000 Employees	5	4.0
>1000 Employees	20	16.1
Government	73	58.9

The highest figure for the industry type of the organization is the government sector (59%) followed by 16% from the computer / IT sector, 8% from the education industry, 4% are from the telecommunication industry and the remaining 7.3% from other industries. The rest of it is well distributed in the manufacturing and services industries.

For the company size other than government sector, 17% have less than 150 employees, about 16% of the companies have more than 1000 employees, 3.2% have 150 – 250 employees, 0.8% have 250 – 500 employees and the rest have about 500 – 1000 employees.

The survey also requested the respondent to indicate the OSS system implemented. The results are as per Table 4-4 below:

Table 4-3: OSS System Implementation

OSS System Implementation

	Frequency	**Percent***
Operating System	99	79.8%
Database	98	79.0%
Manufacturing	4	3.2%
Accounting / Financial	14	11.3%
Marketing / Sales	10	8.1%
Human Resource	18	14.5%
Enterprise Portals	48	38.7%
Others	31	25%

**percentage calculated based on n=124*

About 80% of the respondents implemented OSS for their operating system and database. Another highly implemented system is in enterprise portals where the percentage of implementation is about 38.7%. Implementation of OSS in

accounting/financial and human resource recorded about 11.3% and 14.5% respectively whilst manufacturing recorded the lowest with 3% implementation.

4.4 Analyses of Measures

4.4.1 Descriptive Analysis

Table 4-5 below summarizes the descriptive statistic of independent variables. These figures are calculated using IBM Statistics v20 software.

Table 4-4: Descriptive Statistics for OSS Adoption Independent Variables

Independent Variables Descriptive Statistics					
	N	**Minimum**	**Maximum**	**Mean**	**Std. Deviation**
Open Source System Adoption	**124**	**1.5**	**7**	**5.04**	**1.32**
Technology Context					
Relative Advantage	124	1	7	4.67	1.17
Perceived Compatibility	124	2	7	4.99	1.09
Perceived Complexity	124	1	6	3.53	1.20
Perceived Trialability	124	2	7	5.26	1.08
Organizational Context					
Management Support	124	1.80	7.00	4.66	1.33
Knowledge & Expertise	124	1.00	7.00	4.43	1.33
Environmental Context					
Technology Skills & Services	124	2.00	7.00	4.45	1.15
Platform Long Term Viability	124	2.00	7.00	5.09	1.05

In the technology context, perceived trialability recorded the highest means of 5.26 out of 7. This shows that on average, the respondents tend to agree that the ability to test out the open source system for free and the usefulness of the OSS were among the reason for the adoption of the OSS.

The results also indicate that by implementing OSS, it provides relative advantage to the organization. This is shown by having a mean of 4.65 out of 7. Therefore, based on overall results of descriptive statistics, the respondents indicate that the OSS implementation is not complex, easy to be used and learn as well as a shorter time for the OSS to be implemented successfully is shown in the perceived trialability.

In the organizational context, the mean response to this was positioned 'slightly agree' on interval of the agreement scale (mean~ 4.6). This is reflected in the management support item, where the mean is reported at 4.66 and the internal knowledge and expertise at 4.43. This showed that the respondents slightly agree that both factors play a role in adopting the OSS to the organization.

In the environmental context, platform long term viability factor had the second highest mean of 5.09. The results showed that on average, the factors of adopting the OSS are based on the features of the software, whether or not the solution is viable in the long term.

The respondents 'moderately' agree that there are enough IT skilled workers, availability of online community support as well as external support services by the vendors. Overall, the respondents agree that by implementing OSS, the organization can avoid vendor lock-in. This is reported by having the mean of 4.45 out of 7 for technology skills and services.

For the OSS adoption dependent variable, a mean of 5.04 was reported with standard deviation of 1.32. Further analysis was done based on each of the item in the OSS adoption. Table 4-6 below summarizes the descriptive statistic of dependent variables

Table 4-5: Descriptive Statistics for OSS Adoption Dependent Variables

Dependent Variables Descriptive Statistics

	N	Min	Max	Mean	Std. Deviation
OSS Adoption	**124**	**1.5**	**7**	**5.04**	**1.32**
Implemented OSS in systems and apps	124	1	7	5.27	1.50
Implemented with big impact to business process	124	1	7	5.05	1.46
Implemented with capabilities to support business process	124	1	7	5.12	1.41
Implementation substantially changed business process	124	1	7	4.72	1.42

As per Table 4-6 above, it is interesting to note that although the respondents indicates in Section B of the questionnaire, that their organization do have OSS systems implemented, when it comes to the first statement in OSS Adoption constructs, the responses given were ‘slightly agree’ and not ‘strongly agree’ based on the mean of 5.04 out of 7. Similar to the other responses of the OSS implementation, the average mean is ~5.0 where the OSS’s implementation has a big impact to the business performance as well as supporting the business process. It would seem that the respondent slightly agreed (mean=4.72) that the OSS implementation substantially changed the business process.

