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ADOPTING OPEN SOURCE AND OPEN STANDARDS IN THE PUBLIC SECTOR: FIVE DECIDING FACTORS BEHIND THE MOVEMENT

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This paper examines the five major factors that influence the worldwide spread of open source, open standards-compliant solutions in the public sector. These factors include reduced software expenses, increased security and transparency, digital data durability and future interoperability, national information technology independence and economic development, and the benefit of reducing software piracy. Although public agencies may have different reasons for considering open source and open standards, the findings show that open source and open standards provide a solution to a number of public sector challenges, and have become feasible alternatives to their commercial, proprietary counterparts.

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I. INTRODUCTION

Adopting open source, open standards-compliant solutions in public agencies and institutions has become a global trend over the last few years. National and local governments around the world are actively adopting open source and open standards, and in many cases are encouraging the private sector to do so as well. The trend suggests that open source, open standards solutions have several advantages over their commercial, proprietary counterparts.

One advantage is that open source software can be a low-cost alternative to commercial software solutions such as the Microsoft Windows operating system and other applications that can cost thousands of dollars a month to license. Some governments and businesses are also attracted to open source as open access to the source code allows them to modify the software to meet their needs as well as fix problems themselves. In addition, open standards are critical to developing open, cross-platform services that can last more than the lifetime of a proprietary service backed by a single vendor.

There are less obvious advantages as well. Some national governments encourage the use of open source software to keep from being influenced by software vendors based in other countries in their public operations. Some evidence also indicates that local software providers who participate in the development of open source solutions contribute to the national economy as well as to the local retention of information technology skills. Moreover, in some countries where software piracy is a major concern, governments can use open source software to dissuade their citizens from using pirated copies of commercial software.

This paper begins by briefly describing the concept of open source and introduces the growing global movement toward adopting open source, open standards solutions in the public sector. It will then discuss the five major deciding factors behind the movement to illustrate how

the different needs of particular governments are met when they implement open source, open standards solutions in their public operations.

II. OPEN SOURCE CONCEPT

The term "open source" began to be widely used in 1998, when Netscape decided to open the source code of its Web browser product to the public.[1] Yet, according to Open Source Initiative, a non-profit organization that manages and promotes the Open Source Definition[2], open source is more than just access to the underlying source code of computer software. Unlike commercial software that has restrictions on use and is distributed only in compiled binary format, open source software shares its source code publicly on the Internet and is fully redistributable (Feller and Fitzgerald 2000). Moreover, users can modify the source code, and most open source licenses do not prevent the creation of derivative works. The Free Software Foundation also publishes the Free Software Definition, which explains that users should have the freedom to run, copy, distribute, study, change, and improve the software.[3] Both definitions imply that open source software development processes are open to all users and these users in turn drive the innovation of the software and standards.

This openness in software development processes allows many people to participate in the peer review and peer development processes without discrimination. Most open source software is developed by small groups of individuals or small companies, and its user community actively participates in the development process by providing comments not only

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[1] See "History of the OSI" <http://www.opensource.org/docs/history.php> for a detailed history of open source and the Open Source Initiative.
[2] The full, formal definition is available on the Web at: <http://www.opensource.org/docs/definition.php>.
[3] For full definition, visit: <http://www.gnu.org/philosophy/free-sw.html>
The definition says that the concept of freedom in this context is similar to the free in free speech, rather than in free beer.

about the features, but also about the source code itself. Having many eyes look at the source code helps maintain the quality and reliability of the software, and encourages constant innovation and improvement (Raymond 2001, 26–28, 30–40). The fact that some open source applications such as Apache are category killers in their respective markets[4] shows how the openness in software development processes can contribute to building a robust, high quality software product.

The characteristics of open source solutions discussed above explain why many public administrators worldwide have chosen open solutions rather than proprietary ones, even though each government may have different specific reasons. To some, the reduced cost of acquisition and the community-driven support make open source software attractive. To developing countries, the non-discriminating nature of open source software can be more important because they are able to use the open source code for educational purposes and become less dependent on imported technology and skills in the long run. As illustrated in the following sections, the global trend of adopting open solutions in the public sector shows that the public sector benefits from the openness and freedom of such solutions in several different ways.

