OPEN-SOURCE AS AN ALTERNATIVE TO COMMERCIAL SOFTWARE

Final Report 583

Prepared by:
Sean Coleman
2401 E Rio Salado Pkwy. #1179
Tempe, Arizona 85281

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Arizona Department of Transportation
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16. Abstract

In recent years, open-source software has demonstrated rapid growth in popularity with the proliferation of alternatives to commercial applications. This study investigates the feasibility of ADOT using open-source software by determining overall benefits, candidate applications, and potential cost savings. First, the concept of open-source is introduced through a literature review giving the history and analysis of the *hacker culture* that lies at its core, as well as noting common misconceptions regarding open-source. Additionally, the economic and intrinsic motivation of open-source developers is investigated, along with key development methodologies such as crowd sourcing and transparent peer review. In order to investigate the current landscapes of open-source and commercial software among state transportation agencies, a survey was conducted of several other departments of transportation. Data from the 26 respondents showed that these agencies favored commercial software during the procurement process, despite the rapid adoption of open-source software in the consumer market. Regarding Microsoft Office 2007 and Windows Vista deployments, the consensus was that upgrading is a possibility, but no specific plans have been made. Based on these findings, OpenOffice.org was identified as a strong open-source candidate application comparable to Microsoft Office. In order to further investigate this claim, a pilot test called the OpenOffice Challenge was developed to compare the usability of OpenOffice.org and Office 2007. Results showed that participants generally see OpenOffice.org as a closer alternative to Office 2003, currently the standard office suite at ADOT, than to Office 2007. This study concludes by analyzing current Microsoft licensing contracts and software cost at the department. A potential cost savings based on reduced licensing costs was found to be $410,000 with the implementation of OpenOffice.org. Additional recommendations are made to the Department regarding open-source procurement and accessibility as a government agency.

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SI (MODERN METRIC) CONVERSION FACTORS*

APPROXIMATE CONVERSIONS TO SI UNITS

Symbol	When You Know	Multiply By	To Find	Symbol
	LENGTH			
in	inches	25.4	millimeters	mm
ft	feet	0.305	meters	m
yd	yards	0.914	meters	m
mi	miles	1.61	kilometers	km
	AREA			
in^2	square inches	645.2	square millimeters	mm^2
ft^2	square feet	0.093	square meters	m^2
yd^2	square yards	0.836	square meters	m^2
ac	acres	0.405	hectares	ha
mi^2	square miles	2.59	square kilometers	km^2
	VOLUME			
fl oz	fluid ounces	29.57	milliliters	mL
gal	gallons	3.785	liters	L
ft^3	cubic feet	0.028	cubic meters	m^3
yd^3	cubic yards	0.765	cubic meters	m^3
	NOTE: Volumes greater than 1000L shall be shown in m^3.			
	MASS			
oz	ounces	28.35	grams	g
lb	pounds	0.454	kilograms	kg
T	short tons (2000lb)	0.907	megagrams (or "metric ton")	mg (or "t")
	TEMPERATURE (exact)			
°F	Fahrenheit temperature	5(F-32)/9 or (F-32)/1.8	Celsius temperature	°C
	ILLUMINATION			
fc	foot candles	10.76	lux	lx
fl	foot-Lamberts	3.426	candela/m^2	cd/m^2
	FORCE AND PRESSURE OR STRESS			
lbf	poundforce	4.45	newtons	N
lbf/in^2	poundforce per square inch	6.89	kilopascals	kPa

APPROXIMATE CONVERSIONS FROM SI UNITS

Symbol	When You Know	Multiply By	To Find	Symbol
	LENGTH			
mm	millimeters	0.039	inches	in
m	meters	3.28	feet	ft
m	meters	1.09	yards	yd
km	kilometers	0.621	miles	mi
	AREA			
mm^2	Square millimeters	0.0016	square inches	in^2
m^2	Square meters	10.764	square feet	ft^2
m^2	Square meters	1.195	square yards	yd^2
ha	hectares	2.47	acres	ac
km^2	Square kilometers	0.386	square miles	mi^2
	VOLUME			
mL	milliliters	0.034	fluid ounces	fl oz
L	liters	0.264	gallons	gal
m^3	Cubic meters	35.315	cubic feet	ft^3
m^3	Cubic meters	1.308	cubic yards	yd^3
	MASS			
g	grams	0.035	ounces	oz
kg	kilograms	2.205	pounds	lb
mg	megagrams (or "metric ton")	1.102	short tons (2000lb)	T
	TEMPERATURE (exact)			
°C	Celsius temperature	1.8C + 32	Fahrenheit temperature	°F
	ILLUMINATION			
lx	lux	0.0929	foot-candles	fc
cd/m^2	candela/m^2	0.2919	foot-Lamberts	fl
	FORCE AND PRESSURE OR STRESS			
N	newtons	0.225	poundforce	lbf
kPa	kilopascals	0.145	poundforce per square inch	lbf/in^2