4.4.2 Test of Normality

The result of normality test is as reported in the Table 4-7 below:

Table 4-6: Normality Analysis of Independent Variables

Statistics

		Relative Advantage	Perceived Compatibility	Perceived Complexity	Perceived Trialability	Management Support	Knowledge & Expertise	Technology Skills & Services	Platform Long Term Viability
N	Valid	124	124	124	124	124	124	124	124
	Missing	0	0	0	0	0	0	0	0
Mean		4.6653	4.9871	3.5262	5.2608	4.6597	4.4315	4.4548	5.0914
Std. Error of Mean		.10542	.09748	.10799	.09736	.11938	.11905	.10312	.09422
Median		4.7500	5.0000	3.5000	5.3333	4.9000	4.2500	4.4000	5.0000
Mode		5.00	4.00	4.00	6.00	4.00	4.00	4.00	5.00
Std. Deviation		1.17385	1.08553	1.20248	1.08414	1.32934	1.32569	1.14830	1.04923
Variance		1.378	1.178	1.446	1.175	1.767	1.757	1.319	1.101
Skewness		-.531	-.427	.042	-.530	-.288	.043	.071	-.427
Std. Error of Skewness		.217	.217	.217	.217	.217	.217	.217	.217
Kurtosis		.871	.078	-.624	.385	-.383	-.444	-.298	.380
Std. Error of Kurtosis		.431	.431	.431	.431	.431	.431	.431	.431
Range		6.00	5.00	5.25	5.00	5.20	6.00	5.00	5.00
Minimum		1.00	2.00	1.00	2.00	1.80	1.00	2.00	2.00
Maximum		7.00	7.00	6.25	7.00	7.00	7.00	7.00	7.00
Percentiles	25	4.0000	4.2000	2.5000	4.6667	4.0000	3.5000	3.8000	4.4167
	50	4.7500	5.0000	3.5000	5.3333	4.9000	4.2500	4.4000	5.0000
	75	5.4375	5.8000	4.2500	6.0000	5.5500	5.2500	5.1500	6.0000

The results show that the skew values for each of the variables are close to zero. The further the value from zero, the more likely that the data is not normally distributed (Field, 2009). The data for relative advantage, perceived compatibility, perceived trialability, management support and platform long term viability's data are slightly distributed to the right where the skew value is negative. The kurtosis values for these variables are positive which indicate that it is a pointy and heavy tailed distribution. A histogram for these data is available in the Appendix 3.

4.4.3 Reliability and Validity

As stated in the previous chapter, the reliability of a measure indicates that the items are free from error to ensure the consistency in the measurements. The reliability scale text would be utilized to determine the instruments validity. The common indicators of internal consistency is Cronbach's alpha coefficient (Pallant, 2011). Validity of scale refers to the degree to which it measures what it is supposed to measure. In this study, 37 items were used that make up 8 constructs that were tested for their reliability.

Table 4-7: Reliability Statistics for Research Variables

Reliability Statistics			
	Cronbach's Alpha	**Cronbach's Alpha Based on Standardized Items**	**N of Items**
OSS Adoption	**.933**	**.933**	**4**
Technology Context			
Perceived Relative Advantage	.817	.815	4
Perceived Compatibility	.917	.918	5
Perceived Complexity	.880	.882	4
Perceived Trialability	.815	.813	3
Organizational Context			
Management Support	.938	.938	5
Knowledge & Expertise	.916	.916	4
Environmental Context			
Technology Skills & Services	.860	.860	5
Platform Long Term Viability	.782	.785	3

Table 4-8 above summarized the results from the reliability testing done on each of the constructs. The Cronbach's alpha results shows consistently high in all variables. The alpha for the OSS adoption variable is 0.933. In technology context, perceived relative advantage's alpha is 0.817, perceived compatibility's alpha is 0.917,

perceived complexity is 0.88 and perceived trialability is 0.815. Each of the item is then investigated for perceived relative advantage whether the value can be increased, if item software license is taken out. Therefore, for further analysis (factor and regression), this item will be excluded from the analysis.

The overall Cronbach's alpha result was high for the organizational context resulted high where the management support construct recorded with the highest alpha of 0.938 and knowledge & expertise with a record of 0.916. Thus, both items are highly reliable and valid for this analysis.

Lastly in environmental context, the technology skills and services' alpha is 0.860 and platform long term viability is 0.782. Further analysis was done to item technology skills and services' and found out that if item avoid vendor lock in is deleted, it can increased the alpha to 0.870. Thus, this item is taken out for the rest of analysis.

Nunnally (1978) recommended a minimum level of 0.7 for the Cronbach alpha. Therefore, all of the Cronbach alpha's score in this study are above the recommended value resulting in 37 reliable items to be used.

4.5 Testing of Hypotheses

To test the hypotheses, 2 tests were conducted for this research: correlation – based analysis and regression – based analysis. These two tests are discussed as per below:

4.5.1 Pearson Product-Moment Correlation Coefficient

Pearson correlation is used to explore the relationship between two variables. This will give an indication of the relationship direction whether it is positive or negative and also the strength of the relationship (Pallant, 2011).

Technological Context

Table 4-9 below shows the correlation of the OSS Adoption and the variables under the technological context.

