

# How do Interoperability, Stability, Reliability, User Friendliness and Performance Influence Open Source Software Adoption in Malaysian Organizations?

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## ABSTRACT

Malaysian organizations are well acquainted with software applications in current global world. It is the necessity to adopt some software to engage to process of management positively and efficiently, while the main constraint is to enumerate whether the application is proprietary or an open source. This study examined the constraint and elements which affect the open source software adaptation in Malaysian organizations. For such purpose, different aspects of data have been gathered while focusing many sectors of Malaysia. After implication of different methodologies, it is asserted that plenty of factors prevail in the application while some significance has also been enumerated where the responses were also different from plenty of organizations in accordance to the surveys done.

**Keywords:** organizations, Malaysia, applications, constraints.

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## INTRODUCTION

With the advancement in technology, the way of work, study, and interaction have changed with the use of computer and Internet. In the Malaysian situation, most of the computer users use proprietary software such as Microsoft Office, Windows 9x/ME/NT/XP, Adobe Photoshop, Macromedia Dream weaver, and many more. OSS is not a technology, but it is a different way of thinking or concept on the software development process. With the emergence of OSS, every user, organization, government, and society is able to enjoy a low cost solution in computer related case. Basically, proprietary vendors of software charge from different aspects from their users. However, it is stated that field support cannot be charged. While some product users give answer to question from different free users (Harilal, 2014; De Silva et al., 2018a; De Silva et al., 2018b; Nikhashemi et al., 2013). In the OSS development, the source code of a computer is publicly available and shared via the Internet. During the early days, most of the open source projects started with a single programmer who mainly solves personal problems from other users and makes the solution available to others. At that time, some packages may not support with detail and full documentation, but a lot of improvement has been done for these packages from time to time. Based on a report, mentioned that during the business was generating profits through selling and supporting hardware. Special system of operation was inserted for each hardware devices (Baldiris, Santos, Huerva, Fabregat, & Boticario, 2008; Dewi et al., 2019; Pambreni et al., 2019; Tarofder et al., 2017). The users for these system were highly skilled and specialized IT experts and accountable for the additional software development.

In order to put an operating system which cannot be distributed on plenty of platforms, many efforts and man power were dedicated. The most prominent example for

operating system is UNIX that has been formed at laboratories. For those prominent one who were interested to use this operating system, they were required to provide fee before using it, whereas academic institution could use it under a nominal charge. UNIX is a very powerful operating system, as we can see that it was the main internet technology development and some other operating system such as MSDOS, Linux, and Windows (Demirors, Sklivanitis, Santagati, Melodia, & Batalama, 2014; Doa et al., 2019; Maghfuriyah et al., 2019; Nguyen et al., 2019). The father of OSS is Richard Stallman who believes that every computer user should have the right to share their needs and to be fit there. The website has a very detail explanation on this. During the early 1980's, while enhancing growth of software he resisted for which the developer kept the source code and then he started to built software of GNU. For the open source forming properly, it is necessary to clear the link amid commercial and proprietary software. On other hand, Linux has demonstrated how OSS can be successful in commercial. The next issue is about the protection of software source code by commercial software developers. A computer is a sequence of source code or series guidelines followed to let the system works. During the software development, the programmer also writes documentation which consists of aim and idea for every part for a systematic program. In order to software program, software programmers are required to use a compiler to convert computer source code into a form that can be operated the computer. There is nothing to do with the software as it is free but the right as shown in the following, free to start the program for any reason, freedom to alter the system to suit your requirements for acquiring source code to make this freeness affective in practice, free to supply copies, whether free or charge, freedom to distributed types of the system and benefits to the part from own effort if improvement has been done

(Hussein, Nouacer, & Radermacher, 2017; Pathiratne et al., 2018; Rachmawati et al., 2019; Seneviratne et al., 2019; Sudari et al., 2019; Tarofder et al., 2019). Again from The Dravis Group, Linux is having a wide supportability and it was also the first operating system for the Intel x 86 platforms. Today, Linux support includes the Compaq Alpha AXP, Sun SPARC and Ultra SPARC, Motorola 68000, Power PC, Power PC 64, ARM, Hitachi Super H, IBM S/390, MIPS, HP PA-RISC, Intel IA-64, DEC VAX, AMD x86-64, and CRIS architecture.