III. GLOBAL TREND OF OPEN SOURCE AND OPEN STANDARDS ADOPTION

Governments that are adopting open source and open standards-compliant solutions are geographically, linguistically, developmentally and culturally very diverse.[5] In Europe, governments in countries such as Denmark, Finland, France, Germany, Italy, Norway, Spain,

[4] According to the survey by E-Soft Inc, Apache, the most famous Web server software, held around 75% share in the Web server market on March 2005, which is far greater than that of the next follow-up, Microsoft IIS, at 17.20% (E-Soft Inc 2005).

[5] Hahn (2002) has a list of existing and pending government support of open source software and related legislation at pp. 5-6, current as of the book's publication date.

Sweden, the Netherlands, and the United Kingdom are recognizing the benefits of open source software and encouraging more use of it.[6] In Brazil, the government recently announced a three-year plan in 2003 to replace the Microsoft Windows operating system with Linux in 80 percent of the computers in the ministries and state-owned companies (Miyajima 2003). It is also planning to put computers with open source software into the schools in poor neighborhoods to bridge the digital divide (Benson 2005). In South Africa, the Government Communications and Information Services started to use Apache Web server in 1998 (NACI 2004, 27). In China, Japan, and Korea, the three North Asian hotbeds for open source software, governments are working closely with the private sector to foster the development of open source software and meet the needs of their own citizens.[7]

In addition to national governments, state and municipal governments have also adopted open source solutions. The local government in Munich, Germany's third largest city, voted in 2003 to move the operating systems on 14,000 computers from Microsoft Windows to Linux (Shankland 2003b). The city of Helsinki has also adopted Linux in various departments in the city for both workstation and server uses (European Communities 2005). In addition, in the United States, California (Becker 2004), Massachusetts (Becker 2003), Oklahoma, Oregon, Rhode Island and Texas (Shankland 2003a) are shifting to open source software for new information technology purchases.

There are collaborative efforts as well. In 2003, China, Japan, and Korea signed an agreement to jointly research and develop an open source operating system to support double-

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[6] "Cases of official recognition/adoption of F/OSS" <http://europa.eu.int/information_society/activities/opensource/cases/text_en.htm> and "News about OSS-related government activities in Europe and abroad" <http://europa.eu.int/idabc/en/chapter/469> list a number of cases in Europe and some other countries/cities.

[7] There are private Linux development companies in all three countries, such as China's Red Flag Software, Japan's Miracle Linux, and Korea's MIZI Linux and Hancom Linux.

byte East Asian languages and to reduce their dependency on Microsoft Windows (CNETAsia Staff, 2003). They introduced Asianux[8], a GNU/Linux server operating environment, in 2004, and continue to hold meetings in each country to discuss standardization, cooperative development, technology, and human resource exchange (Myoung 2004). In Europe, since 2000, the European Commission has been pursuing eEurope initiatives to promote the use of open source software in European governments through exchange of experiences across the European Union.[9] In the United States, in June 2004, eleven state government agencies launched the Government Open Code Collaborative[10], a voluntary collaboration between the public sector and nonprofit academic institutions, to encourage the sharing of computer code developed for and by government entities, and to make more efficient use of open source software (Rosencrance 2004).

The continuously changing list of public agencies that are adopting open source, open standards-based solutions suggests increasing interest in what such solutions can offer, though different groups have different expectations. Discussed below are five major factors that influence the adoption of open source, open standards-compliant solutions in the public sector.

IV. FIVE DECIDING FACTORS BEHIND THE GLOBAL TREND

The five deciding factors discussed here are the following: reduced software expenses, increased security and transparency, digital data durability and future interoperability, national information technology independence and economic development, and the benefit of reducing software piracy.

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[8] http://www.asianux.com/

[9] Details about the eEurope – eGovernment initiative is available at:
<http://europa.eu.int/information_society/eeurope/2005/all_about/egovernment/index_en.htm>.

[10] http://www.gocc.gov/

1. REDUCED SOFTWARE EXPENSES

Many governments are switching from commercial software to open source software to reduce the amount of public funds spent in licensing and managing proprietary, commercial software. When calculating the total cost of ownership in software, one must consider four aspects: acquisition, migration, management, and support. Open source software has a clear advantage in the cost of acquisition because most such software can be obtained free of charge, or for a nominal charge usually related to product support. The other three aspects, however, can cost governments more than the savings in initial acquisition cost when they make the switch. For instance, not all types of software available from commercial vendors are available in open source at this time, thereby making migration complex and costly. These are mostly domain-specific applications such as integrated software development environment, mathematics/statistics, healthcare, Enterprise Resource Planning, or storage management software packages. Also, costs related to educating and documenting new systems and solutions must not be overlooked. The cost-benefit calculus of switching, therefore, is not equal for every government.