Table 4-8: Correlation Table of Technological Context > OSS Adoption

Correlations

		Relative Advantage	Perceived Compatibility	Perceived Complexity	Perceived Trialability
OSS Adoption	*r*	.489**	.739**	-.383**	.557**
	Sig. (2-tailed)	.000	.000	.000	.000
Relative Advantage	*r*	1.000	.466**	.012	.296**
	Sig. (2-tailed)		.000	.891	.001
Perceived Compatibility	*r*		1.000	-.314**	.717**
	Sig. (2-tailed)	.000		.000	.000
Perceived Complexity	*r*			1.000	-.162
	Sig. (2-tailed)	.000	.000		.000
Perceived Trialability	*r*				1.000
	Sig. (2-tailed)	.000	.000	.000	

r= Pearson Correlation

**. Correlation is significant at the 0.01 level (2-tailed).

Based on Table 4-9, 2 constructs in the technological context have a strong relationship with the OSS adoption. Cohen (1987) in his study suggested the following guidelines for Pearson Correlation value:

Small r=.1 to .29

Medium r=.30 to .49

Large r=.50 to 1.0

Therefore, there is a strong relationship between perceived compatibility and OSS adoption where r=0.739, N=124. Similarly, perceived Trialability has a strong and significant relationship to the compatibility of the OSS system in the organization, r=0.557, N=124. For perceived relative advantage, there is a moderate relationship to the OSS adoption where r=0.489. The relationship for perceived complexity is also moderate negatively related as the r value is at -0.383. All of the items have a significance value of 0.

Organizational Context

Table 4-10 below shows the correlation of the OSS Adoption and the variables under organizational context.

Table 4-9: Correlation Table of Organizational Context > OSS Adoption

Organizational Correlations

		Open Source Adoption	Management Support	Knowledge & Expertise
Open Source Adoption	*r*	1	.633**	.668**
	Sig. (2-tailed)		.000	.000
Management Support	*r*		1	.791**
	Sig. (2-tailed)			.000
Knowledge & Expertise	*r*			1
	Sig. (2-tailed)			

**. Correlation is significant at the 0.01 level (2-tailed).

There is a strong correlation between the Organizational context and the OSS adoption variable where high level of management support, knowledge and expertise

are associated with the OSS implementation adoption. Based on Table 4-10 above, the management & support has a strong relation to the OSS adoption where r= 0.633 and the knowledge & expertise has r = 0.668 and the significance *p*-value of 0.

Environmental Context

Table 4-11 below shows the correlation of the OSS Adoption and the variables under the environmental context.

Table 4-10: Correlation Table of Environmental Context > OSS Adoption

Environmental Correlations

		Open Source Adoption	Technology Skills & Services	Platform Long Term Viability
Open Source Adoption	*r*	1	.524**	.576**
	Sig. (2-tailed)		.000	.000
Technology Skills & Services	*r*	.524**	1	.595**
	Sig. (2-tailed)	.000		.000
Platform Long Term Viability	*r*	.576**	.595**	1
	Sig. (2-tailed)	.000	.000	

**. Correlation is significant at the 0.01 level (2-tailed).

For the environmental context, there is a strong relationship between the item technological skills and services with the OSS adoption (r=0.524, *p*-value= 0). Platform long term viability also states a large correlation with the OSS adoption by having r = 0.576. Both have a positive relationship with the OSS adoption.

4.5.2 Factor Analysis

OSS Adoption

As stated in the previous chapter, factor analysis is conducted to check if the items can be reduced. Analysis is done based on each context. The first context is on the OSS adoption as reported below.

Table 4-11: KMO and Bartlett's Test

KMO and Bartlett's Test		
Kaiser-Meyer-Olkin Measure of Sampling Adequacy.		.851
Bartlett's Test of Sphericity	Approx. Chi-Square	433.983
	Df	6
	Sig.	.000

Pallant (2011) states that in order to verify the suitability of the data, the Kaiser-Meyer-Olkin Measure of Sampling Adequacy (KMO) value is .6 or above and the Bartlett's Test of Sphericity value is significant. Based on Table 4-12 above, the KMO sampling adequacy is 0.851 and the Bartlett's test is significant, p=0.000. Therefore factor analysis is appropriate.

Table 4-12: Total Variance Explained for OSS Adoption

Total Variance Explained

	Initial Eigenvalues			Extraction Sums of Squared Loadings		
Component	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %
1	3.338	83.461	83.461	3.338	83.461	83.461
2	.349	8.734	92.195			
3	.183	4.585	96.779			
4	.129	3.221	100.000			

Extraction Method: Principal Component Analysis.

As per Table 4-13, the principal components in the total variance analysis revealed the presence of one component with Eigenvalues exceeding 1, contributing 83.4% to the data. Thus, all the items listed in the OSS adoption will be grouped together to represent the construct.

Technological Context

KMO and Bartlet's test result is as per Table 4-14 below:

Table 4-13:KMO & Bartlett's Test for the Technological Context

KMO and Bartlett's Test		
Kaiser-Meyer-Olkin Measure of Sampling Adequacy.		.835
Bartlett's Test of Sphericity	Approx. Chi-Square	1233.866
	df	105
	Sig.	.000

The KMO test resulted with 0.835 for technology items with Bartlett's significance values at p=0.000. Therefore, these items are suitable for further analysis.

