Best Practices and Recommendations Report For Implementing OSS in Government Agencies

E- Government Program – Yesser

Document Date: Jun 2017

Version v1.0
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1. Introduction

This document provides a literature survey on best practices as carried out by different countries for the introduction, awareness, implementation of open source software, and preparation of OSS policies. The document will also list a set of recommendations using which E-Government Program (Yesser) and government agencies can commence multiple initiatives to enable government agencies to adopt open source software. This document does not provide a national OSS strategy or policy. This report is mainly comprised of four major sections. Section 1.3 lists countries that are selected to identify best practices that are adopted on the promotion and use of OSS. Section 2 lists the elements related to OSS that the team will examine. Section 3 provides literature survey on the promotion and use of OSS. Section 4 provides recommendations. Finally, Section 5 summarizes the key discussion points that were collected during the site visits to the selected government agencies.

Governments around the world have favored the use of open source software as a matter of policy [1]. Most of the government and private sectors in many countries of the world are heading towards adopting and using Free and Open Source Software (FOSS) for their daily business operations. The main reasons for this trend are the following: (i) Open Source Software (OSS) are sometimes more efficient than commercial tools; (ii) cost of ownership and expenditure on Information Technology (IT) are low (from both operational and maintenance point of view); and (iii) data security capabilities and privacy options are better. In addition, there is a large knowledge bank developed by the community using OSS that helps fellow peers in improving OSS, adding new features, and strengthening the security. This preference has led them in saving cost on licensing, building human capital, reducing reliance on vendors, and creating IT jobs.

To achieve the same benefits, Kingdom of Saudi Arabia (KSA) has been promoting the use of OSS in public and private sectors for the past few years. Earlier in 2012, the government initiated a project under Communication and IT national plan [2] that sought to “encourage local programming industry to depend on free software for its programing requirements, and to create a thriving market through selling of services and technical support and cost saving
by becoming less dependent on software licenses for over-the-shelf-software. The project aimed at supporting open source applications, research, and development in this area”.

For this purpose, King Abdulaziz City for Science & Technology (KACST) established a center named “Motah” which acted as national program for the technologies of FOSS. The program encouraged and boosted using of FOSS through creation of partnerships with several partners from both the public and private sectors in order to meet the program’s objectives. The program provided and facilitated various activity aspects of the FOSS e.g. developing and supporting of software, building of open source resources, establishing of software digital library, and supporting of research in the area of open source software. Considering the crucial significance of this matter, an initiative for identifying the usage of open source software has been included in the e-Government 2nd Action Plan.

To continue the promotion of open source in public sector, Yesser e-Government Program initiated a project under the 2nd Action Plan entitled as “Promoting the Use of Open Source Software in the Government Sector”. The goal of the project is to promote implementation and use of OSS in government agencies, reduce reliance on commercial and proprietary software, and cut expenses associated with licensing costs, E-Government Program (Yesser) took the initiative as indicated in 2nd action plan and to carry on with the work started by KACST. As part of the initiative, E-Government Program (Yesser), with the consultation of KFUPM, documented best practices for promoting use of OSS in government sector. Using this document, government agencies in the Kingdom can take necessary steps for successful implementation of OSS, aid in building local expertise in software development, and assist the Kingdom to achieve its goal in the light of Vision 2030.

In addition, a survey is conducted to measure adoption of OSS in government agencies. Yesser and KFUPM conducted an OSS survey to identify the current status of OSS awareness and implementation. It is found that presence of OSS in the government sector of the Kingdom is very minimal. Moreover, agencies which implemented OSS are working independently. Platform and mechanism are needed for promoting OSS in all agencies so that benefits can be seen at the national level. Also, it is found that no standard OSS policy or practices exist at the national level that can govern implementation and use of OSS. See Appendix B for survey results and details.
Due to lack of awareness, lack of trust, insufficient human capital, education, and training, government agencies are mostly reluctant in implementing OSS solution. Due to these reasons, OSS is still in its early development phase in the Kingdom. The development of the OSS ecosystem in Saudi Arabia will help in building of human capital and localized solutions and will contribute to knowledge-based economy.

1.1 Background to OSS

Traditionally, when using commercial and proprietary software, certain undue cost is associated with the use of the software which include licensing, support, and maintenance. In addition, access to the source code is usually restricted by the software vendor. Typically, under the licensing agreement, reuse or redistribution of the software is prohibited by the vendor. In addition, customization of the software is generally restricted or the company has to pay a huge cost for implementing customized solutions. In the long run, use of proprietary software incurs in huge licensing cost, interoperability issues, and vendor lock-in.

In contrast to commercial software, OSS delivers a software development and distribution model where the software license ensures certain freedom to developers and end-users. Two of the main advantages for using OSS include: (1) the right to access and modify the source code and (2) to reuse and redistribute the software without any constraint or inappropriate cost. The major strength factors for using OSS include: (a) no licensing costs, (b) ease of integration with other software and data standards, (c) ease of customization, and (d) in-house development skills. The companies which use open source software may spend on vendors for maintenance services and support.
1.1.1 Definition of Open Source

In order to be labeled as “open source”, software needs to conform to one of the certified licenses of Open Source Initiative (OSI). The Open Source Initiative (OSI) is a non-profit corporation with global scope formed to educate about and advocate for the benefits of open source. One of the most important activities of OSI, as a standards body, is maintaining the Open Source definition.

According to the OSI, “Open Source” doesn’t just mean access to the source code. OSI has published 10 criteria to which each license must conform. These criteria form the basis of open source software. The distribution terms of OSS must adhere with the criteria:

**Free Redistribution**
The license shall not restrict any party from selling or giving away the software as a component of an aggregate software distribution containing programs from several different sources. The license shall not require a royalty or other fee for such sale.

**Source Code**
The program must include source code, and must allow distribution in source code as well as compiled form. 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. Deliberately obfuscated source code is not allowed. Intermediate forms such as the output of a preprocessor or translator are not allowed.

**Derived Works**
The license must allow modifications and derived works, and must allow them to be distributed under the same terms as the license of the original software.

**Integrity of the Author’s Source Code**
The license may restrict source-code from being distributed in modified form only if the license allows the distribution of "patch files" with the source code for the purpose of modifying the program at build time. The license must explicitly permit distribution of
software built from modified source code. The license may require derived works to carry a different name or version number from the original software.

**No Discrimination against Persons or Groups**
The license must not discriminate against any person or group of persons.

**No Discrimination against Fields of Endeavor**
The license must not restrict anyone from making use of the program in a specific field of endeavor. For example, it may not restrict the program from being used in a business, or from being used for genetic research.

**Distribution of License**
The rights attached to the program must apply to all to whom the program is redistributed without the need for execution of an additional license by those parties.

**License Must Not Be Specific to a Product**
The rights attached to the program must not depend on the program's being part of a particular software distribution. If the program is extracted from that distribution and used or distributed within the terms of the program's license, all parties to whom the program is redistributed should have the same rights as those that are granted in conjunction with the original software distribution.

**License Must Not Restrict Other Software**
The license must not place restrictions on other software that is distributed along with the licensed software. For example, the license must not insist that all other programs distributed on the same medium must be open-source software.

**License Must Be Technology-Neutral**
No provision of the license may be predicated on any individual technology or style of interface.
1.1.2 Open Source vs. Freeware

Similar to OSI, another organization called “Free Software Foundation (FSF)” promotes the use of “Free Software”. Both OSI and FSF allow users to have freedom of access to source code; FSF tends to focus more on ethical aspects of free software, while OSI inclines to help businesses in seeing the benefits of adopting as well as contributing to free software. For more details on FSF, please visit [http://www.fsf.org/](http://www.fsf.org/). Sometimes, users refer to FOSS as freeware which is not true. Freeware is usually a closed source or proprietary software that is available to download and use at no cost. Example of such software is Adobe Acrobat Reader. Similarly, there exists key differences that distinguish freeware and shareware from OSS. Freeware was often peddled to bolster a brand or spread awareness of a product. While these programs are free of cost, they are not free as in freedom. Users typically aren’t allowed to distribute the software without the permission of the owner. There are, however, some pieces of software where the owner or vendor provides permission to distribute, and those are known as shareware. Despite all this, even though one has a copy of the software, he is not permitted to alter it or sell it, and he doesn’t have access to the source code as well. FSF and OSI both refrain from this ideology and believe that software must be free of cost, and users have the freedom to do what they wish to do with it.