The system is prominent as a successful project in OSS project and valuable in many solution of software such as Web Sphere based on a report from Berlecon Research GmbH. A data base which is developed in 1994 initially and was created by some Europeans, MySQL is widely used in a lot of big organizations, which involved Cisco System, Motorola, Yahoo, NASA, (HP) and various has been fixed based of not fewer than 4 million users (Stamelos, Angelis, Oikonomou, & Bleris, 2002; Nikhashemi et al., 2017; Tarofder et al., 2019; Ulfah et al., 2019; Tarofder et al., 2016; Udriyah et al., 2019). In addition, Nu Sphere is one of the companies which distributed together other providers which integrate. The objectives of this research are to, identify and compare the adoption factors of OSS and proprietary software in a sample of Malaysian business organizations, identify factors that affect for adoption of OSS and proprietary software by Malaysian users in business organizations (Sigfridsson, 2010; De Silva et al., 2018a; De Silva et al., 2018b; Nikhashemi et al., 2013). In the early days, this program used started on the functional routine and on a flexible configuration file.

#### LITERATURE REVIEW

Distribution of licensing and software are of several forms in computer software industry. It is differentiated with other form which is the available price and source code. Source code is always written in high form of language programming such C++, Visual Basic, C#, PHP, and others. It is variant from code of binary where it is readable and understandable by computer, consisting of ones and zero (Khan & Shamimul, 2017; Dewi et al., 2019; Pambreni et al., 2019; Tarofder et al., 2017). The word "Open Source" is also known as a link which is alternative of accessible software. By an open source trade mark making, it would be easier to control over the concept, so that it would not meet the same fate as the term hacker which due to media and press almost acquired a criminal meaning.

It is necessary to include the code of source and its distribution must be allowed as well as compiling (Giannozzi et al., 2009; Doa et al., 2019; Maghfuriyah et al., 2019; Nguyen et al., 2019). Where some form of a product is not distributed with source code, there must be a well-publicized means of obtaining the source code for no more than a reasonable reproduction cost—preferably, downloading via the Internet without charge. The source code must be the preferred form in which a programmer would modify the program (Crowston, Wei, Howison, & Wiggins, 2008; Pathiratne et al., 2018; Rachmawati et al., 2019; Seneviratne et al., 2019; Sudari et al., 2019; Tarofder et al., 2019). Deliberately obfuscated source code is not allowed. Intermediate forms such as the output of a preprocessor or translator are not allowed.

According to the Office of Government Commerce (2002) in United Kingdom, one of the obvious reasons to use OSS is it is able to save a huge amount of money since OSS is free of charge. Intel IT Vice President, the company has

saved USD 200 million in a year by using Linux operating system instead of proprietary software (Lokare, Potdar, Pandya, Thakkar, & Patel). Since OSS comes with the source code, so it will guarantee the right to customize the software to suit the user's needs compared to proprietary software which will charge a certain amount of fee and require time to negotiate with them in order to get this feature.

Again, OSS has shown a dramatic advantage compared to some comparable proprietary software based on several studies. OSS has more effective development models than proprietary software model, massive independent peer review for both source code and design, and greater pride of authorship. All these contribute to this phenomenon. However, there are some companies which offer rewards for those who are able to find any bugs in their software (Valetto, Kaiser, & Phung, 2005; Nikhashemi et al., 2017; Tarofder et al., 2019; Ulfah et al., 2019; Tarofder et al., 2016; Udriyah et al., 2019). Overall, the usage of OSS is very difficult to estimate due to some reasons: Proprietary software vendors take the total amount of sold licenses and add an estimation of unlicensed copies to it. Unfortunately, this is only possible to apply in proprietary software but it is unable to use as in the case of OSS since no licenses are sold at all. However, the number of downloaded copies is also a poor indicator for usage because some people may download more than one copy or some people may use one copy and installed in many computers. So, it is uncertain to know how many computers are actually installed (Haefliger, Von Krogh, & Spaeth, 2008). The estimate is targeted especially at licenses which need good gesture of assent in order to form a contract amid licensee and licensor. Giving authorization about so called click wrap may contradict with important ways of distributing software such as FTP download CD-ROM, web mirroring and anthologies such provisions may also hinder code re-use.