Table 4-14: Total variance explained for theTechnological context

Total Variance Explained

Component	Initial Eigenvalues			Extraction Sums of Squared Loadings		
	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %
1	5.857	39.047	39.047	5.857	39.047	39.047
2	2.919	19.462	58.509	2.919	19.462	58.509
3	1.910	12.736	71.245	1.910	12.736	71.245
4	.805	5.364	76.609			
5	.629	4.194	80.803			
6	.515	3.436	84.239			
7	.437	2.913	87.152			
8	.376	2.509	89.661			
9	.331	2.207	91.868			
10	.291	1.937	93.805			
11	.242	1.613	95.417			
12	.217	1.447	96.865			
13	.171	1.137	98.002			
14	.168	1.122	99.124			
15	.131	.876	100.000			

Extraction Method: Principal Component Analysis.

The three-component solution explained the cumulative variance of 71% with the same amount of variance contributions as the earlier testing as per Table 4-15 above. To support the analysis, the varimax rotation was performed to produce rotated component matrix.

For the technological context, as per Table 4-16 below, the results of the varimax rotation show that both items in relative advantage and perceived complexity are highly loaded in component 2 and 3 separately. Perceived compatibility and perceived trialability are highly loaded in 1 component.

Table 4-15: Rotated Component Matrix for Technological Context

Rotated Component Matrix[a]

	Component		
	1	2	3
Hardware Cost			.895
Software Cost			.835
Switching Cost			.813
OSS System Features are as per Propietary	.758		
Co-Existance with Curent Key Applications.	.814		
Good Fit Current IT Architecture	.771		
Organisational Fit as Per Business Needs	.818		
Matches Well with The Organisation's Need	.783		
Difficult to Use		.826	
Learning to Operate Would Be Hard		.884	
Interaction Would Be Confusing		.833	
Takes a Long Time to Use Succesfully		.842	
Ability To Test The Software	.675		
Less Difficult To Try Out	.868		
It is Useful To Try Out The Software	.794		

Extraction Method: Principal Component Analysis.
Rotation Method: Varimax with Kaiser Normalization.
a. Rotation converged in 5 iterations.

Organizational Context

KMO & Bartlett's test results for the organizational context as reported as per Table 4-17 below:

Table 4-16: KMO & Bartlett's Test for the Organizational Context

KMO and Bartlett's Test

Kaiser-Meyer-Olkin Measure of Sampling Adequacy.		.914
Bartlett's Test of Sphericity	Approx. Chi-Square	1052.522
	Df	36
	Sig.	.000

The KMO value for the organizational context exceeded the recommended value at 0.914, which is considered as best (Walker & Maddan, 2008). The next step is to

extract the factor using the principle component analysis. Below Table 4-18 below presents the total variance explained fort the organizational context.

Table 4-17: Total Variance Explained for the Organizational Context

Total Variance Explained

Component	Initial Eigenvalues			Extraction Sums of Squared Loadings		
	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %
1	6.468	71.872	71.872	6.468	71.872	71.872
2	.797	8.858	80.729			
3	.430	4.778	85.507			
4	.348	3.870	89.377			
5	.281	3.117	92.494			
6	.241	2.673	95.167			
7	.190	2.108	97.275			
8	.139	1.548	98.823			
9	.106	1.177	100.000			

Extraction Method: Principal Component Analysis.

There is only 1 factor identified representing 71.87% of the common variance with Eigenvalues at 6.468. The rest of the factors have Eigenvalues less than 1, which do not contribute an average amount to explain the variance. Since there is only 1 factor, there is no rotated component matrix. Therefore, management support as well as knowledge and expertise can be grouped together as one factor.

Environmental Context

The next analysis shows the results for environmental context.

Table 4-18: KMO & Bartlett's Test for Environmental Context

KMO and Bartlett's Test		
Kaiser-Meyer-Olkin Measure of Sampling Adequacy.		.822
Bartlett's Test of Sphericity	Approx. Chi-Square	415.702
	df	21
	Sig.	.000

The above KMO values shows 0.822 which is above the acceptable value of 0.6. Therefore it is appropriate to do the factor analysis.

Table 4-19: Total Variance Explained for the Environmental Context

Total Variance Explained

	Initial Eigenvalues			Extraction Sums of Squared Loadings		
Component	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %
1	3.781	54.009	54.009	3.781	54.009	54.009
2	1.264	18.059	72.068	1.264	18.059	72.068
3	.607	8.678	80.746			
4	.502	7.167	87.913			
5	.321	4.582	92.495			
6	.311	4.441	96.936			
7	.214	3.064	100.000			

Extraction Method: Principal Component Analysis.

The principal component analysis for environmental context shows that there are 2 components that have Eigenvalues of more than 1 with a cumulative variance of 72%. The first component accounts for 54% of the variance related to the environmental context. The second component accounts for 18% of the variance. The rotated component matrix is then derived to identify the grouping of the item as per Table 4-21.