There exists a number of OSS licenses (with different versions as well) such as GNU GPL, Apache, BSD, and LGPL etc. While these licenses differ on certain ideas, they all enforce freedom of distribution, alteration, use, and sale of the licensed software in both binary and source code forms. Some of them are stricter than others in certain areas, e.g. GPL does not allow use of any code or statically linked library that is not GPL, thereby forcing develops of new code wishing to use GPL code to write more GPL code. The LGPL alleviates this restriction, but it’s still much stricter than other licenses. It’s important to note, though, that this does not restrict the freedoms of the author or the licensed code because the author is not forced to use GPL code and the GPL licensed code is protected from being incorporated into projects that are not open themselves [18].
1.1.3 Government Sector and OSS

Over the past decade, a noticeable increase in the maturity level of OSS products and services has been observed. This led to increase the trust associated with OSS and helped governments of many countries to engage and implement OSS. Despite many efforts in the Kingdom, very few agencies have adopted OSS. The main hurdles in gaining trust for OSS usage in government sector is due to lack of trust on open source solutions, misconceptions about OSS security, procurement culture, unease of getting man-power support, and maintenance support from vendors.

In order to introduce OSS in the government sector, policies need to be introduced that shall be able to change the mindset of the people who write business and IT requirements and do procurement decisions. One way of doing so is to ask vendors to propose both open source and commercial solutions, and procurement committee shall fairly compare both solutions and make decision accordingly.

Governments perceive definition of open source differently [1]; for example, Italy interpret open source as a feature rather than product or a software. Also, some countries (for example, European countries) mandate and prefer to use open source solution. On the other hand, countries such as United Kingdom (UK) sees this preference as a breach of competition law that fair competition among different vendors for the benefit of end-users. Furthermore, mandating open source would preclude the option of commercial software from the procurement process. For some governments, e.g. UK, it is yet to be proven that OSS provides better value for money when considering the Total Cost of Ownership (TCO). Therefore, Cabinet Office of UK takes the position that it will level the playing field for open source software, allowing departments to select the best value-for-money option.
1.1.4 Positive Sides of OSS

The main advantages of Open Source Software are the following:

- As the software and code freely available costs are lower, lower TCO.
- Ability to re-use open source code, reduces time and required resources.
- Promotes open source standards that enable interoperability of different systems.
- More stable and provides better security.

In general, pros of open source may include [1]:

- The acquisition, development and implementation costs are likely to be lower than for proprietary software. It is less likely that there will be upgrade costs. However, the total cost of ownership over the lifetime of usage must be taken into account.
- Data transferability; with open source code and a move towards open data formats, there are greater opportunities to share data across interoperable platforms.
- Increased opportunities for re-use. Reuse is enabled because open source is free from per user or per instance costs, and there is a guaranteed freedom to use in any way.
- Paying once for development (if at all) and reuse across government where appropriate, hence offering cost effectiveness.
- By virtue of their collaborative design, the interfaces of many open source products are intuitive for the user.
- Potential for fast cycle time of releases and bug fixes. However, this is dependent on whether or not there are people, resources and interest to develop the releases and bug fixes.
- Opportunities for customization and community innovation within government and the wider public sector and SMEs.
- Open source licenses do not limit or restrict who can use the software, the type of user, or the areas of business in which the software can be used. Therefore, OSS provides a licensing model that enables rapid provisioning of both known and unanticipated users and in new use cases.
- Open Source solutions are scalable in both directions – upwards and downwards with a reduction in the risk of longer term financial implications.
• Open source software can be operated and maintained by multiple suppliers encouraging competition and providing an opportunity for SMEs to compete in the government market.
• Open source software is particularly suitable for rapid prototyping and experimentation, where the ability to test drive the software with minimal costs and administrative delays can be important.
1.1.5 Concerns on OSS

In general, cons of open source may include [1]:

- Support and maintenance costs may outweigh those of the proprietary package and include hidden commitments. A full assessment of the total cost of ownership along with the proposed supplier will help to mitigate this risk.
- Availability of the right level of expertise is mandatory for those considering using and developing open source in-house to manage it effectively.
- Large suppliers (vendors) may be reluctant to propose open source solutions which may generate less revenue and not be aligned with their product or skill set.
- Open source solutions may require additional development to enable integration with an existing proprietary environment. Moreover, some open source solutions may never work well with established proprietary products.
- Staff are traditionally trained and have experience in using proprietary software programs. Thus, the introduction of new programs/software may require staff retraining in order to enable them to use open source solutions.
- Individuals believe that making the source code available to the wider community, increases vulnerability to threats from the hacker community. This belief is based on false rumors and old myths and has been proven wrong by different OSS communities. In fact, each OSS project is supported by a huge development community that work continuously to fix the bugs and to harden the code security.
1.2 Success Stories around the Globe

Open source is now being widely used by private and public sectors and they have reaped benefits from its use. According to Gartner about 85% of companies in USA are using OSS tools [25]. Many OSS projects are funded by big commercial companies like IBM, Sun, Red Hat, and Novell. The future of IT industry is cloud computing and smartphones. These areas are already having significant contributions from OSS such as Android, Red Hat’s cloud, Cloudera etc. Moving towards OSS and open systems is a logical choice for the industry to become a competitive global player.
1.2.1 OSS in the United States

Until recently, there was no official FOSS policy in the US federal government, in August 2016 [19], the government of the United States issued a new federal software policy that aims to improve efficiency, transparency, and innovation across government by promoting the use of open source.

There are a few success stories in the U.S government, yet they still lag behind the rest of the world in making use open source. Without its own open source policy in place, United States risks widening economic and technological competitive gaps between itself and the rest of the world [20].

The White House recently announced the launch of Code.gov, a website that shows off U.S. government open-source projects and offers relevant resources for government agencies. By launching this site, the White House is hoping to improve public access to the government’s software and encourage the reuse of software across government agencies.

The launch comes four months after the White House introduced the Federal Source Code policy, which specifically mandates that government agencies “make custom-developed code available for Government-wide reuse and make their code inventories discoverable” at Code.gov, with certain exceptions. The new site already has almost 50 code repositories from more than 10 agencies.

Code.gov provided useful tools and best practices to help agencies implement the new policy. It’s a step to help Federal agencies avoid duplicative custom software purchases and promote innovation and cross-agency collaboration. It is also a step to enable the brightest minds inside and outside of government to work together to ensure that Federal code is reliable and effective [21].
1.2.2 Success Story from Germany:

In 2001, Horst Bräuner, the IT director of Schwäbisch Hall, a city in southern Germany, faced a situation familiar to many local government officials. Germany was in an economic slump — the country’s economy had been flat for several years. The gross domestic product dropped from a 2.5 percent rate of growth in 2001 to an anemic 1.4 percent in 2002. In response, the federal government expanded the number of tax deductions firms could take on as losses.

Since local governments in Germany depend heavily on business taxes, the change in the country’s tax law coupled with the broader economic recession led to a sharp decline in local tax revenue. But according to Bräuner, Schwäbisch Hall’s problems were even worse. Just as government budgets were cratering, Microsoft Corp. upgraded its operating systems from Windows NT to Windows XP, forcing IT directors like Bräuner into a difficult choice: retain an outdated operating system without support from Microsoft, pay for the new operating system, or find an alternative. When Schwäbisch Hall’s technological and budgetary challenges collided, it felt to Bräuner like a slow moving tsunami. Things would only get worse.

While most governments opted for the Microsoft upgrade, three cities in southern Germany embarked on something radically different. Munich, Schwäbisch Hall and Treuchtlingen adopted and implemented plans to migrate all PCs to open source operating systems and applications.

Treuchtlingen, Schwäbisch Hall and Munich may represent the most advanced migration to FOSS among local governments in the world. The cities vary in population from 13,000 for Treuchtlingen to 1.3 million for Munich. They also differ in the degree to which they’ve implemented their FOSS migration policy. Treuchtlingen and Schwäbisch Hall have completed migration, but Munich’s migration is only partially finished. Although each city followed its own path toward FOSS, they overcame similar organizational and personnel challenges that reveal what local governments should take into account as they consider open source.

For governments, the decision to switch to FOSS operating systems, such as Linux, is wrought with challenges. There are technical issues of compatibility and interoperability since many popular applications are designed for the proprietary software operating systems: Windows
and Mac OS. And as with any new IT application or system, there are personnel challenges associated with training, accepting and adjusting to new systems and different ways of doing things. Also, as with any change in technology, a switch to FOSS can be costly in the short run.

Despite the immense challenges, Treuchtlingen, Schwäbisch Hall and Munich opted for innovation over the status quo. The adoption of new technology is difficult under any circumstances, whether proprietary or FOSS. Studies indicate political backing is an essential ingredient to a successful migration since IT managers need the freedom to take risks. The experiences of the three cities confirm this. In each case, the mayor and parliamentary majority supported the shift to FOSS. As one IT director put it, “The political leadership must embrace the change to FOSS in order to give the IT administrator the freedom to make mistakes and try new things.”