Some patented proprietary file format is not able to be read by OSS. For example OSS could not read Microsoft's Advanced Systems Format (.asf) format. As in the real situation, software patents are given out without any strict policy. As a result, it is claimed that US Patent Office employees are measured on the number of patents granted, but not the total number of these accessed. Software patents are generally opposed by those who support OSS or free software (Krejcar & Cajka, 2010). In this case, a contractual regulation would be able to prohibit the software owner from publicly revealing discovered bugs within the software. As a result, this non communication situation would lead to a much less transparent and thereby to a much less secure condition under which the software is used.

Since the existence of OSS, it not came up with any sort of support, all the installation and troubleshooting is done by the user themselves (Dowling, Schäfer, Cahill, Haraszti, & Redmond, 1999). The companies of open source aim to give support and services on OSS, and there are some companies which specialize in giving upgrades, maintenance and technical support for OSS and software enabling systems. In addition, such organizations are widely engaged in development of OSS. With OSS, anyone with certain computer knowledge could contribute and provide any constraints and patches of security for software (Nečas & Klapetek, 2012). Compared with the proprietary software vendor, all the bugs fixing tasks are done by them alone which require longer time to complete. By practicing this concept in OSS, Meanwhile, OSS also based on some of its reliabilities and its quick

cycle of development that is able to come out with a quicker way to a stable implementation.

As we know, OSS comes along with the source code. This would be easier for the local developers to produce localized version software in any language (Yang et al., 2011). When it happens, it can access to a larger scope of ICT deployment into less developed and rural areas in Malaysia, thus bringing it into a more mature age in ICT and reducing the digital divide. Under the OSS concept, it provides free use of source code. A person may include the code either with or without modification in his/her own project (Albuquerque et al., 2007). However, if the source code has a copy left license it will require that project to release OSS as well. Sometimes, it is like a very large scale object orientation; where large chunks of source code can be reused and the users or developers require concentrating on new features or algorithms instead of reinventing the wheel to cover basic functionality. In other words, it means not wasting any effort to redevelop a code function, work, and software which already exist.

Mentioned that, about 6 years ago a public sector institution in France has increasingly use OSS solution for their business and systems, the Ministry of Defense has done a series of testing before installing OSS and Linux operating system in their system (Feller & Fitzgerald, 2000). Besides, around 400 servers are migrated from UNIX and NT to Linux at The Ministry of Culture and plan to set up their whole department on OSS by end of 2005. On the other hand, various OSS solutions such as Apache web servers and Perl are also being used at The Ministry of Justice (Dravis, 2003). They also think of migrating from PHP, MySQL and UNIX to Linux proprietary. Meanwhile, the industrial, financial and economical industry is migrating 950 servers and 60 workstations to Red Hat Linux 6.2 due to lower system requirements, costing, security, and reliability. Meanwhile, OSS helping in driving to production and invention of local goods produced or devices digitally in cheap ways. Where there is local piece of hardware locally produced, it will allow using of customized OSS to strive it and hence can offer manageable alternates to the computer (Sadoun, Al-Bayari, & Al Rawashdeh, 2014). On other hand, almost all of the OSS distribution under single line of "Public License" which provide that codes can be accessible with low cost of distribution for all users.