Still, maintaining commercial software solutions can be more expensive than the cost to switch. In 2002, Microsoft introduced a new subscription-based licensing program called "Software Assurance." While Microsoft customers previously had a choice of upgrading their Microsoft software, under this new program, customers are forced to pay an annual subscription fee for the right to upgrade their software and stay up to date, regardless of Microsoft's release cycles or customer satisfaction. The estimated increase in volume-licensing fees is from 33

percent to 107 percent of the original licensing fees (Wilcox 2002). Such changes in licensing agreements of commercial vendors are making governments consider alternatives.

To lower the migration, management, and support costs, some governments are encouraging local companies and local software professionals to participate in open source software development and support. In 2001, the Beijing municipal government in China awarded contracts to six local software vendors, covering office automation, antivirus, and operating systems. One of the local vendors, China's own Red Flag Linux, won the contract bid, and Microsoft lost its bid (Lettice 2002). The Korean government set up a government-supported education program in 2001 to train Linux systems administrators and technical support personnel to prepare for the future increase in demand for those skills. These efforts can lead to long term cost reductions in management and support.

As another way of lowering the cost of management and support, some governments and public agencies choose to purchase hardware equipment and support services from firms that support open source, such as IBM, Sun, and Hewlett-Packard (HP). One example is high-performance hardware tailored to Linux, sold and supported by these large companies. The U.S. Department of Energy purchased $24.5 million worth of Linux configuration for biological and environmental research from HP in 2002 (Krane 2002). The weapon research unit at the U.S. Air Force office in Florida bought a 64-processor IBM Linux computing cluster and three years of technical support for $130,000, replacing the $750,000 Silicon Graphics system (Krane 2002). IBM's Linux customers also include countries such as Canada, France, the United Kingdom, Spain, China and Singapore.

As shown above, there are ways to reduce the costs involved in all four aspects of software expenses – acquisition, migration, management, and support – in the long run.

Moreover, by collaborating with local software industries, governments can not only save in software expenditure but also strengthen their national competitiveness in software technology and boost their national economies. Further discussion of this issue follows in the discussion of the fourth factor.

2. SECURITY AND TRANSPARENCY

In 2002, the MITRE Corporation did a study to determine what kinds of open source software are used in the U.S. Department of Defense, how they are being used, and the security and reliability implications of using open source software (The MITRE Corporation 2003). Through the study, they found that open source software is being widely used and is playing a vital role in the Department. According to the study, cost is seldom the only reason for using open source software; it provides a number of additional benefits to security. The study identified the following security benefits of free and open source software (FOSS) (The MITRE Corporation 2003, 20):

1. Some FOSS applications such as the OpenBSD operating system have been intensively reviewed for security and reliability, and therefore are less likely to fail and less susceptible to cyber attacks. Even though the system may be considered more vulnerable to attacks because of open source code, identifying security holes in advance by code analysis outweighs the danger of hostile attacks. Also, the number of security holes and worms that exploit the vulnerabilities in open source environments is no greater than that in proprietary ones (Caterinicchia 2002).
2. FOSS communities have long been involved in developing sophisticated applications, such as SARA and Snort, for analyzing network and system weaknesses. Moreover, FOSS developers constantly improve the strategies of both finding security holes and defending attacks by competing with each other to find flaws in each other's systems.

3. Being able to freely modify the source code enables prompt responses to new or innovative forms of infrastructure attacks. If necessary, security groups can rapidly change source code without going through slow, confusion-prone processes with code owners.

Open source code thus allows agencies with enough good "eyes" to better maintain software security. By having many people look at the source code both from inside and outside their organization, agencies can quickly identify and fix potential problems. With proprietary software, they would have to go through the process of reporting problems to the software producer and then waiting for patches and upgrades, which could take months or even years. Open source software, on the other hand, allows anyone to create and share a fix whenever necessary, making it more attractive to many security professionals. Yet, since not every piece of open source software goes through a rigorous peer review process, the "many eyeballs" effect of maintaining code security in open source community may lead to inadvertently trusting less scrutinized software too much. Therefore, governments and agencies with less competent software professionals might need to be cautious of this issue when incorporating open source software in security-critical systems.