In Munich, a high-level administration member took a leadership role to shepherd staff through the process. In practice, this meant the administrator did several things: made the case for adoption; took the political heat when the migration process hit a glitch, thereby shielding the IT staff; and consistently communicated to the Parliament and public the rationale for the migration, thus controlling the terms of the debate about FOSS.

Scholars note the importance of cost savings in the motivations of local governments to consider FOSS. The experience of these three German cities supports this view generally. However, the story is more interesting. Each government turned to FOSS not when surplus funds became available to try something new and innovative. Instead, FOSS became an option for the cities when a change in the federal government’s tax system triggered a sudden budget deficit. The federal change served as a catalyst that directed public officials’ attention toward the need to save money and be self-sufficient. It was in this new environment, created by the change in federal tax law, that FOSS found fertile ground. A lesson offered by the German cities’ experiences is that although leadership, knowledge and expertise are important, an unexpected event or crisis is often needed to create an opportunity to redirect organizational attention and behavior in a new direction.

While a decline in tax revenue created an opportunity to adopt FOSS, each of the IT administrators echoed findings in much of the FOSS literature, namely that its adoption and implementation is costly. As with any new technology, FOSS requires a significant investment in training, implementation service and maintenance to succeed. The IT administrators also
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acknowledged that it’s easy to manipulate the total cost of operation of any type of technology. Although cost savings are important, they say IT directors must also make the case for FOSS on other grounds, including better cooperation among governments; greater independence from monopolistic software providers; more flexibility and security; and increased local economic development. Thus, the two takeaway lessons from the three cities are: to be successful, FOSS is likely to be expensive in the short run; and while cost savings are important, officials should strive to make the case for FOSS on other grounds.

The three IT directors said it was unusual for a municipality to completely switch to FOSS in a single step, particularly if the governments have little experience with FOSS. The directors suggested taking incremental steps or a “soft migration.” They recommended beginning with common software applications like the Firefox browser, Thunderbird e-mail program and OpenOffice suite (an equivalent to Microsoft Office). In Schwäbisch Hall and Treuchtlingen, city employees were given free programs on a single disk and encouraged to install and use the software on their home computers. As mentioned, such steps reduced the anxiety of city employees to the new software. A second step is for the city to develop macros, templates and forms in the OpenDocument format, and set up pilot desktop stations in each department that run on the Linux-based operating system.

While the IT directors suggested an incremental approach, they also stressed the need for an overall strategy. “You have to know where you are going,” said one director.

IT administrators said organizational structure is important. IT infrastructure is often decentralized so that each department has its own IT person. Officials in the three German cities stressed that a change as fundamental as migrating to FOSS is easiest with a centralized IT department. Based on their experience with migration, the directors reported that a decentralized IT structure creates cultural and structural barriers in the organization that make it difficult to adopt a governmentwide strategy.

In sum, the German cities’ experiences suggest that the decision to switch from proprietary to open source software is neither easy nor obvious. It depends on a range of factors — administrative capacity, political backing and organizational structure. Yet, the experiences of the three cities underscores that while FOSS may not be appropriate for every circumstance, it should at least be considered by U.S. local government officials as a viable, perhaps even superior, alternative to its proprietary counterpart [22].
1.2.3 Brazilian Success Story on Using OSS:

In most countries, government initiatives that encourage the use of open source software (OSS) are primarily motivated by the goal of reducing costs. In Brazil, the goal is different. According to Rogerio Santanna, Secretary of Logistics and IT at the Brazilian Ministry of Planning, Budget and Management, "open source is a strategic choice of the Brazilian Federal Government since 2003 because it reduces costs, increases the competition, creates jobs and develops the knowledge and intelligence of our country. Our preference for open source is not motivated only by economic aspects. But there is also the possibility to develop new products, distribute the knowledge, access to new technologies and to stimulate the development of software in collaborative environments".

Since 2003, the Brazilian government has begun to adopt the use of OSS in many institutions. Brazil has been changing politically, and a group coordinated by the Brazilian government, the Information Technology Institute (ITI), has set the guidelines, objectives and priority actions for the implementation of OSS within the Brazilian government.

From these guidelines, several actions were undertaken by the Brazilian government to achieve these goals. In practice, the Brazilian government is actually using OSS and has created a portal to disclose the use of OSS in Brazil.

The Brazilian government supports many projects that rely on OSS. Many organizations of the Brazilian government use Java as a primary development platform. Brazil has been using electronic voting since 1995 and 136.8 million people voted in the 2006 election. The next version of the voting machines uses GNU/Linux. In education, University enrollment is done via the Internet. E-Proinfo is an e-learning project that has already trained 50,000 students. It is public software which was developed for the Secretariat of Distance Education and released under the GPL. Since 2006, the government is backing the development of OSS for clusters and grids, with a focus on high availability, load balancing, database replication, distributed mass storage, and virtualization. In addition to open source, achieving interoperability through the use of open standards is important. The Brazilian e-Government Interoperability Standards (e-PING) use XML and are browser compliant. Metadata standards are set using the e-Government Accessibility Model (e-MAG) [23].
One lesson to be learned is that without government support, these initiatives probably would not have happened; the market would not have allowed such initiatives to succeed as they were not principally matters of competition but rather matters of "sharing the cake." In such cases, open source is the uninvited guest at the party—hence myths that open source is not profitable and inferior [24].

Case of Bank of Brazil
The Bank of Brazil, the largest public bank in Brazil, has more than 100,000 workstations, more than 6,000 servers, 15 IBM mainframes and more than 42,000 automated teller machine (ATM) terminals. The Bank of Brazil began to use OSS in 2001 with the use of Linux servers and the squid caching proxy.

Since then, various initiatives using OSS have been deployed at the Bank of Brazil. The main initiatives include:

- the deployment of OpenOffice on more than 60,000 stations that reduced by 70% the amount of licenses paid to Microsoft for its Office Suite, and
- the migration of over 5,500 servers and more than 57,000 stations to Linux.

In terms of economy, the Bank generated a savings of more than $30 million USD in the reduced licensing of software.

Brazil is creating laws to obligate entities, such as government departments, to use only OSS. In some departments, users are not allowed to use proprietary office software and must instead use OSS equivalents. In contrast, the Canadian Government believes that mandating one type of solution, such as OSS, restricts the decision-maker's flexibility to choose the best available solution according to their business needs and the principles of the government's Federated Architecture Program.
### 1.3 Shortlisted Countries

The countries that are shortlisted for collection of information on the usage of open source software are USA, UK, Malaysia, Egypt, India, and European Union Countries. The selection criterion includes maturity of the countries in terms of OSS adoption/usage and policies and availability of relevant information.
2. **Elements to be Analyzed**

2.1 **Awareness and Promotion of OSS**

This vertical will help the team in identifying process and procedures, which other countries have taken for the awareness and promotion of OSS. The exercise will help in identifying techniques using which promotion of the use of OSS will become easier and transition from proprietary to OSS could be possible.

2.2 **Policies and Practices for Transition**

Policies and procedures that are adopted by shortlisted countries in order to promote and implement open source software in replacement of commercial software will be analyzed. This exercise will help in identifying and recommending suitable policies that will be beneficial for government agencies in the Kingdom. Furthermore, it will help the team in identifying best practices that countries have taken to do transition from commercial IT products to open source software. This will help in identifying stages through which each country has gone through for the implementation of the open source.

2.3 **Concerns**

The team will compile a list of different risks that were faced by the shortlisted countries when performing the transition from commercial to open source or during the implementation of new open source product.
3. Findings of the Literature Survey

3.1 Awareness and Promotion of OSS

In order to aware and promote OSS, government needs to apply certain processes to make sure successful implementation of open source software in public sector. To do awareness as well promote adoption to OSS, Malaysian government periodically launched Award program. This award is to recognize and acknowledge the public sector agencies for their efforts in developing and implementing the Open Source Software (OSS) that promotes the service excellence and effective use of ICT. In India, in order to identify awareness among institutions and organization, online questionnaires were used to collect the opinion of the officials. MCIT of Egypt suggested that the government should play a pivotal role in raising awareness about the benefits and uses of FOSS. This can be done by doing partnership with the private sector, academia, the public sector, IT and computer software organizations, and OSS advocates and experts [16]. In this report, it is suggested that promoting OSS practices could also take place through frequent reports on OSS-related material in formal government publications, as well as through conducting relevant meetings and conferences on local, regional, and international levels.

Promoting open source practices to different sectors and agencies could be achieved through a careful selection of pilot projects to try out OSS policy, and the introduction of OSS to users who would likely be enthusiastic about trying new products. Other important factors in this vein are developing, publishing, and circulating OSS implementation/migrations guidelines. This is in addition to hosting a number of workshops for government CIOs and OSS civil society to discuss the FOSS strategy, implementation/migration guidelines, the national projects, infrastructure problems and others.
3.2 Policies

In this section, key practices and processes are documented that are either carried out or recommended by the shortlisted countries. These policies have helped the countries in implementing and promoting the use of open source software.