Table 4-20: Rotated Component Matrix for the Environmental Context

Rotated Component Matrix[a]

	Component	
	1	**2**
Availability Of Skilled OSS Support (Online Community)	.671	
External Support Services (Vendors)	.860	
Technical Information Availability	.878	
Availability Of It Skilled Worker	.850	
Software Features		.799
OSS Security Features		.827
Winning Standards Platform		.793

Extraction Method: Principal Component Analysis.
Rotation Method: Varimax with Kaiser Normalization.
a. Rotation converged in 3 iterations.

The principal component analysis groups the items into 2 components. Items in technological skills and services are being accounted in 54% of the variance and items in platform long term viability in 18% of the variance.

Based on the factor analysis done, 6 factors are being used for multiple regression analysis. The items are being identified accordingly to measure the underlying dimensions. The list of factors are relative advantage, perceived compatibility & trialability, perceived complexity, management support & knowledge expertise, technological skills and services as well as the last factor platform long term viability.

4.5.3 Multiple Regression

The standard multiple regression was applied to test the research hypotheses. This is due to the dependent variable which is a continuous variable and because as the scores are normally distributed (Pallant, 2011). The regression analysis is used to

"predict an outcome variable from one predictor (simple regression) or several predictor variables (multiple regression)" (Field, 2009).

The first analysis is done on the correlation of the new factors with the dependent variable In model summary Table 4-22, the overall model explains 80.3% of the variance. The R squares explained that the model explains 64.5% of the variance in OSS adoption.

Table 4-21: Model Summary

Model Summary[b]

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.803[a]	.645	.627	.79751

a. Predictors: (Constant), Platform Long Term Viability, Perceived Complexity, Relative Advantage, Technology Skills & Services, Management Support, Knowledge & Expertise, Perceived Compatibility & Trialability

b. Dependent Variable: Open Source Adoption

To look at the significance of the relationship between the factors, the ANOVA analysis was conducted. The results were as per Table 4-23. It is reported that the significance value is 0.00, where there is about zero chance in 1000 type 1 error. This also shows that the data reliability with the OSS adoption decision is strongly related.

Table 4-22 : ANOVA Table

ANOVA[a]

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	135.131	6	22.522	35.410	.000[b]
	Residual	74.415	117	.636		
	Total	209.546	123			

a. Dependent Variable: Open Source Adoption

b. Predictors: (Constant), Platform Long Term Viability, Perceived Complexity, Relative Advantage, Technology Skills & Services, Management Support, Knowledge & Expertise, Perceived Compatibility & Trialability

From the correlation table 4-24 below, 2 factors have high correlations with the dependent variable. The factors are perceived compatibility & trialability, The Pearson Correlation r value for perceived compatibility and trialability is 0.720 with and significance at p=0.00. The other factor is management support, knowledge & expertise resulted r=0.685 and its significance is at p=0.00.

Table 4-23: Correlations Table

Correlations

		Open Source Adoption	Relative Advantage	Perceived Compatibility & Trialability	Perceived Complexity	Management Support, Knowledge & Expertise	Technology Skills & Services	Platform Long Term Viability
Pearson Correlation	Relative Advantage	.387	1.000	.268	.081	.267	.256	.255
	Perceived Compatibility & Trialability	.720	.268	1.000	-.276	.711	.533	.703
	Perceived Complexity	-.383	.081	-.276	1.000	-.354	-.145	-.198
	Management Support, Knowledge & Expertise	.685	.267	.711	-.354	1.000	.612	.544
	Technology Skills & Services	.459	.256	.533	-.145	.612	1.000	.489
	Platform Long Term Viability	.576	.255	.703	-.198	.544	.489	1.000
Sig. (1-tailed)	Open Source Adoption		.000	.000	.000	.000	.000	.000
	Relative Advantage	.000		.001	.185	.001	.002	.002
	Perceived Compatibility & Trialability	.000	.001		.001	.000	.000	.000
	Perceived Complexity	.000	.185	.001		.000	.054	.014
	Management Support, Knowledge & Expertise	.000	.001	.000	.000		.000	.000
	Technology Skills & Services	.000	.002	.000	.054	.000		.000
	Platform Long Term Viability	.000	.002	.000	.014	.000	.000	

Table 4-24 : Coefficient Table

Coefficients[a]

Model		Unstandardized Coefficients		Standardized Coefficients			Correlations			Collinearity Statistics	
		B	Std. Error	Beta	t	Sig.	Zero-order	Partial	Part	Tolerance	VIF
1	(Constant)	.646	.521		1.239	.218					
	Relative Advantage	.217	.059	.216	3.650	.000	.387	.320	.201	.868	1.152
	Perceived Compatibility & Trialability	.485	.120	.375	4.025	.000	.720	.349	.222	.349	2.862
	Perceived Complexity	-.208	.066	-.191	-3.168	.002	-.383	-.281	-.175	.832	1.202
	Management Support, Knowledge & Expertise	.269	.092	.259	2.929	.004	.685	.261	.161	.387	2.586
	Technology Skills & Services	-.029	.077	-.027	-.371	.712	.459	-.034	-.020	.580	1.725
	Platform Long Term Viability	.114	.098	.091	1.153	.251	.576	.106	.063	.484	2.065

The coefficient analysis gives the estimates for standardizes beta. This value indicates the relationship of dependent variable and the predictor. As per Table 4-25, relative advantage has positive b-values (0.216) which indicate a positive relationship with OSS adoption. This is similar to perceived compatibility & trialability, management support, knowledge & expertise as well as platform long term viability where positive b-values are recorded. Two items showed negative relationship; perceived complexity and technology skills & services (b=-0.191 & b=-0.027).