SI is the symbol for the International System of Units. Appropriate rounding should be made to comply with Section 4 of ASTM E380

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

GLOSSARY OF ACRONYMS

API	Application Programming Interface
ADOT	Arizona Department of Transportation
BSD	Berkeley Software Distribution
COTS	Commercial Off-the-Shelf Software
CAR	Common Average Rank
CSRG	Computer Science Research Group
DOT	Department of Transportation
FSF	Free Software Foundation
GNU	GNU's Not UNIX
GPL	General Public License
IT	Information Technology
LGPL	Lesser General Public License
MPL	Mozilla Public License
NASA	National Aeronautics and Space Administration
NCSA	National Center for Supercomputer Applications
OASIS	Organization for the Advancement of Structured Information Standards
OSI	Open-source Initiative
OSS	Open-source Software
PHP	PHP: Hypertext Preprocessor
RFP	Request for Proposal
ROI	Return on Investment
SaaS	Software-as-a-Service
SQL	Structured Query Language
TAC	Technical Advisory Committee
TBO	Total Benefit of Ownership
TCO	Total Cost of Ownership
VBA	Visual Basic for Applications
XML	Extensible Markup Language

1.0 EXECUTIVE SUMMARY

1.1 INTRODUCTION

The Arizona Department of Transportation (ADOT) currently spends more than $1 million per year on commercial software licensing, resulting in a recognizable financial strain. The increasing popularity of open-source software (OSS) and its nominal licensing fees are making many organizations, including ADOT, look at ways to take advantage of its lower software costs. The purpose of this research is to investigate ways other government agencies and transportation departments are utilizing OSS to reduce costs, as well as identify key areas and open-source applications that will provide value to ADOT. Additionally, this study provides estimated cost savings for particular applications and makes general recommendations regarding the software procurement process and OSS.

1.2 LITERATURE REVIEW

This section presents findings from published literature regarding OSS and provides an introduction to the concept and paradoxical meanings of *free software*. An extensive history of open-source is provided by outlining significant projects and people at the roots of the open-source movement. Additionally, this section outlines programmer motives and economics that define the anthropologic *gift culture*[1]at the core of the open-source community, demonstrating why developers contribute to projects without monetary compensation. Finally, previous government OSS implementations are provided to analyze success stories as a base for open-source introduction at ADOT. Several notable items are summarized:

- Openly sharing source code was the original method of programming software that led the development of computer science. Originally, hardware and software of a computer system were so tightly coupled that keeping source code proprietary provided no competitive advantage.
- The social concept of a *gift economy* is prevalent across open-source communities in which programmers regularly exchange source code without any expectation of repayment. However, social classes are developed within project teams in which an individual's status is defined by what he or she contributes.
- Public sector organizations are increasingly adopting OSS to realize increased file accessibility through open formats. Additionally, many governments around the world are recognizing cost savings without reduced functionality by migrating to alternative open-source applications.
- The Total *Cost* of Ownership (TCO), a narrowly focused metric used in software procurement, might well be inferior to the Total *Benefit* of Ownership (TBO). Investigation of TBO may reveal qualitative advantages such as open formats, usability, and development quality.

[1] A gift culture contrasts to a market economy since valuable goods and services are regularly given away without any expectation of reward or compensation.

1.3 EXTERNAL AGENCY SURVEY

To gain an understanding of the collective software landscape of external transportation agencies, a survey was conducted to explore their software use. Survey questions were developed to satisfy the following three objectives:

- Gain insight into the overall use and perception of proprietary software and OSS among departments of transportation (DOTs), as well as investigate their future software implementations.
- Discover DOTs that have experience with OSS implementations and that may serve as continued references and give useful comments.
- Provide an avenue for other state DOTs to benefit from the research constituting this study.