Formulating an OSS policy is fundamentally similar to creating other national policies. However, it is worth examining the different stages in the formulation process. Due to its unique nature, an OSS policy potentially involves a larger segment of society than some of the more focused policies.

Once the basic needs and motivations have been identified, an assessment of the existing environment has to be conducted to determine the suitability of OSS policies and their specific benefits to the society as a whole. This involves taking a look at many factors, including but not limited to:

- Existing ICT infrastructure.
- Existing human ICT capacity, both in the public sector and in the society.
- Education infrastructure and capabilities within the country.
- Existing and proposed national policies.
- Regional context.

OSS policies may interact greatly with or be affected by other policies. Some policies may in fact prevent the implementation of an OSS policy. Hence, a detailed survey of national policies, laws and standards must be undertaken to ensure that OSS policy can peacefully coexist with broader national objectives. In particular, OSS policy should not be separate from the national ICT policy. Other policies/strategies that can also significantly affect OSS policy include education and intellectual property.

Most regions in the world today have varying degrees of active OSS initiatives and policies in progress. An assessment of regional efforts is important to ensure that OSS policies will work in the regional context. This will help in identifying areas of cooperation or common interests.

Once the benefits and suitability of an OSS policy have been established, goals and targets of the policy need to be stated in a clear, measurable manner and linked with the larger goals of the nation.
There are different strategies for achieving any conceivable policy goal. Each strategy has its own advantages and drawbacks. No strategy should be taken and implemented without careful consideration of the local environment. Other issues such as language, economic development, legal environment and cultural attitudes can highly affect a particular strategy.

OSS promotion strategies via government procurement fall into four broad categories.

- **Mandating OSS**: This is the most radical approach as it mandates the usage of OSS systems throughout the government sector. This means replacing the entire existing proprietary infrastructure, which involves large implementation and training costs. The high costs and risks involved are the main deterrents in this approach.

- **Preferring OSS**: Recognizing the difficulty of switching the entire government infrastructure over to OSS, many governments have moderated their approach by preferring OSS solutions for the new procurements. When all traditional commercial measures are equal (functionality, cost, risks, stability, etc.) then the OSS solutions are selected in recognition of the social benefits, which can be hard to quantify. This approach has the benefit of being easier and less risky to implement. It is also more flexible, allowing procurements to be decided on a case by case basis, taking into account factors such as the possible lack of a local developer pool.

- **Mandating Open Standards**: Mandating open standards often has a complementary effect on OSS systems. One of the most effective ways in which software vendors lock in their users is the use of proprietary standards. OSS systems are at a disadvantage in a mostly proprietary software environment due to the lack of interoperability. The mandating of open standards would level the playing field and introduce increased competition, not just between proprietary software and OSS but also between different proprietary software solutions. However, this often requires modifying procedures and legacy documents that are still stored using proprietary standards.

- **Best Value**: This approach focuses mostly on the economic value of OSS, de-emphasizing the national and social benefits of wide scale OSS adoption. This approach is the least controversial and is the standard policy in most countries. However, due to the relative newness of OSS and lack of general awareness, there
have been calls for legislation or policy that explicitly places OSS on the same level playing field as established and reputable proprietary software.

Malaysian government has marked 5 policy goals or KPI to assess the effectiveness of its policy. These 5 goals are Awareness, Re-skilling, Education, Procurement, and Implementation. To accomplish the goal, Malaysian government had launched a master plan in which IT personnel got OSS trained and certified, school teachers got trained on OSS tools, and institutions of higher education utilize OSS education and teaching tools.

Government of India has published a detailed policy document for the adoption of OSS in public sector entitled as “Policy on Adoption of Open Source Software for Government of India” [2]. The aim of the policy is to define components that shall lead to successful enablement of OSS in public and private sector. The policy clearly defines mechanisms and actions that need to be carried out for successful implementation of open source solutions in e-government applications. It is mandatory for all government agencies to comply with the policy. Policy clearly dictates agencies to give open source solutions a fair chance in comparison with commercial software. For compliance, all agencies, while implementing e-Governance applications and systems, must include a specific requirement in Request for Proposal (RFP) for all contractors to consider OSS along with commercial solution while submitting proposals. In case of proposing commercial solution only in the proposals, contractor shall provide a reasonable justification for exclusion of OSS. When evaluating the solutions, government agencies shall ensure compliance with the requirement and decide by comparing both open source and commercial solutions options with respect to capability, strategic control, scalability, security, life-time costs, and support requirements.

European Union published their Open Source Software Strategy for 2014-2017. It is stated the European Commission shall continue to adopt formally, through the Product Management procedure, the use of OSS technologies and products. The Commission shall ensure a level playing field for open source software and demonstrate an active and fair consideration of using open source software. For more details about the EU strategy, refer to Appendix A. Moreover, a comprehensive action plan has been created. This action plan involves coordination of many activities with different services at the Commission in order to ensure that the principles of the strategy are followed. Details about the action plan are available in the Appendix A.
The governments of UK and Iceland have also developed policies regarding OSS, Open Standards, and Re-Use. Both of them emphasize on the points mentioned earlier in this Section. Details of the mentioned policies are provided in the Appendix.
3.3 Procurement of OSS

In order to introduce OSS in the government sector, policies need to be introduced that shall be able to change the mindset of the people who write business and IT requirements and do procurement decisions. One way of doing so is to ask vendors to propose both open source and commercial solutions. Procurement committee shall fairly compare both solutions and make decision accordingly.

The European Union published a Guideline on public procurement of Open Source Software. This guideline showed how open source software can even be downloaded free of charge without a call for tenders, and provided criteria that can be included in tenders to ensure good practice procurement of software.

This guideline stated that today's software procurement is far from a "level playing field". Widespread preferences in public tenders for specific, named, proprietary software and their vendors is one justification of why such guideline is needed. It also provided an overview of the legal issues involved in public procurement of software. The guideline provided "ready-to-use" text for tenders which aims to simplify the process of translating the suggestions contained in this guideline into actual calls for tenders [4].

Similarly, the Government of India has adopted a comprehensive and supportive open source policy which is built on their earlier efforts to adopt open standards for procurement [5]. The policy is similar to the trend discussed earlier in the document as well as seen around the globe. The policy pushed government agencies to endeavor adoption of OSS in their e-Governance systems as a preferred option in comparison to commercial software, provided a balance and justified comparison is done for both options. To reinforce and make the policy effective, before the purchase of new software, the government dictated agencies the following:

- All Government Organizations, while implementing e-Governance applications and systems must include a specific requirement in Request for Proposal (RFP) for all suppliers to consider OSS along with CSS while responding.

- Suppliers shall provide justification for exclusion of OSS in their response, as the case may be.
- Government Organizations shall ensure compliance with this requirement and decide by comparing both OSS and CSS options with respect to capability, strategic control, scalability, security, life-time costs and support requirements.

Such policies are important to level the playing field, not merely highlighting the benefits of open source to governments (saying it’s ok to use it) but also providing meaningful answers to commonly asked questions by government IT professionals. The French government, for example, published a guideline in late 2012 urging the country’s public administrations to not only make a thorough and systematic review of free alternatives when building and revising IT infrastructure and applications, but also to use the savings realized by the use of open source to develop expertise and engage upstream communities.

The challenge is changing a culture and approach that provides the GOI with options. As Ram Sewak Sharma, the Secretary of the Department of Electronics and Information Technology (Deity) indicated in a media review, "the objective of the policy was to ensure both the options [of closed and open source] are compared and the best possible solution adopted. The objective of the policy is not to narrow down the opportunities for closed source software companies, but to ensure that both CSS and OSS options are properly evaluated."

Moreover, claims that the GOI policy 'mandates' OSS are also misplaced. Secretary Sharma went on to say: "It is clarified that the policy does not make it mandatory for all future applications and services to be designed using the open source software (OSS). The compliance part of the policy clearly states that the solution suppliers should consider OSS along with closed-source software (CSS) while proposing solutions. They can always propose CSS solutions, provided they can justify it over OSS."

The government of UK published an ICT advice note regarding the procurement of open source software. The objective of this document was to provide high level advice on how to ensure open source software is fairly considered when procuring an ICT solution. Providing a level playing field for open source entails ensuring that the requirements specified are justifiable and output based taking into account operational and technical requirements and cost. The note stated that procurers should not be naming a particular software vendor or drafting the tender documentation in a way that favors a particular vendor. To do so is a breach of EU procurement rules. Where projects are being evaluated, questions are being asked about whether open source has been considered [6].
Current UK Government Policy states, however, that where there is no significant overall cost difference between open and non-open source products, open source will be selected on the basis of its inherent flexibility.