The real investment for IBM in Linux has been somewhat lower than stated because IBM has taken advantages of Linux and the open source movement. During its first year, IBM claimed to have almost recouped its investment through increased sales of their software and systems. At the same time, IBM also installed Linux to some of their mainframe systems (Neugebauer, MacDonald, & Tayler, 2010). In the same year, stated that almost all of the mainframe capacity processing sold by IBM in the fourth quarter of 2001 was for Linux. Almost all the Linux operating systems use the same suite of services and application such as server of apache, exchanging of send email, MySQL database, fixed and Open LDAP for the part name and service directory, and KDE and Gnome GUI environment. Besides, some of the software of closed source are established and allowed to use under platforms of open source (Bauer, 2018). Such kind of software evolves engines of database from IBM, Oracle and Sybase and Informix web servers for vendors. By switching from one platform to another will surely incur some cost on it and very difficult to avoid. Malaysia still lacks behind other countries in the computer industry of

software. By obtaining some sources that were inherent in OSS like technology transfer building and open source utilization, it would improve Malaysia's software industry position (Bonaccorsi, Giannangeli, & Rossi, 2006). Moreover, some organization and universities that are involved in research framework could help them to strive better for leveraging plenty of work existing in the world of open source and establish fresh services and technology which can be locally and nationwide commercialized. Promoting OSS in national education system would also be able to support ICT development and competency in computer software Malaysian industry. Besides, it could also help the economy to strive better in assisting aims of MSC and for better contributions.

Based on a report, it shows that HP has an advantage in incorporating Linux into its solutions compared to other hardware manufacturers. HP is capable of selling their hardware, solutions, and some proprietary operating system such like Microsoft Windows as a package (Renard et al., 2010). Traditionally, no source code is provided along with software since all of them are proprietary software they only have the same motive which is profit. In this case, people may not be able to modify the software and have to pay certain amount of money if needed. Now, the computer software is changing by practices OSS where source code is available for everyone and anyone who is interested can implement and modify the software, and learn the new technologies anytime. By practicing OSS concept in Malaysia, it would help the vision of nation to overcome all the flaws and can be consistent and reliable with adoption of technical and knowledge exporter. Currently, Malaysia have lack of developers of the system software in accordance to their competencies (Nichols & Twidale, 2002). This kind of talented people and skills are needed in order to implement Information and Communications Technology (ICT) and other local invented technologies. Once the adoption of OSS is being held in Malaysia, it will increase the rate and speed in advanced technology learning, skills and quickly enables the capabilities of technical education in achieving to be in par with other developed nations.

Those projects mentioned earlier are rather diverse and are the motivations behind Sun's engagement in open source project. Sun is buying the proprietary Star Office and later releasing it as OSS named Star Office as a marketing strategy to increase its reputation in the OSS community and weakening Microsoft at the same time (Liu, Tan, & Chen, 2013). A RM988 PC running a Linux-based operating system bundled with the Open Office productivity suite; and a RM 1,147 desktop with the Bahasa Malaysia version of the Microsoft Windows XP operating system and Works Suite 2004. Among the sales of units which were ten thousand in the start of month's persistent to the debut of brand, where Linux based machines were more than seven thousand in units.

Following are the hypothesis of this study;

H1: Performance/Speed, User Friendly, Reliability has impact on Adoption of Open Source Software.

H2: Stability, Security, Interoperability has impact on Open Source Software.

## METHODS

This study adopts a survey approach in order to determine the factors that are affecting the adoption of OSS in Malaysian organizations. A total of 200 questionnaires have been distributed to different company's CEO and I.T. staff. 128 questionnaires from 45

companies were returned, presenting a response rate of 70%. However, 12 participants have returned an incomplete form which is not able to analyze for this study. The organizations in were Malaysia from different states and industries. The sectors included such ones as insurance, banking, government, education and information technology. Secondary and primary data is to be collected in this study, where the data of secondary aspects is obtained from various sources about OSS adoption in different countries. Primary data about the various issued related to adoption and problems of adopting OSS will be collected from a sample of Malaysian business organizations. Data will be collected from personal interview with a questionnaire in hard copy form and also form an online format. While some independent variables to check the effect are User friendly, reliability, stability, security, interoperability and performance/speed while dependent variable is Adoption of software of open source compared with software of proprietary.