The survey was sent to the state transportation agencies of the other 49 states and the District of Columbia. Twenty-six responded, which was a favorable return. The survey showed a consensus that commercial software was the dominant player, but also revealed a strong interest in advantages OSS provides. Some key results are:

- 18 survey respondents stated that a deployment/upgrade to Windows Vista is a possibility, but no plans have been made.
- 11 respondents stated that a deployment/upgrade to Office 2007 is a possibility, but no plans have been made.
- All survey respondents reported that they do not use an OSS office suite; however the Wisconsin DOT responded that it has implemented an OSS operating system.

1.4 THE OPENOFFICE CHALLENGE™

Based on the findings of the survey, OpenOffice.org was identified as a strong candidate for an OSS pilot test. Transportation agencies, including ADOT, showed reluctance to deploy Microsoft Office 2007 because of its significant change in usability, interface, and interoperability compared to previous versions. The OpenOffice Challenge™ was developed to test the hypothesis that OpenOffice.org, an open-source office suite comparable to Microsoft Office, is more similar to Office 2003, which is the current version used throughout ADOT, than is Office 2007. The following outlines key results and conclusions from the pilot test:

- OpenOffice.org 3 is more comparable in terms of usability and functionality to Office 2003 than is Office 2003's successor, Office 2007.
- There was consistent favoring of OpenOffice.org 3 as an "easier-to-learn" application in comparison to Office 2007.
- OpenOffice.org 3 is a reasonable alternative to Microsoft Office 2003 in terms of usability, efficiency, and functionality.

1.5 RECOMMENDATIONS

One objective of this research study is to offer recommendations to ADOT regarding open-source software. Findings throughout the research led to three overall recommendations:

- ADOT should implement OpenOffice.org 3 as a dual deployment with Microsoft Office 2007 within a normal upgrade cycle. By providing OpenOffice.org as an alternative to Office 2007, the culture will gradually shift to using OpenOffice.org, as seen in the conclusions from the OpenOffice Challenge ™. Additionally, a dual deployment mitigates migration costs and risks associated with immediately switching to an entirely different platform.
- A policy should be implemented to require the consideration of open-source applications during software procurement and RFPs.
- ADOT should seek to encourage the proliferation of OSS throughout the department by offering IT support for OSS and allowing developers to contribute up to 10% of their time toward open-source projects.

2.0 LITERATURE REVIEW

2.1 INTRODUCTION

The use of OSS is one of the fastest-growing trends among both consumers and large organizations. With the increasing cost of commercial software, individuals and technology leaders are looking for ways to reduce software licensing fees. The nominal prices and extensive popularity of OSS packages have led consumers, small businesses, and large enterprises to switch from proprietary software configurations to OSS. Although many factors are used to decide on software used throughout an organization, a reason against using OSS stems from the distributed-development model of OSS projects.

Generally speaking, commercial software is developed, distributed, and supported by profit-seeking companies. The universal goal of such companies is to create reliable and feature-rich products that will sell and generate revenue. Customers realize that the companies stand behind their products in order to guarantee future sales. However, OSS projects do not have the same economic motivation to guarantee support and reliability in the software. Instead of a centralized corporation, a distributed network of skilled computer system administrators, database administrators, computer programmers, and other engineers contribute to OSS products that in many cases are regarded as equivalent, if not superior, to similar proprietary software.

This report covers the following aspects of OSS: definitions, history, economics and philosophy, TCO analysis, advantages and disadvantages, and government implementation. First, the OSS definition is introduced, along with commonly used OSS software licenses as governed by the Open-source Initiative (OSI). Next, the historical background of OSS is summarized, along with the history of UNIX and Linux, the two projects at the historical roots of OSS. In addition, the philosophical basis for OSS success, as well as the development models for both OSS and proprietary companies, is investigated. The TCO of large-scale OSS implementation is analyzed and reviewed using various case studies. Next, specific advantages and disadvantages are looked at in both OSS and proprietary software to gain a better understanding of how to analyze an organization's information technology (IT) infrastructure. Finally, several case studies of governmental OSS implementation are summarized, providing a look at the success of OSS implementation at the enterprise level.