In order to ensure that open source is given a level playing field, an ICT solution should be purchased in accordance with best practice. This involves specifying requirements in terms of outputs. An output based specification with a well informed and detailed evaluation will help to ensure that the solution offering the best value is purchased, whether this is open source or proprietary.

The following requirements should be considered when purchasing any ICT solution:

1. Security
2. Scalability
3. Functionality
4. Limits of Liability
5. Maintenance and support requirements
6. Future requirement for re-use
7. Compliance with open standards
8. Total cost of ownership

3.3.1 **Scalability of License Requirement:**

Consideration should be given as to how license requirements will vary over time. A question around how the supplier will deal with these scenarios should be included in the RFPs documentation. In general, it may be appropriate to include this in any cost modelling. Open source solutions tend to be more flexible in this regard, being scalable in both directions – upwards and downwards with a reduction in the risk of longer term financial implications. For example, agencies will not have to pay a license fee on a “per user” basis so they are not left with redundant licenses. Organizations will also need to assess the scalability of support.
3.3.2 Maintenance and Support Requirements:

The level of support and maintenance agreements required should be specified within the RFPs documentation. Consideration also needs to be given to what can be provided internally and the risk attached to the provision of the support being offered. In-house support and third party support will require analysis of the technical and commercial capabilities available at the agency, and capacity of resources.

3.3.3 Re-Use

The purchasing organization should consider the level of transferability of licenses. Transferability helps future proof an organization against structural changes causing licenses to become invalid. Open source software is generally more flexible with regard to transfers than proprietary software.

3.3.4 Open Standards

Open Standards, as defined by the ITU [7], are standards made available to the general public and are developed (or approved) and maintained via a collaborative and consensus driven process. Open Standards facilitate interoperability and data exchange among different products or services and are intended for widespread adoption.

In January 2011 a Procurement Policy Note was issued entitled “Use of Open Standards when specifying ICT Requirements”. The key point in this note is that the Government of UK will use open standards in its procurement specifications and require solutions to comply with open standards.

Cabinet Office also mandates that when purchasing software, ICT infrastructure and other ICT goods and services Government departments should wherever possible deploy open standards in their procurement specifications. This is because Government assets should be interoperable and open for re-use in order to maximize return on investment, avoid technological or supplier lock-in, reduce operational risk in ICT projects and provide responsive services for citizens and business.
3.3.5 **Total cost of ownership**

A complete and balanced assessment of any ICT Solution requires analysis on the basis of value against the Total Cost of Ownership (TCO), throughout the likely life of use.

Total Cost of Ownership (TCO) allows departments to look at both the short and long term costs of any particular solution. Traditionally cost has been associated with the purchase price alone or purchase price plus support costs, however the initial procurement cost is typically only a relatively small percentage of the total cost of owning and operating most IT products.

TCO looks at the complete cost from purchase to disposal and is a way of thinking about cost when attempting to fairly assess the merits of open source vs. proprietary. It is often difficult to predict accurately what the lifetime costs of a solution will be, so carrying out a Total Cost of Ownership (TCO) assessment provides an opportunity to identify, explore and challenge any assumptions and biases. Calculating Total Cost of Ownership (TCO) is necessary to quantify and compare costs of all software options, and applies equally to both proprietary and open source.

The following lists areas to consider that make up an assessment of TCO [8]

**Acquisition and procurement**

- selection
- upfront evaluation
- purchase price
- licenses,
- hardware
- Integration

**Operation and Management**

- migration (data and users)
- use
- maintenance
- upgrades
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- support services
- training
- software scaling
- cost of customization
- development, modification
- Carbon footprint

End of Life Management

- Retirement
- disposal
- migration (data and users)

It may not be possible to calculate exact figures for all of the items on the list. An assessment of high, medium or low may be more realistic. This should not pose too much of a problem as the same criteria are used to evaluate all options within a procurement.

Thinking in terms of TCO educates and raises awareness of full costs of IT solutions.

However, TCO modelling does not:

- assess how well the solution meets requirements.
- assess risk or how well a particular technology fits with an organization’s strategic goals or needs.
- necessarily track environmental or social costs and benefits.
3.4  **Capacity Development**

The major hurdle in OSS implementation in countries is shortage of OSS capacities and IT manpower in their economies. Any major OSS policy require building of local capacity, include both experts and companies, to support OSS projects. There are several focus areas for strategies on OSS capacity development that include education, training programs, and certifications. Introduction of OSS in the government sector will lead to a positive contribution in the development of local human capital, allow individuals to diversifying their IT skills and developing their indigenous capacity. Such shift of human development will lead to economic growth and social development of the country [16].

3.5  **Regional Context**

The International Open Source Network (IOSN) is a Center of Excellence for Free/Open Source Software (OSS) in the Asia-Pacific Region. The IOSN is tasked specifically to facilitate and network OSS advocates and human resources in the region. Their vision is that developing countries in the Asia-Pacific Region can achieve rapid and sustained economic and social development by using affordable yet effective OSS ICT solutions to bridge the digital divide. IOSN has posted a document that discussed the necessity of having a governmental policy for the implementation of OSS [11]. The document discussed policy formulation approach which has been briefly discussed earlier in the section.

IOSN stated that countries in the Asia-Pacific region should be aware of a regional effort by China, Japan, and South Korea to produce a common, regionally localized and customized OSS system [14] and utilize this in their own countries. Malaysia, Taiwan, Thailand, and Viet Nam, have strong OSS initiatives or formal policies encouraging OSS. In such a situation, a country that belongs to the Asia-Pacific region and does not have OSS capabilities would be at a serious disadvantage.
3.6 Establishing a National Center for Open Source

One of many OSS policies is to have a strategy plan that helps in establishing a center that does research in the area of OSS development (both skill development and knowledge base) and perform the following activities:

- **OSS awareness raising and promotion.**
- **Implementing pilot projects in e-government.**
- **Documenting current best practices of OSS usage.**
- **Providing technical support for government agencies.**
- **Providing training of both end-users and technicians.**
- **Aggregating news and resources on OSS.**

One of the properties of open source is that it promotes collaboration and participation, rather than just consumption through public procurement. Hence, the EU's Open Source Observatory and Repository (OSOR) provides a platform for collaboration among public agencies in Europe: from finding out about open source; selecting, evaluating and downloading software; getting support from peers and suppliers; and even developing and releasing software.

Malaysian Administrative Modernization and Management Planning Unit (MAMPU), the body which is responsible for promoting open source in Malaysia, has established a center “Open Source Competency Center (OSCC)”.

To encourage public sector agencies and make OSS implementation possible, Malaysian government initiated a master plan. Following activities were targeted under this plan.

- **Creation of an Open Source Competency Center (OSCC),**
- **Formulate OSS policies, guidelines and standards to facilitate OSS implementation,**
- **Maintain Knowledge Bank for sharing of knowledge and experience,**
- **Create greater awareness, and promote OSS and the OSCC,**
- **Conduct and coordinate OSS training and certification programs for public sector personnel,**
- Provide technical support, and facilitate, coordinate, advise, and assist Government agencies in OSS implementation, and
- Conduct, facilitate, coordinate and monitor OSS Research and Development programs.

In order to facilitate and assist OSS users and implementers in Malaysia, OSCC serves as a Knowledge Bank and acts like a Community of Practice. This provides a platform for OSS implementers and users through which they can browse, share, and participate with the other community members as well as vendors/providers. Furthermore, Malaysian government encourages both individuals and companies to share source code or participate in the development of government applications. To accomplish this, government maintains and hosts a website that facilitate such activities.

Similarly, in European Union, the Open Source Observatory [12] is a community for exchanging information, experiences, and best practices around open source solutions for use in public administrations. The center also helps in finding open source software made available by other public administrations and solve issues related to development. The center also lets developers to share their own solutions. The establishment of such centers typically help in developing OSS competency in the country, especially in the public sector. In larger countries, multiple centers may be established, one per major region.

Department of IT, MCIT of India, took an initiative of establishing a center called “National Resource Centre for Free and Open Source Software (NRCFOSS)”. The center was established in 2005 with the roles of bridging the digital divide as well as strengthening the Software industry. The center contributes to the growth of FOSS in India through research & development, human resource development, and networking & entrepreneurship development. In addition, it serves as the reference point for all OSS related activities in the country [17].
3.7 Concerns

OSS and its solutions have recently become more stable and popular. Relatively speaking, countries that have existing ICT infrastructure in-place for decades relies on commercial proprietary solutions and have trained technical manpower to oversee applications to smoothly run the business processes. This poses significant issues in many ways. Authorities, especially in government organizations, have many concerns regarding OSS solutions. Organizations have bought commercial products and invested in building technical expertise for these products.