Based on the significance values, it is identified that four factors are significant to OSS adoption. They are:

1. Relative Advantage
2. Perceived Compatibility & Trialability
3. Perceived Complexity
4. Management Support, Knowledge & Expertise

4.5.4 Hypothesis Testing

The first hypothesis (H1) tested on the relationship between perceived relative advantage and OSS adoption. As reported in the coefficient analysis above, the standardized coefficient (β) between perceived relative advantage and OSS adoption is 0.216 and the significance at 0.000, which is significant at $p < 0.05$. In other words, there is high level perceived relative advantage of OSS adoption in the organization. Thus, the result provides support for H1.

The second and fourth hypothesis (H2, H4) tests the relationship of perceived compatibility and trialability with OSS adoption. The standard coefficient beta (β) is 0.375 with significant level at p=0.000. This shows that the item is significant at $p <$ 0.05. With this, the perceived compatibility and trialability does significantly contribute to the OSS adoption in an organization.

The third hypothesis (H3) tests the relationship of perceived complexity with the OSS adoption. The regression table state the coefficient beta (β) at -0.191 and it is significantly contributed to the OSS adoption by having a significant level which is less than 0.05 (p=0.002). Thus, it is perceived that complexity has a unique contribution to the OSS adoption.

In the organizational context, two hypotheses were tested and during the regression analysis, both items were grouped together. The fifth hypothesis (H5) states the relationship between management support and the OSS adoption while (H6) relates the knowledge and expertise with the OSS adoption. The beta (β) value is at 0.259 and the significance level is at 0.004. Hence this results shows that management support, knowledge and expertise significantly contributed to the OSS adoption for the significant p<0.05 and does support H5 and H6.

In the environmental context, the seventh hypothesis (H7) relates the technological skills and services to the OSS adoption. As shown in the table above, the standardized coefficient (β) is -0.27 and the p-value is 0.712, which is more than p at 0.05. Hence,

the result does not support for H7 and H7 is insignificantly relates to the OSS adoption.

The last hypothesis (H8) tested on the platform long term viability relationship with the OSS adoption. The results in the table above, shows that the coefficient beta (β) is 0.091 and the *p*-value is 0.251 which is higher than *p* at 0.05. This means that the platform long term viability does not make a significant unique contribution to the OSS adoption. Hence, the result does not support H8.

Overall, two hypotheses are not supported by the results of the analysis and both of which are under the environmental context. On the other hand, both technology and the organizational context do have a significant contribution to the decision on the OSS implementation in the organization.

4.6 Summary of Research Results

In total 6 hypotheses are supported and 2 hypotheses are being rejected. The summary of the hypotheses testing results are shown in table 4-26 below.

Table 4-25: Summary of Hypothesis Testing Results

No	Hypothesis	Conclusion
	Technological Context	
H1	Perceived higher relative advantage of OSS is positively affecting the adoption of OSS.	Supported
H2	Perceived higher compatibility of OSS is positively related to the adoption of OSS.	Supported
H3	Perceived complexity of OSS is negatively affecting the adoption of OSS.	Supported
H4	Perceived triability of OSS is positively related to the adoption of OSS.	Supported
	Organizational Context	
H5	Greater top management support of OSS is positively affecting the adoption of OSS.	Supported
H6	Higher knowledge & expertise of OSS is positively related to the adoption of OSS.	Supported
	Environmental Context	
H7	Higher availability of technological skills and services is positively related to the adoption of OSS.	Rejected
H8	Greater platform long term viability is positively affecting the adoption of OSS.	Rejected

4.7 Discussion of Research Result

As per the factor analysis that has been made, the factors have been reduced to only 6. These are:

1. Perceived Relative Advantage
2. Perceived Compatibility & Trialability
3. Perceived Complexity

4. Management Support, Knowledge and Expertise
5. Technology Skills and Services
6. Platform Long Term Viability

From the regression analysis done, four out of six factors are being supported and indentified as significantly contributing to the OSS adoption in organizations. From the four factors, the two highest significant factors for the contribution to the OSS adoption are perceived compatibility & trialability as well as management support, knowledge and expertise with coefficient beta (β) at 0.375 and 0.259 respectively.

Perceived compatibility and trialability of OSS adoption is one of the important factors in deciding the OSS implementation. In this study, the respondents were asked whether the ability to co-exist with the current infrastructure and processes as well as the ease of use and testing significantly contributed to the adoption. Supported with previous studies, this factor is significantly important to the organization who adopts OSS (Dedrick & West, 2003, 2004; Glynn et al., 2005; Kshetri, 2005; Morgan & Finnegan, 2007; Ven & Verelst, 2008; West & Dedrick, 2005).