FRAMEWORK.

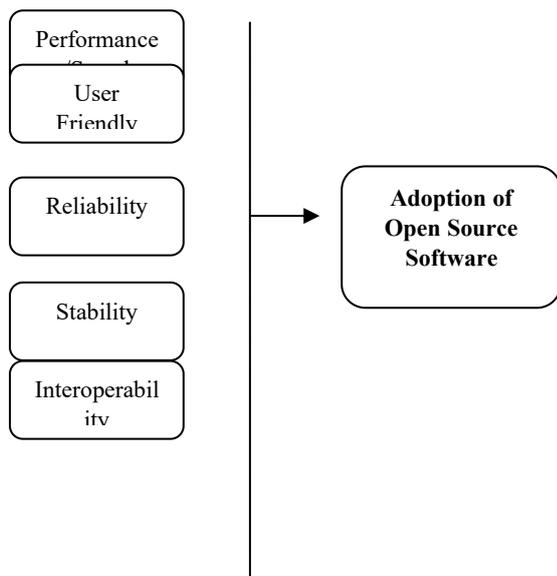


Figure 1: Dependent & Independent Variables

Some assumptions are made that the data and information that gathered regarding its usage, benefits, drawbacks, I.T. personnel, data collection methods, and the methods used to present the findings including in the review of related literatures will be valid and correct to provide the writer the necessary knowledge to develop, instruct, and implement this study.

**ANALYSIS**

The results from this study have been generated on the basis of data collected in this study where the interpretation of dependent and independent variables have been perform through different aspects and analysis.

Table 1: Descriptive statistics for problems faced in PS for both gender

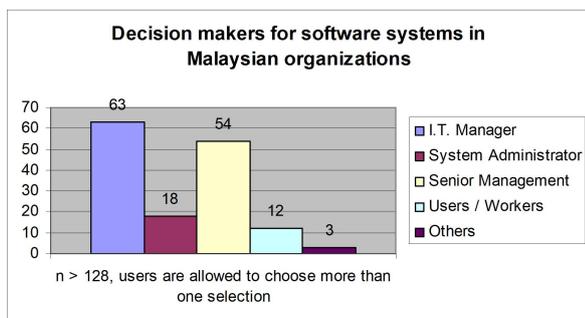
Descriptive Statistics					
	N	Minimum	Maximum	Mean	Std. Deviation
PS_Less_Func	115	1.00	5.00	2.6174	.88139
PS_Low_Perfm	115	1.00	5.00	2.6870	.85188
PS_Security	115	1.00	5.00	3.2957	.96404
PS_Cost	115	2.00	5.00	3.8609	.84694
PS_Prod	115	1.00	5.00	2.7913	.78913
PS_Update	115	1.00	4.00	2.5913	.97239
PS_Slow_Update_Cycle	115	1.00	5.00	2.9391	.95777
PS_Access_Source_Code	115	1.00	5.00	3.0087	1.29436
PS_Knowledge	115	1.00	5.00	2.9826	.71307
PS_Training	115	1.00	5.00	3.0261	.78875
PS_Choices	115	1.00	5.00	3.0261	.73103
PS_Unsure	115	1.00	5.00	3.0435	.70576
Valid N (listwise)	115				

In the interpretation of proprietary software it is analyzed from the problem that male users are unable to interact due to the security and increasing cost which disable them to allow the source code where the mean and standard deviation values are given as above. In interpretation of variables it is analyzed that performance is interacting with the standard deviation of .85 with an ultimate mean value of 2.69 which is rendering the weakness in achieving the problems of such software. In analyzing the users training and knowledge it is clear that the lack of training and knowledge unable to get acquainted with the true use of software where the standard deviation of training and knowledge is given as .78875 and .71307 with an ultimate mean value rendering 3.0261 and 2.9826. In this result, it is also denoting that the problems by proprietary are interrelated with each other. There is another context of the female users where the bugs and problems are very much clear via descriptive statistics. It further enumerates that update and access codes are giving standard deviation of .97239 and 1.29436 with the value of mean which is 2.9391 and 3.0087. All the elected values are stood still at minimum value of 1 while the cost value is rendered in this result is 2 where the maximum value is also rendered as 5 but the updating value of maximum is 4.