2.2 DEFINITIONS AND LICENSE TYPES

2.2.1 Free Software

In addition to the concept of open-source, the Free Software Foundation (FSF) provides meaning for the term *free software* often used in discussing open-source software. However, the word *free* is not used in the context of *gratis*, meaning "without cost"; instead, it is based on the meaning of *libre*, or "free as in freedom." This definition was made popular by Richard Stallman, the FSF's founder and formerly a programmer at the Massachusetts Institute of Technology (MIT) artificial intelligence (AI) lab, in a magazine article titled "GNU Manifesto."[2]

[2] Stallman, Richard. "The GNU Manifesto." The GNU Operating System. http://www.gnu.org/gnu/manifesto.html (accessed March 22, 2009).

Although free software and open-source software essentially describe the same applications and are often used interchangeably, the terms are specifically defined. Stallman describes free software as a social movement that contrasts with the open-source development methodology in this way:

> "Nearly all open-source software is free software; the two terms describe almost the same category of software. But they stand for views based on fundamentally different values. Open-source is a development methodology; free software is a social movement. For the free software movement, free software is an ethical imperative, because only free software respects the users' freedom. By contrast, the philosophy of open-source considers issues in terms of how to make software "better"—in a practical sense only. It says that non-free software is a suboptimal solution. For the free software movement, however, non-free software is a social problem, and moving to free software is the solution."[3]

For the purpose of this study, "open-source software" will be used as defined by the OSI below.

2.2.2 The Open-source Definition

The OSI [4] is a non-profit corporation that governs open-source standards and licenses in order to provide a framework for OSS developers. Based on the terminology of open-source, many believe that the only requirement for a project to be considered open-source is to give the public access to the source code. Others believe that free software is, by default, considered open-source. However, the OSI provides strict criteria for a software project to be considered open-source:

- **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 by 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.

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[3] Stallman, Richard. "Why Open-source misses the point of Free Software." The GNU Operating System. http://www.gnu.org/philosophy/open-source-misses-the-point.html (accessed March 22, 2009).

[4] Open-source Initiative. http://www.opensource.org/ (accessed March 22, 2009).

- **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 using 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 OSS.
- **License Must Be Technology-Neutral:** No provision of the license may be predicated on any individual technology or interface style.

2.2.3 OSS Licenses

The term "copyleft" is often used to describe the rights regarding free and open-source software. Playing upon the term "copyright," copyleft ensures the freedom of software use and distribution. The FSF, established in 1985, is dedicated to promoting computer users' rights to use, study, copy, modify, and redistribute computer programs. The FSF describes copyleft as "a general method for making a program or other work free, and requiring all modified and extended versions of the program to be free as well."[5] OSS licenses are often based on a version of copyleft in order to ensure the freedom of use and modification of the software.

The OSI, besides enforcing the open-source definition, manages OSS licenses that organizations and individuals may use to distribute software. Several popular licenses are used by the various communities to license open-source projects; however, many

[5] Free Software Foundation. http://www.fsf.org (accessed March 20, 2009).

organizations have created specific licenses that they use for their products. To have an OSS license approved, the author must follow an eight-step process that includes an in-depth analysis of how the OSS project conforms to the open-source definition. The license is finalized with approval from the OSI.

Among the numerous open-source licenses, several public-use licenses are popular among developers. Stephen Fishman, an intellectual property attorney and OSS advocate, describes the main open-source license types:

2.2.3.1 GPL (General Public License)

> The GNU GPL (General Public License), one of the first open-source licenses and still by far the most widely used, was the first to implement copyleft. Linux, the most famous open-source application, uses the GPL [created by] Richard Stallman and Eben Moglen.

2.2.3.2 MPL (Mozilla Public License)

> The Mozilla Public License (MPL) is the most popular open-source license that contains a weak copyleft provision. It was developed to distribute the Mozilla web browser (the open-source version of the Netscape browser). It requires the inclusion or publishing of the source code for all publicly distributed modifications. The length of time necessary to publish the code is limited to a period of one year or six months, depending on the situation. [6]

The OSI has approved a multitude of additional licenses based on the concept of copyleft. This includes the Lesser General Public License (LGPL) which doesn't have the extensive redistribution requirements that the GPL has. In addition, the Berkeley Software Distribution (BSD) License was created with the BSD UNIX variant (Sec. 2.3.1) and has been modified for use with many new projects. Typically, new open-source projects will include the modification of previous open-source licenses to fit the description and scope of the new project.