Management support, knowledge and expertise in the organization are also important as to support the usability of the system. This is supported by Goode (2005) study which reads that the management would be unwilling to explore the extant of an OSS should there be no business need, thus contributing to low support from the management. Ven and Verelst (2008) stated in their study that the organization that

cannot easily obtain both internal and external knowledge are less likely to adopt the OSS. Quite a number of literature discussed the existence of boundary spanners in the organization which also leads to the availability of OSS expertise in the organization (Dedrick & West, 2003, 2004; Glynn et al., 2005; Gurusamy & Campbell, 2012; Ven & Verelst, 2012).

Apart from these two factors, the other factors which also significantly contributed to OSS adoption is under the technology context, relative advantage (β= 0.216) and perceived complexity (β= -0.191).

Perceived complexity and perceived relative advantage are among important factor in the adoption decision of an OSS and the organization who perceives OSS as complex is less likely to make use an OSS (Ellis & Belle, 2009). The finding of relative advantage in the implementation cost (both hardware and software) is consistence with previous research (Dedrick & West, 2003, 2004; Glynn et al., 2005; Larsen, 2004; Lundell, 2006; Morgan & Finnegan, 2007) so is the incompatibilities of OSS to the existing infrastructure causing the organization to incur switching costs (Dedrick & West, 2003; Fitzgerald, 2003; Ghosh, 2005; Goode, 2005; Ven & Verelst, 2012) .

The findings also indicate that the OSS implementation is not complex and this is also being supported by Chau and Tam (1997) in their study. The adoption of a complex technology can be described as a process of accumulation and is not an 'overnight' event.

However, two factors in the environment context were not supported; technological skills and services and platform for long term viability. These two factors were strongly supported by previous studies (Dedrick & West, 2003; Ven & Verelst, 2012) but somehow they are not supported in this study. However, not all contexts discussed in this study have a direct impact to the adoption, which are also identified as depending on which the adoption takes place (i.e. different region), would have different results (Ven & Verelst, 2012).

4.8 Chapter Summary

This chapter presents the research results and the analysis. The data is analyzed based on descriptive statistics of the respondent's profiling as well as the reliability testing using Cronbach's alpha analysis, test of normality and correlation analysis using Pearson's correlation co-efficient. The data was then further analyzed using standard multiple regression to obtain the significance level as well as measuring the strength of relationships between the factors and the OSS adoption.

Chapter 5 Conclusion and Recommendation

5.1 Introduction

This chapter covers the summary of this study. It will start with a summary and conclusion as well as discussion on the limitation of this study. There will be suggestion for future work for other researcher and implications are also discussed.

5.2 Summary and Conclusion

This research uses the TOE theory of Tornatzky and Fleischer (1990) framework as a foundation to study the adoption of OSS from the Malaysia perspective. Three contexts were being investigated to understand the decision to adopt the OSS. The three contexts are technology, organization and environment.

Factors for each of the context were identified based on the previous studies done on OSS adoption and thus, data collection was performed based on a survey. In total, 124 organizations responded to the survey and the data was analyzed and grounded in the technology adoption literatures. The technology and organizational contexts were found to be significantly important in the OSS adoption in Malaysia. Four factors out of six were identified as the most important factors to the OSS adoption namely "perceived relative advantage", "perceived compatibility and trialability", "perceived complexity" and "management support, knowledge and expertise".

Based on the findings above, in Malaysia, there is a high level of OSS systems adoptions in the organization especially in the Government sector. This finding is supported by the initiative by the Government on the implementation of OSS systems in the public sector. Malaysian Administrative Modernization and Planning unit (MAMPU) has the capabilities of developing open source applications that can be used for free by all government agencies as well as various improvements have been made to the existing systems. Thus, with such efforts made, many small organizations and businesses have able to benefit form it.

This research also attempts to identify the variables and significant factors that relate to the OSS adoption as well as the level of the adoption. Thus the first question addressed in this research is "*What is the level of adoption of OSS enterprise systems in Malaysia?"*. Based on the results, the level of adoption is high especially in the government sector in Malaysia. As mentioned in chapter 4, based on the results, 73% of the respondents were from the government sector and another 27% were from various industries. The results also show a very high implementation in operating systems as well as the databases.

Research was then further conducted to analyze the significant factors that influence the manager's decision by constructing the second question "*What are the significant factors that influence a managers' adoption of OSS enterprise system"*. This question fulfills the first three objectives of the research by using the TOE framework as the basis.

The research adapts the Tornatzky and Fleischer (1990) framework and it uses the grounded theory developed by Dedrick and West (2003) to identify the factors for each of the contexts in the TOE framework. The first context that this research used is technological. In technological, four factors were being used: relative advantage, compatibility, complexity and trialability. From these four factors, this research managed to reduce the four factors to three factors. The three factors are perceived relative advantage, perceived compatibility and perceived triability and perceived complexity. All three factors were found significant to the adoption of OSS.