Table 2: Descriptive statistics for problems faced in PS for both gender

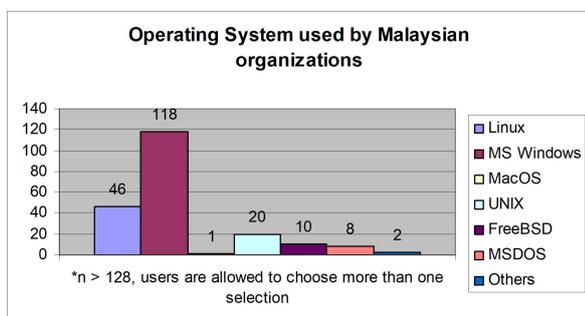
Descriptive Statistics					
	N	Minimum	Maximum	Mean	Std. Deviation
OSS_Less_Func	115	1.00	5.00	3.1217	.95649
OSS_Low_Perfm	115	1.00	5.00	2.7565	.82282
OSS_Security	115	1.00	5.00	2.9043	.99977
OSS_Cost	115	1.00	5.00	2.6435	1.01040
OSS_Prod	115	1.00	5.00	2.8087	.77114
OSS_Update	115	1.00	5.00	2.9304	.96174
OSS_Slow_Update_Cycle	115	1.00	5.00	2.9565	.88249
OSS_Access_Source_Code	115	1.00	5.00	3.1739	1.18663
OSS_Knowledge	115	1.00	5.00	3.2957	.89809
OSS_Training	115	1.00	5.00	3.3913	.89536
OSS_Choices	115	1.00	5.00	3.2609	.99196
OSS_Unsure	115	1.00	5.00	3.4000	.83561
Valid N (listwise)	115				

For the open source software, some t tests have been performed where the problems have been faced by the both genders, here the main problems are statute of functioning and the process of slow cycle of updating by rendering standard deviation value of .95649 and .88249 respectively while the values of means are different with them which further describes values of 3.1217 and 2.9565. There is description of both genders which are acquainted with the software where the open source software is an important mean which describes the familiarity and functioning with the analyzing modes.



**Figure 2: Decision makers for software systems in Malaysian organizations**

The results further describes that the users working in the organizations are acquainted with the software where most of the users are under the management where some restriction prevail with their workings. According to the graph it is describes at the respondents are under the managers of IT which is more than 60 % which further follows the orders of seniors, where the administrators are upper the seniors which are more than 15%. It is clear than senior management is approximately 54% holding authorities while the users and others are respectively more than 10% and less than 5%.



**Figure 3: Operating System used by Malaysian organizations**

According to the graph it is stated that, most of the organizations are using operating systems with certain elected respondent which renders the usage of Linux at 46 %, while the lesser is MacOS which places its usage at 1%. It is understood that MS windows are the most widely and continuous using operating system in the organization with having 118%.

**Factor analysis**

While reviewing above results following are the interpreted below analysis which renders the various opinions towards OSS.

**Table 4: Summary of rotated component matrix for opinions toward OSS**

Name of variables	Factor 1 Product features	Factor 2 OSS market prospect	Factor 3 Lack of software choice and improvement
OSS stability	0.451		
OSS security	0.439		
OSS functionality	0.804		

OSS user friendly	0.64		
OSS user support	0.719		
OSS replace PS	0.555		
OSS better than PS	0.632		
OSS ROI	0.791		
OSS advertisement	0.71		
OSS best alternative	0.671		
OSS high growth rate	0.572		
OSS less choice		0.754	
OSS needs improvement			0.698
Eigen values	4.431	2.218	1.216
Variance	34.348	17.18	9.637

While referring the factor analysis outputs which interpreted results according to the elected variables which denotes that factors 1 which is related to the features of product citing the variance of 34.348 whereas; factor 2 highlighting prospects of the OSS market is citing 17.18 with 9.637 with the attachment of factor 3 which shows the lack of software choice and improvement.