3.7.1 Change Management

Any organization is resistant to change, and ICT departments are no different. In procuring new IT products, IT personnel and decision makers are likely to be more comfortable staying with the same technology as their existing systems and biased against new solutions and technologies, including OSS solutions. A strong resistance is expected to be encountered by decision makers when OSS policy will be introduced in these organizations. An effective change management policy shall be introduced before formally introducing OSS policy in organizations. According to Prosci’s change management best practices research [13], perform the follow-up steps before introducing new changes: (1) Do change management right the first time (2) Expect resistance to change, (3) Address resistance formally by preparing, managing, and reinforcing for change, (4) Identify the root causes of resistance, and (5) Engage the “right” resistance managers.

Change management processes are needed to embrace OSS in government sector. Officials from agencies need to be ensured about the reliability and security which OSS provides. Introducing OSS in government sector may encourage other agencies to adopt OSS which will lead to IT skill development and innovative solutions.

3.7.2 Migration Cost

Although OSS assumes to be free, an initial cost is likely to be encountered for those organization who will be migrating from existing commercial solutions to OSS solution. A number of factors contributed to this cost: (1) training on OSS, (2) transfer of data from technology and data format to the other, and (3) interoperability among other IT systems. Depending on the technology, a migration from commercial to open source solution could
cost an organization a lot. Due to this, organizations resist to the change in migrating to new technologies and OSS solutions. For example, migrating from Oracle or MSSQL database to open source database solution will be expensive as well time-consuming activity which itself associated with a manpower cost. Before proposing to migrate to open source solution, a compelling justification will be needed for authorities and decision-makers for this migration cost. A cost-to-benefit analysis with long-term RoI (Return on Investment) needs to be presented.

### 3.7.3 Compatibilities Issues with Existing Systems

Even if a total migration to OSS systems were contemplated, there will be a period of time when both OSS and proprietary systems must coexist peacefully. Unfortunately, a common strategy with proprietary software is to make their systems not fully compatible with other systems, be they competitor proprietary software or OSS systems. In some cases, this incompatibility is relatively minor (for example, text documents that are strangely formatted). But in other cases, data interchange may be quite complicated.

For these reasons, implementing a OSS infrastructure or at least creating a OSS-friendly environment is much simpler when the existing infrastructure is limited.

With relatively developed countries, OSS policy issues tend to focus on migration strategies, open standards, new procurement and coexistence issues. Relatively undeveloped countries focus on capacity-building and legal issues to ensure that the infrastructure they build, from the very beginning, is OSS-friendly.

### 3.7.4 Security

Authorities, higher management, and decision-makers have greater concerns when it comes to security of open source solutions. Many of them, especially those with non-IT background, believe on a myth that commercial solutions are secure than open source because of the closed nature of the product. The government of UK published a note that highlights some of the key security considerations for the use of open source software in Government, and their implications for procurement practice. Firstly, open source, as a category, is no more or less secure than closed proprietary software. All software, including open source and closed proprietary, will have vulnerabilities. Individual software products, regardless of category, will have strengths and weaknesses in security characteristics such as provenance, quality,
support, and vulnerability management. Given the range of vulnerabilities and diversity of exploits, on balance, neither category is considered more or less secure than the other [14]. Therefore, open source software cannot be excluded from an options analysis for Government IT. Given that no one type of software is inherently more secure than another, neither open source nor closed proprietary software should be excluded from an options analysis for security reasons. It is UK Government policy for open source software to be evaluated in an options analysis, and for suppliers to provide appropriately detailed evidence of the reasoning behind their selection. It is entirely possible that an open source option is not selected for valid reasons, such as insufficient functional fit, inability to meet performance requirements, or higher cost of ownership due to more expensive security controls. It is important that the same selection criteria are applied to all options. It is also important that requirements are not exaggerated, unnecessarily inflating costs. For US, government agencies fear about low quality or malware. Sharing of source code is a great concern as many OSS license providers dictate to share source codes with other users and entities. It is also recommended by other studies that open source software shall be disclosed to public. Many consider this as a security risk. For example, in US study [3], it is mentioned that many agencies would no doubt object to the perceived security risk involved in disclosing government source code. IT security experts consider this argument fallacious. A determined attacker can find security flaws in software with or without the source code, so concealing the source is actually more of a hindrance to those who could seek out and correct security flaws than to those who would exploit them. To put it simply, concealing source code leads to a false sense of security. Opening source code to the public, though it may create short-term apprehensions, will result in more secure software in the long run.
4. Recommendations

4.1 Recommendations for Government Agencies

- Periodically perform OSS awareness sessions for decision makers and IT staff within the organization.
- Perform training sessions for staff on deployed OSS end-user applications.
- Build a repository for in-house developed OSS solutions and make it accessible to other government agencies in the Kingdom.
- Encourage IT staff to implement and use OSS applications.
- Prepare policies that allow transfer of knowledge to IT staff for building local expertise.
- Encourage building and retaining human capital in IT department for supporting OSS solutions.
- Prepare policies to allow fair competition between commercial and OSS solutions.
- Prepare guideline on procurement of OSS.
  - Instead of going big bang, it might be suitable to introduce OSS at small level, for example use of OpenOffice (or similar application) and use of open source system and networking monitoring tools.
  - This can be achieved by introducing new procurement policy that shall serve as a roadmap for future software procurement.
  - For procuring new software or renewing existing licenses, a comparative study must be done to do risk-free analysis of existing open source solution as that of commercial tools. In addition, change management and feasibility assessment needs to be done to identify man-power efforts, reliability, security, and costs for implementing open source solution.
- Prepare a policy that mandate transfer of knowledge to local IT staff when a vendor implements OSS solution.
- Build OSS training and certification programs for IT manpower in the organization.
• Establish a unit that conducts OSS research and develops new products that fulfill IT requirements of the organization.

• Encourage building OSS solutions in Arabic language.

• Be aware of the local efforts by other agencies in the Kingdom.

• Communicate with other agencies to provide as well as get benefits from their experience on implementing OSS solutions.

• Communicate with international agencies and communities to get benefits from their experience.
4.2 **Recommendations for leading agencies in supporting OSS in the Kingdom**

- Periodically perform workshops and awareness sessions with high officials in government agencies for the use of OSS in the public sector.

- Periodically publish OSS-related material in formal government publications.

- Facilitate establishment of a center for excellence in GCC (Gulf Cooperation Council). This will be similar to IOCN a Centre of Excellence for free software (also known as FLOSS, OSS, or open-source software) in the Asia-Pacific region or OpenForum Europe (OFE) which is a European open source software advocacy group. The purpose of these centers (or groups) is to encourage the use of open source software among businesses, consumers, and governments. The following could be the objectives and goals of the center:
  
  o Standout as a single source of information on OSS in the region.
  
  o Build an open source repository for government, consumers, and end-users that shall access to source code without any restriction.
  
  o Encourage building local expertise.
  
  o Provide a platform that allow developers to share and contribute to open source solutions that shall later contribute to more secure solutions, national GDP, and local skills development.
  
  o Encourage building open source software in Arabic language.
  
  o Development of local software capacity.
  
  o Communicate with centers worldwide to get benefits from their experience.

- Establish a center that foresee OSS implementation in the Kingdom. The goals of the center shall be as follows:
  
  o Encourage government agencies to implement OSS.
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- Prepare policies with the help of other agencies such as Ministry of Finance, MCIT, and CITC that shall allow fair competition between commercial and OSS solutions in the government sector.

- Prepare guideline on procurement of OSS.

- Build an OSS repository for common government applications.

- Prepare policies that allow transfer of knowledge among agencies for the implementation and use of OSS.

- Prepare policies that ensure OSS implementation in public sector without conflicting any existing policies.

- Build a platform that acts like a Knowledge Bank for OSS implementation through which government agencies can share experience and knowledge.

- Build OSS training and certification programs for IT manpower in the public sector.

- With the help of local government institutions, conduct OSS research and develop new products that fulfill the requirements of government agencies.

- Establish a platform for OSS developers and vendors in the Kingdom for collaboration with public agencies in the kingdom.

- Be aware of the regional effort by other neighboring countries.

- Communicate with other centers worldwide to get benefits from their experience.

- Instead of going big bang, it might be suitable to introduce OSS at small level, for example use of OpenOffice (or similar application) and use of open source system and networking monitoring tools. This can be achieved by introducing new procurement policy that shall serve as a roadmap for future software procurement. For procuring new software or renewing existing licenses, a comparative study must be done to do risk-free analysis of existing open source solution as that of commercial tools. In addition,
change management and feasibility assessment needs to be done to identify manpower efforts, reliability, security, and costs for implementing open source solution.