Code transparency is also an important security issue. Some countries choose open source software instead of a proprietary counterpart produced by a software maker from another country because they want to be assured that the software they use for critical government operations is free of any security holes that might have been placed by another country, intentionally or otherwise. Open source solutions allow them to be free from such worries because they can easily discover such holes, if any, by examining the source code.

3. DIGITAL DURABILITY AND FUTURE INTEROPERABILITY

Governments are responsible for storing a large amount of private and sensitive data, including birth and death records, medical and insurance records, tax records, and other information that must remain available for centuries. Thus, it is essential for governments to store such data in a format that will be accessible for many years to come. Proprietary software companies typically seek to improve their competitive position by locking users into their products, that is, by making them dependent on a particular data or file format (Shapiro and Varian 1999). If a government uses a software product created by such a company for data management, all data would be in a format that may not be compatible with other similar applications. Then, if the company goes out of business or stops supporting the product, the government is left with important data that is no longer accessible. Therefore, by using open source software, or software that supports open standards, governments can avoid being locked into a proprietary data or file format and better ensure that the public records will remain accessible in the future.

Open source software developers tend to favor open standards because they ensure interoperability. When pursuing interoperability, however, open source developers often face difficulties in supporting proprietary formats protected by commercial software makers in their open source applications (IDA 2001, Part 3). For instance, if many public documents are already written and stored in Microsoft Word format, finding a solution that is compatible with those files would be a major roadblock to switching to open source software.

Still, being locked into a local proprietary software company played a positive role in Korea's adoption of Linux as a desktop operating system in the public sector. Most Korean government, education, business, and military institutions have been using Hangul word

processor software by Haansoft, one of the leading software development companies in Korea, since the days of MS-DOS. It is a commercial application that uses a proprietary file format. It is also optimized for the Korean language environment, and has obtained over 70 percent of the entire Korean word processing software market since its introduction in 1990. What's more, this company developed open source software and service packages such as Hancom Linux distribution, which lets users easily view and type in Korean, and Hancom Linux Office, which works with both file formats of Hangul word processor and Microsoft Office. So, in 2002, the government purchased 120,000 copies of Hancom Linux Deluxe package to replace Microsoft products in public agencies across the nation (Cullen 2002), and was still able to access all documents produced previously.

This example brings up the significance of retaining information technology and skills locally, which is discussed in the next section.

4. National Information Technology Independence and Economic Development

Supplier independence and limited vendor lock-in allows countries to become independent in their information technology and to boost their local information technology economy. Encouraging local companies to participate in open source software development not only reduces the cost spent for licensing foreign technology but also develops local software competitiveness by internalizing all processes of software development, maintenance, and support. Internalization of software technology gives countries more choices in the use of software in the public sector, and helps prevent influence by commercial software makers over their public operations. Also, countries that are implementing open source solutions expect their local software developers to handle most of their software needs, keeping a large amount of

government funds within each nation itself. For example, the Venezuelan government switched to open source software because, according to Planning and Development Minister Dr. Felipe Pérez-Martí, "the government and the people of Venezuela were increasingly concerned that over 75 percent of the funds for software licenses went to foreign nations, 20 percent to foreign support agencies, and only 5 percent to Venezuelan programmers" (Proffitt 2002). As a result, the government migrated to open source software and contracted more local software developers to help improve the local information technology skill base and foster the local software and services economy.

Moreover, for less developed countries with a relatively short history of software development, open source software is a means of education and innovation. Open source code presents an excellent learning opportunity to those not already open to other quality source code repositories by allowing programmers to study the inner workings of a program. In addition, open source software fosters innovation by allowing derivative works. In these countries, local programmers can use open source to share their work with other programmers worldwide, get peer reviews, and create more innovative works, increasing the national information technology skill base and competitiveness.