**Table 5: Summary of rotated component matrix for criteria of selecting software**

Name of variables	Factor 1 Product features	Factor 2 User knowledge and vendor related	Factor 3 Cost saving and user support
User friendly	0.553		
Reliability	0.814		
Stability	0.779		
Security	0.701		
Interoperability	0.808		
Access source code		0.613	
Functionality		0.842	
Avoid single vendor lock-in		0.815	
Increase I.T. knowledge/skills		0.854	
Cost reduction			-0.654
Performance / speed			0.613
Technical support			0.608
Eigen values	4.969	2.102	1.164
Variance	42.354	17.654	9.769

In the outputs of factor analysis the interpreted results according to the elected variables which denotes that factors 1 which is related to the product features enumerating the variance of 42.354 whereas; factor 2 highlighting user knowledge and vendor related is

enumerating 17.654 with 9.769 with the attachment of factor 3 which shows cost saving and user support.

**Table 6: Summary of rotated component matrix for problems faced in adopting OSS**

Name of variables	Factor 1 Product features	Factor 2 Productivity and product supportability	Factor 3 Knowledge, training and choices for software
OSS less function	0.745		
OSS low performance	0.738		
OSS security	0.541		
OSS cost	0.545		
OSS access source code	0.449		
OSS productivity		0.641	
OSS update online		0.82	
OSS slow update cycle		0.675	
Less choice in OSS		0.669	
Lack OSS knowledge			0.81
Lack OSS training			0.841
Unsure OSS product to use			0.601
Eigen values	4.189	1.669	1.334
Variance	34.921	13.949	11.154

In the explanation of problems faced by the adoption of OSS there are some variances which have been found out after the interpretation where the factor 1 variance showing 34.921, while the factor 2 and factor 3 which shows productivity and supportability and knowledge, training and choice for software is rendering the values respectively as 13.949 and 11.154. It is further explained as these factors are important which prevails while the adoption of OSS.

**CONCLUSIONS**

Identify and compare the adoption factors of OSS and proprietary software in a sample of Malaysian business organizations, Identify factors that affect for adoption of OSS and proprietary software by Malaysian users in business organizations, Identify the dimensions of the different factors faced in adopting OSS software by Malaysian users in business organizations, Compare the result of adoption of OSS with other countries to determine whether Malaysia is lacking behind. This paper aims to examine the issues related to the adoption of OSS in Malaysian organizations. For this purpose, questionnaires were distributed and data was collected from 128 I.T. executives in 45 organizations in Malaysia in various industries including automobile, banking, consultancy, education, electronics, factory, government, health care, hotel, housing development, Information Technology, and manufacturing in order to investigate

the progress and awareness of OSS in Malaysia. This data for this research is mainly collected from I.T. executives in 45 Malaysian organizations, the result might not as accurate with the actual situation. The respondents from each organization vary and different organization had different number of responses. On other hand, proprietary software has some benefits. For example Microsoft is a de-facto standard and thus has a higher level of adoption Some of the main parts of the policies proposed from government of Malaysia could emphasize solutions of open source along with the proprietary in procurement of ICT, government of Malaysia use product of ICT and their services were based on standards openly, government of Malaysia should enhance the open source in the programs and events of ICT and government of Malaysia should enable and give increments to development of open source via promotions and private and civil sector adaptations. In some countries such as France and Germany, open source is very popular for them and they are even in the top of the world in the adoption of open source. While most of the Asia countries such as Malaysia just started their footsteps on this. As the OSS is gaining more awareness among Malaysians, some government organizations such as PIKOM, MAMPU, MIMOS, and Asian Open Source Center (ASIAOSC) together with some big organizations such as Hitachi, SAP, Hewlett Packard, IBM, and Oracle have started to involve themselves to promote and encourage more and more of local companies and users to use OSS.

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