- Policy similar in nature as that of government of India needs to be prepared. Their policy structure can be used as a template to construct as per the requirements of the Kingdom.

- A change management policy is needed prior to introducing OSS policy. A change management policy can be prepared by following popular change management practices as introduced by PMP® or other similar organizations.

- Sharing of source code of open source government applications to other agencies.

- Introduce collaborative software development environment that enable agencies to use, share, and release OSS. This can in turn reduce costs, reduce development time, and improve overall quality, including security (through increased transparency and mass peer review).
5. Feedback Received from Government Agencies in Saudi Arabia during Survey:

- There is a need to encourage agencies to go for open source software.
- It is important to take CITC as one of the key stakeholders in any initiative related to open source software.
- Authorities can choose to adopt open-source for non-sensitive systems and activities.
- The main challenges that must be resolved: knowledge transfer, security, and resources.
- Online Training, offshore Employees, and volunteer trainers are ways to overcome challenges.
- One of the opportunities that exists is cooperating with universities. Find mechanisms to encourage students to support open-source software by graduation projects and contests.
- Agencies can act as a model for others in the use of open source software.
- The existence of successful experiences (stories) of institutions similar in size will encourage others to move to open source software.
- Many agencies indicated a concern on who will be held responsible for failure or disaster in case of using OSS as opposed to commercial tools.
- Establish a specialized center that does research and development. After confirmation of the maturity of the tool, then it can be circulated to agencies in order to save time of the agencies in the search for a suitable tool.
- Implement cloud services for government applications.
- Resolve resistance from higher management.
References


[15] Professional re-usable software - principles for the Public Sector, July 2016


[23] [https://timreview.ca/article/250](https://timreview.ca/article/250)


Appendix
Appendix A.

Important Notes on OSS Policy of selected countries
European union, Open Source Software Strategy 2014-2017

1. The Commission shall continue to adopt formally, through the Product Management procedure, the use of OSS technologies and products.

2. The Commission shall ensure a level playing field for open source software and demonstrate an active and fair consideration of using open source software – taking account of the total cost of ownership of the solution.

3. For all future IT developments, the Commission shall promote the use of products that support recognised, well-documented and preferably open technical specifications that can be freely adopted, implemented and extended. Interoperability is a critical issue for the Commission, and use of well-established standards is a key factor to achieve it.

4. For the internal development of new information systems, in particular where deployment is foreseen by third parties outside the EC infrastructure, OSS shall be the preferred choice and used whenever possible.

5. The Commission shall further clarify the legal context around the internal use of OSS and make this clarification available to interested parties. The main topics to be addressed include: licensing schemes, Intellectual Property Rights, equal opportunities in the context of procurement and participation in OSS communities.

6. The Commission shall further develop guidelines and best practices allowing the setup of OSS and mixed solutions covering the full set of professional services, including deployment of OSS solutions in its data centres at the same level of service as the proprietary ones.

7. The Commission shall continue to develop and adopt best practice and tools emerging from OSS communities while applying state-of-the-art governance practices, particularly in the domain of security. In addition, the EC will facilitate and promote the creation of communities for those OSS products released by the Commission and facilitate participation in external OSS communities.

8. OSS plays an important role in e-Government projects and shall be therefore considered within the framework of these activities.

1 ec.europa.eu/dgs/informatics/oss_tech/strategy/strategy_en.htm

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9. The collaboration between Commission teams in charge of the internal and external OSS strategies shall be further enhanced in order to achieve convergence, in particular through alignment with and reuse of validated solutions produced by the ISA programme.

10. The ICT ecosystem is extremely dynamic, innovative, and constantly evolving; as such it impacts many areas of the Commission’s policies. Within this context, DIGIT shall continue to play an active role in promoting partnerships focusing on OSS between the European Institutions and other stakeholders.
Action plan

Together with the strategy, a comprehensive action plan has been created, addressing all 10 points above. It is scheduled for execution during the period 2015-2017.

This action plan involves coordination of many activities with different services at the Commission in order to ensure that the principles of the strategy are followed internally. The activities include:

- Inventory
- Product management and procurement processes
- Promotion of standards
- External diffusion of EC produced software
- OSS based architecture stack
- Compatibility of licenses
- Clarifications and recommendations to developers
- Service around OSS used at the Commission
- Actions around communities, follow-up, participation

As these actions are mostly internal, the visible outcome will be the provision of equal opportunities in procurement, publication of the clarifications for developers, usage of the OSS in published developments, etc. as expressed in the strategy.
UK Government Policy\textsuperscript{2}

Open Source Software

- The Government will actively and fairly consider open source solutions alongside proprietary ones in making procurement decisions.

- Procurement decisions will be made on the basis on the best value for money solution to the business requirement, taking account of total lifetime cost of ownership of the solution, including exit and transition costs, after ensuring that solutions fulfil minimum and essential capability, security, scalability, transferability, support and manageability requirements.

- The Government will expect those putting forward IT solutions to develop where necessary a suitable mix of open source and proprietary products to ensure that the best possible overall solution can be considered.

- Where there is no significant overall cost difference between open and non-open source products, open source will be selected on the basis of its additional inherent flexibility.

Non-Open Source Software

- The Government will, wherever possible, avoid becoming locked in to proprietary software. In particular, it will take exit, rebid and rebuild costs into account in procurement decisions and will require those proposing proprietary software to specify how exit would be achieved.

- Where non open source products need to be purchased, Government will expect licenses to be available for all public sector use and for licenses already purchased to be transferable within the public sector – including into cloud based service environments - without further cost or limitation. The Government will where appropriate seek pan-government agreements with software suppliers which ensure that government is treated as a single entity for the purposes of volume discounts and transferability of licenses.


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Open Standards

- The Government will use open standards in its procurement specifications and require solutions to comply with open standards. The Government will support the development of open standards and specifications.

Re-Use

- The Government will look to secure full rights to bespoke software code or customizations of commercial off the shelf products it procures, so as to enable straightforward re-use elsewhere in the public sector. Where appropriate, general purpose software developed for government will be released on an open source basis.
- Where the public sector already owns a system, design or architecture the Government will expect it to be reused and that commercial arrangements will recognize this. Where new development is proposed, suppliers will be required to warrant that they have not developed or produced something comparable, in whole or in part, for the public sector in the past, or where they have, to show how this is reflected in reduced costs, risks and timescale.
- When suppliers are proposing a third party product there should be full price transparency. If there is a pan-Government agreement there should be the option to source through this where doing so would maximize overall public sector value. The Government will expect to be charged only the cost the supplier incurs unless the supplier can clearly and transparently provide evidence of the additional value created.
Icelandic Government Policy Regarding Free and Open-Source Software

1. When purchasing new software, free and open-source software and proprietary software are to be considered on an equal footing, with the object of always selecting the most favorable purchase.

2. Every endeavor shall be made to choose software based on open standards, regardless of whether the software in question is standard or bespoke (custom-designed). Generally, software which is free for anyone to use is also typified by open standards.

3. Public bodies shall endeavor to avoid any undue dependence on particular software manufacturers or service providers. The utilization of free and open-source software is one means of this.

4. One goal for bespoke (custom-designed) software financed by public bodies, including software for research and development projects, should be its reusability. Keeping the software free and open-source is one way to achieve reusability. Strategies shall be devised at the outset of such projects for ensuring reuse of the software.

5. Students in Icelandic educational institutions shall be given the opportunity of learning about and using free and open-source software on a par with proprietary software.

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3 https://eng.forsaetisraduneyti.is/media/English/Free_and_Open_Source_Software_-_Government_Policy_of_Iceland.pdf
Appendix B.

Survey on Current Status of Open Source Software in Government Sector
I. Introduction

In order to identify level of awareness and to document current status of OSS implementation in the government sector, Yesser and KFUPM have conducted a survey with government agencies. Total of 15 government agencies were surveyed. The findings are reported in this document.

II. General Findings

The following information is observed from the results:

- IT departments in government agencies are aware of OSS definition but have little know-how of different OSS solutions.
- Almost all agencies are aware of the fact that source code of OSS is freely available, source code can be modified and redistributed, and has no licensing cost.
- IT departments in the agencies are familiar with famous OSS GNU GPL license but not aware of others including LGPL, BSD and Apache.
- Almost all agencies agree that there is a need to reduce the licensing fees. The agencies are interested in implementing OSS solution, but have concerns related to lack of resources, security, maintenance, and support.
- No OSS policy exists at national or agency level.
- Many of the agencies do not recommend to vendor to propose OSS when releasing RFP for new solutions.
- Many agencies have implemented few OSS solutions without involving external vendors. This is due to certain maturity of IT skills. The OSS solutions mostly include web applications, software development, and database servers.
- IT personnel in government agencies are well-aware and have some experience in implementing open source database systems, developing applications, and managing Linux servers. They are also having expert level skills for developing front-end web applications using HTML, CSS and JavaScript, software development using PHP, C/C++, Java and C#, and managing Apache webserver configuration.
III. Rating

To identify awareness level of the organization related to OSS, scoring was assigned to different levels as shown in the Table below.