The second context this research focused on is the organizational which fulfilled the second objectives of this research. Two factors were being identified, management support as well as knowledge and expertise. During the factor analysis, these two factors were reduced to one i.e. "management support, knowledge and expertise". The results show that this factor is significant in relation to the OSS adoption. It is therefore safe to assume that it is important for any OSS implementation to have support from the top management as well as having internal knowledge and expertise. This is to ensure the success of the implementation. It is noted that support from management is because of the low cost that is associated with OSS implementation (Morgan & Finnegan, 2007).

The last context discussed in this study is the environment. Two factors were being identified; technological skills and services and platform long term viability. These

factors were being highlighted as important factors in adopting OSS in numerous studies but it have been proven not to be supported in this study. In Malaysia, these two factors do not influence the adoption of OSS in the organization. It could be due to the fact that Malaysian organizations consider other factors which are more important such as the monetary aspect or the relevance and requirements of the OSS to the business.

Without the technological skill and services, the organization would opt to have its own internal staff to support the system which is also relates to the availability of knowledge and expertise in the organization in the organizational context. This could be one of the reasons why technological skills and services factor was rejected in relation to the OSS adoption.

Similarly, for platform long term viability, the results showed that this factor was rejected in relation to the OSS adoption. As mentioned earlier in this study and defined by Coppola and Neelley (2004), the improvement of OSS are being contributed by the users or the community who have fixed or added new features to the software. Thus, it is not required for the OSS to be winning standards or enriched features in order for the user to implement the OSS.

5.3 Limitation to the Study

Based on the data, this study has several limitations that affect the generalization of the findings.

The first limitation is due to the unfairly distribution between the public and private sector and this is due to several of reasons:

1. Low response of the survey from the private sector as there is no specific list of such organization which implements the OSS in Malaysia. The distribution of the survey was by sending out email to the OSS community forum as well as by using the social media. Using this method, the target respondent cannot be reached.
2. During the data collection, there was a conference on Government OSS held (MyGOSS 2012). But the researcher was unable to participate in the conference due to the conference organizer's disapproval of the researcher's participation in the conference, hence contributing to the low data collection.

A second limitation to this research is the collection method of this survey. The main method of distribution is via email and the distribution list is only on the public sector based on the OSS adoption report by OSCC. Due to time constraints, the target respondents were being contacted via email. Thus, the response will be based on the recipients' decision on whether or not to participate with the survey. This may limit the researcher to generalize the findings.

A third limitation is due to the location of the organization, which is unfairly distributed where most of the organizations who responded were located in the Klang Valley and Putrajaya. Only a few of the organizations are from other states in Malaysia which do not represent the overall findings.

Lastly, this study was taken at the point of time of the OSS implementation. The results might differ by doing surveys on continuous usage or cross sectional surveys of the OSS implementation.

5.4 Suggestions for Future Research

It would be interesting to do an exploratory research of this study to investigate further the actual perceptions of managers on the OSS adoption. This is to address any other factors that were not counted such as the security features of the systems and source code availability.

Further study can also be done to differentiate the effects in the public and private sector separately as this study is generalized for both sectors. The significant factors might be different between the two sectors.

This study also can be extended to different levels of respondents. Data can be collected from the top management level in an organization to the end users. This is to explore different views of the OSS adoption in an organization.

Data can be collected from other states in Malaysia to generalize the findings. In the current study, data collected was mainly from the Klang Valley, Putrajaya and a few from Pulau Pinang, Pahang, Sabah and Sarawak.

The external support in the market could also use this research to create a better support and services to be offered to the organization. This research can also be duplicated by other practitioners in other regions to test out the effects especially in developing countries.

5.5 Implications

This study provides empirical study of the technological, organizational and environmental factors in Malaysia. Thus, giving managers some insight before adopting the OSS enterprise system.

This study shows that from the TOE framework, only two contexts are applicable in the Malaysia perspective. The contexts are technological and organizational. This shows that a different finding may result when conducted in a different region than the originated study. The findings from this study add evidence to existing studies on the OSS adoption specifically to those using the TOE framework.

For practical use, the findings from this study assist managers to concentrate on the significant factors for an OSS implementation in their organization.

- Managers should consider the *relative advantage* when evaluating the OSS application to the organization. In this study the respondents agree that the cost of implementation for hardware, software and switching cost were significant in adopting the OSS.
- *Compatibility and trialability* were also cited in various study of the OSS adoption (Dedrick & West, 2004; Glynn et al., 2005; Gurusamy & Campbell, 2012). The respondents preferred more compatible OSS platform to the existing applications to ease the transition process. Organizations would also like to be able to test the software before implementing it. And the same applies to the *complexity* factor. Similarly, this study has proven that these factors are significant with the OSS adoption.
- Top management support has proven to be a crucial factor in implementing the OSS. Thus, decision makers should ensure the 'buy-in' from the top management for a successful OSS adoption to the organization.
- The availability of internal *knowledge and expertise* is also another factor to consider when evaluating the OSS. Without internal knowledge and expertise, it is harder to adopt the OSS implementation in the organization.