The ability to optimize software to local languages and cultures is also a significant benefit of open source. Most of the leading commercial software packages are available solely in English or in only a handful of the languages used worldwide. Furthermore, even when a language is supported in commercial software, such software sometimes does not fully capture the interests of the language users. For instance, support for the Korean language character set in Microsoft Windows has remained flawed for many years, and users are confined to only a subset of all possible Korean word combinations. However, Microsoft has been unresponsive to

requests to fix it because the problem is an underlying code level issue, not a more apparent user interface level issue. Furthermore, in the countries whose language is not supported by major software vendors many citizens also have no basic training in the use of computers, further decreasing the nation's international information technology competitiveness. Therefore, these countries are trying to solve such development issues by using open source software whose source code is open to localization. One South African NGO needed only three months to completely translate KDE, an open source desktop environment application that provides graphical user interface to Linux, because it not only had open source code but also was built for easy localization (NACI 2004, 28). KDE is currently available in 70 different languages, including some languages rarely supported by commercial software such as Afrikaans, Catalan, Estonian, Esperanto, Icelandic, Latvian, Lithuanian, and Slovenian, far exceeding the number of supported languages in Windows.[11]

5. ALTERNATIVE TO SOFTWARE PIRACY

Some governments see open source solutions as a means of reducing software piracy in their nations and also of coping with diplomatic pressure regarding intellectual property issues. In countries like Pakistan, where per capita annual GDP is around US $300, affordability of software is a key issue (Noronha 2002). To reduce the amount of pirated software used in the country, the Pakistani government is running a GNU/Linux task force, adopting Linux and other open source software in the public and education sectors, and actively advertising the benefits of open source software to its citizens.

[11] The number is current as of March 2005. See the current data at: http://www.kde.org/whatiskde/i18n.php

China has also turned to open source software to fight the high rate of software piracy and to conform to international regulations on intellectual property protection. In China, most people who cannot afford a licensed copy of software easily opt for a pirated copy that costs much less than a legally licensed one. According to the global software piracy study by Business Software Alliance and International Data Corporation, China has the highest rate of software piracy in the world in 2003, tied with Vietnam at 92% (BSA and IDC 2004, 4). As China became a member of the World Trade Organization (WTO) in 2001, it has been required to reduce software piracy to comply with the TRIPS agreement that protects WTO member nations' intellectual property rights. As a result, China is investing in several local open source software companies such as Red Flag Linux to increase their market presence in China. It is also trying to avoid foreign proprietary software companies like Microsoft when awarding government software contracts to decrease the market share of such companies in the country (Oates 2004).

These decisions by China had an unexpected effect. The size of the Chinese software market became so large that Microsoft could not ignore the possible outcome of the government initiatives favoring open source solutions. Therefore, driven by the Chinese government's action to avoid their products, Microsoft has begun heavily investing in the local Chinese software development and research industry to persuade the government to rethink their decisions (Microsoft 2002). The Microsoft Research Asia center in Beijing is the largest Microsoft research center outside the U.S. and employs hundreds of local programmers and engineers (Denlinger 2003), which in turn contributes to the national competitiveness.

At this moment, no long-term observational research exists on the effectiveness of promoting open source software as a way to reduce software piracy. However, in countries where the cost of foreign proprietary software is too high for the average citizen, and the rate of

software piracy is high as a result, open source software may be an effective and relatively inexpensive means to educate their people to use more legitimate copies of software.

V. CONCLUSION

The deciding factors described in this paper explain why public administrators decide to use open source, open standards-based solutions given their different needs and circumstances. The findings suggest that open source may provide solutions to the various needs of public agencies, including:

- Affordable software for individuals, businesses, and governments;
- Increased security and reliability;
- Reduced costs and less dependency on imported software technology and skills;
- Access to government data without the barrier of proprietary software and data formats;
- Ability to customize software to local languages and cultures;
- Educational resources for local developers, lowering barriers of entry to the global software market.

Public sector managers facing these challenges should consider open source software as a way to meet the goals of their agency or organization. Open source software gives public agencies the freedom to use the existing source code in order to shape the technology to their needs, and thus promotes innovation for the benefit of all. Although the specific reasons for each government to choose open source, open standards-compliant solutions may differ according to the level of economic development and specific technology needs, the global trend shows that such solutions are quickly becoming feasible alternatives to their commercial, proprietary counterparts. Governments can encourage sustainable economic growth by employing open source solutions in the public sector and by promoting their use to the general public.

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The public sector, which is expected to lead in the anti-corruption battle, may be short of qualified and adequately motivated personnel. Or other serious institutional capacity deficiencies may impede progress.Â â€¢ Enable the experts to deliberate on preventive measures that need to be adopted to strengthen corruption pre-empting capacities, highlighted in the United Nations Convention; â€¢ Focus the expertsâ€™ attention on specifying the various roles of governance actors in the design, implementation, and monitoring of corruption prevention and follow-up anti-corruption measures; and.