<table>
<thead>
<tr>
<th>Level of Experience</th>
<th>Score Points</th>
</tr>
</thead>
<tbody>
<tr>
<td>Expert</td>
<td>3</td>
</tr>
<tr>
<td>Well Aware and Have Little Experience</td>
<td>2</td>
</tr>
<tr>
<td>Aware but no Expertise</td>
<td>1</td>
</tr>
<tr>
<td>Unaware</td>
<td>0</td>
</tr>
</tbody>
</table>

To identify experience level of the organization in software development, scoring was assigned to different levels as shown in the Table below.

<table>
<thead>
<tr>
<th>Level of Experience</th>
<th>Score Points</th>
</tr>
</thead>
<tbody>
<tr>
<td>Expert</td>
<td>3</td>
</tr>
<tr>
<td>Intermediate</td>
<td>2</td>
</tr>
<tr>
<td>Beginner</td>
<td>1</td>
</tr>
<tr>
<td>No Experience</td>
<td>0</td>
</tr>
</tbody>
</table>
To capture opinions on different features of OSS, score points were assigned as shown in the Table below.

<table>
<thead>
<tr>
<th>Level of Experience</th>
<th>Score Points</th>
</tr>
</thead>
<tbody>
<tr>
<td>Strongly Agree</td>
<td>5</td>
</tr>
<tr>
<td>Agree</td>
<td>4</td>
</tr>
<tr>
<td>No Opinion / Neutral</td>
<td>3</td>
</tr>
<tr>
<td>Disagree</td>
<td>2</td>
</tr>
<tr>
<td>Strongly Disagree</td>
<td>1</td>
</tr>
</tbody>
</table>

Table 3: Rating Score Point.
IV. Results

IV.1 Awareness and Knowledge of Open Source Software

Q. Is your IT department aware and have knowledge of Open Source Software (OSS)? (Single Choice)

![Figure 1. Awareness of OSS in Government Sector](image)

Is your IT department aware of any of the following features of Open Source Software (OSS)? (Multiple Choice)

![Figure 2. Awareness of OSS Features](image)
Q. How do you rate the technical capabilities of your IT department in terms of maturity for installing, modifying, and maintaining Open Source Software (OSS)? (Single Choice)

![Figure 3. Maturity of Technical Capabilities for Managing OSS](image)

Q. Are there people in your organization who are supportive of OSS? (Single Choice)

![Figure 4. Users within Organization who are Supportive of OSS](image)
Q. Is your IT department aware of and use any of the following open source projects (Operating Systems)? Please rate the level of expertise.

Figure 5. Awareness of Open Source Projects (Operating Systems)

Q. Is your IT department aware of and use any of the following open source projects (Compilers and Programming Languages)? Please rate the level of expertise.

Figure 6. Awareness of Open Source Projects (Compilers and Programming Languages)
Q. Is your IT department aware of and use any of the following open source projects (Networking Tools and Libraries)? Please rate the level of expertise.

![Figure 7. Awareness of Open Source Projects (Networking Tools and Libraries)](image)

Is your IT department aware of and use any of the following open source projects (Database Systems)? Please rate the level of expertise.

![Figure 8. Awareness of Open Source Projects (Database Systems)](image)
Is your IT department aware of and use any of the following open source projects (Scientific Software)? Please rate the level of expertise.

![Bar chart showing awareness of open source projects in scientific software.](image)

**Figure 9. Awareness of Open Source Projects (Scientific Software)**

Is your IT department aware of and use any of the following open source projects (Software Development Tools and Platforms)? Please rate the level of expertise.

![Bar chart showing awareness of open source projects in software development tools and platforms.](image)

**Figure 10. Awareness of Open Source Projects (Software Development Tools and Platforms)**
Is your IT department aware of and use any of the following open source projects (Productivity Software)? Please rate the level of expertise.

![Graph showing awareness of open source projects (Productivity Software)](image)

**Figure 11. Awareness of Open Source Projects (Productivity Software)**

Is your IT department aware of and use any of the following open source projects (IT Services)? Please rate the level of expertise.

![Graph showing awareness of open source projects (IT Services)](image)

**Figure 12. Awareness of Open Source Projects (IT Services)**

Q. Is your IT department aware of any of the following open source software licenses?

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Figure 13. Awareness of OSS Licenses

Q. Do you agree or disagree for the following?

Figure 14. Opinion on Different OSS Features

Q. How do you rate the organization for having following skill set? (Multiple Choice)
Figure 15. Software Development Expertise in Government Agencies
IV.II Policies

Q. Are you required by any entity or by any government policy to choose only proprietary software? (Single Choice)

![Figure 16. Existence of OSS Policy in Government Sector](image)

Q. Given that both proprietary and open source solutions satisfy your requirements, which will your organization prefer? (Single Choice)

![Figure 17. Preference of Solution: OSS v Proprietary](image)
Q. If a vendor proposes an open source solution rather than a popular proprietary solution, will the organization accept it? (Single Choice)

Figure 18. Organization inclination towards OSS Solution (Proposals)

Q. When releasing an RFP, would the organization recommend to the vendor to choose or suggest an open source solution? (Single Choice)

Figure 19. Organization inclination towards OSS Solution (RFPs)

Q. Does your organization have any strategy or policy for adopting open source software? (Single Choice)

Figure 20. Existence of an OSS Policy within Organization
IV.III  Usage of Open Source Software

Q. Have you used any Open Source Software (OSS) in your data center? (Single Choice)

![Figure 21. Implementation of OSS in Organization](image)

Q. For what purposes is the Open Source Software (OSS) used? (Multiple Choice)

![Figure 22. Business Areas where OSS used](image)
Q. In which applications is the Open Source Software (OSS) used? (Multiple Choice)

![Figure 23. OSS Applications Implemented within Organization](image)

- Web servers: 100%
- Software development IDEs: 67%
- Database servers: 67%
- Application servers: 56%
- Content management (CMS): 44%
- Software and documentation repositories (e.g., ...): 44%
- Network monitoring: 44%
- Learning management (LMS): 33%
- Productivity applications (e.g., office): 33%
- Business process management: 33%
- IT asset management: 22%
- Document management (DMS): 22%
- Private, local cloud: 22%
- Virtualization: 22%
- Technical support and help desk (ticket system): 22%
- Enterprise firewall: 22%
- Application monitoring: 22%
- Business intelligence: 22%
- Scientific applications: 11%
- High-performance computing: 11%
- Internet proxy: 11%
- Email servers: 11%
- HR: 11%
- ERP: 11%
- Simulations: 0%
- Asset management: 0%
- Accounting: 0%
Q. Which of the following primarily use Open Source Software (OSS): (Multiple Choice)

![OSS Users in the Organization](image)

**Figure 24.** OSS Users in the Organization

Q. While using Open Source Software (OSS), did your organization engage an external consultant to install, configure, and/or maintain it? (Single Choice)

![Reliance on Vendors for Implementation of OSS Solution](image)

**Figure 25.** Reliance on Vendors for Implementation of OSS Solution
IV.IV Concerns on the use of Open Source Software

Q. What have been your greatest concerns about Open Source Software (OSS)? (Multiple Choice)

- Maintenance & support: 87%
- Identifying a reliable, secure, and robust open source software that fulfill business needs: 73%
- Lack of vendors in the local market: 67%
- Skill personnel and their retention: 67%
- Deploying and configuring the software properly: 47%
- Resistance from end-users: 27%
- Resistance from administration and management: 27%
- Resistance from IT team: 20%

Figure 26. Concerns related to OSS
IV.V Spending on Licenses of Proprietary Software

Q. What was the percentage of software license fees out of your IT budget?

Figure 27. Expenditure on Software Licenses out of IT Budget

Q25. Do you think that this percentage of license fees out of your IT Budget is high?

Figure 28. Opinion on Expenses related to Software Licensing
Q. Do you think there is a need to reduce the license fees expenditure in your organization within the next two years?

![Pie chart showing opinion on reducing expenses related to software licensing.](image)

**Figure 29.** Opinion on Reducing the Expenses related to Software Licensing
D.6  Future Plan

Q. In the near future, do you anticipate your organization replacing some proprietary software by Open Source Software (OSS)?

![Figure 30. Organization willingness to move to OSS for few applications](image-url)

- Yes: 53%
- No: 47%