2.3 HISTORY OF OPEN-SOURCE

The concept of sharing source code freely was standard long before software was developed and packaged for profit. Original software applications were developed exclusively for use with a specific set of hardware and seen not as stand-alone products, but as a portion of the overall package. Early software developers and organizations embraced the concept of sharing source code for the sake of speedy feedback and collaboration. However, early data showed that the large corporations employing or retaining these developers were unresponsive to their suggestions and the needs of customers. As a result, many disgruntled employees left their respective companies and developed applications that rivaled their commercial counterparts, knowing that their system architecture and necessary features meant certain success for these rogue developers. Many current large-scale OSS projects were started through this process, including UNIX, Linux, Sendmail, and Apache.

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[6] Fishman, Stephen. "Open-source Licenses Are Not All the Same." ONLamp.com. http://www.onlamp.com/pub/a/onlamp/2004/11/18/licenses.html (accessed March 20, 2009).

In response, over the past 20 years, the software industry has switched from the extensive collaborative environment of external source code sharing to one where companies guard their source code as intellectual property. As software started becoming more complex and companies recognized that software could be a competitive advantage, they started closing their source code. Although the software market is currently controlled by commercial software vendors, the industry has begun to view open-source projects as a viable option once again.

Table 1 shows a brief historical timeline of the significant open-source developments discussed in the following paragraphs of this section.

Table 1: Brief Historical Timeline of Significant Open-source Events

1969	UNIX development starts at AT&T Bell Labs for the PDP-7.
1979	UNIX V7 is released, the grandfather of all extant UNIX systems.
1984	Richard Stallman starts GNU project.
1985	Richard Stallman creates Free Software Foundation.
1989	GNU General Public License (V1) is published.
August 1991	Linus Torvalds begins developing an operating system kernel.
December 1993	The UNIC OS, FreeBSD 1.0 is released.
March 1994	Linux V1.0 kernel is officially released.
January 1995	Apache Web server is started by programmers from the National Center for Supercomputing Applications (NCSA).
April 1996	Apache takes 29% market share
February 1998	The term “open-source” is coined during a conference in Palo Alto, California; the Open-source Initiative is founded.
April 2003	First annual MySQL conference is held.
July 2003	Mozilla Foundation is formed.
June 2004	Sun Microsystems licenses Solaris as open-source.
May 2007	Dell announces it preloads Linux on its computers.

2.3.1 UNIX

During the early days of computing, large-scale commercial computers were developed by IBM and AT&T Bell Labs and other companies. These commercial computers each had distinct operating systems that were written specifically for a unique hardware profile —the software could not be run on multiple platforms. To eliminate the hardware profiling of software, many programmers started developing a new operating system that would reach beyond a computer’s original hardware. In 1969, as Jesus Gonzalez-Barahona describes it, “Kenneth Thompson, Dennis Ritchie, and others at AT&T Bell

Labs began developing a small operating system on a little-used PDP-7. The operating system was soon christened UNIX, a pun on an earlier operating system project called MULTICS (Multiplexed Information and Computing Service)."[7] The UNIX project was the most successful of all the attempts to develop a cross-platform operating system. One of the biggest catalysts for success was the collaborative nature of the project. The UNIX source code was freely shared among the many talented programmers who contributed to the project. Carolyn Kenwood of The MITRE Corporation credits a majority of the collaboration to a computer network:

> "The process of sharing code rapidly accelerated with the emergence of Usenet, a computer network begun in 1979 to link together the UNIX programming community." [8]

After years of development, the seventh edition (V7) of UNIX was released in 1979. This version is described as "the grandfather of all extant UNIX systems."[9] Although UNIX had rapid success, the project was not without problems. Throughout the software's history, no entity had tried to claim property rights to the source code until AT&T did in the early 1980s.[10] In response, Stallman started out to produce a free version of UNIX. One of the important aspects of this new project was that any individual could contribute to source code. As Kenwood tells it:

> "This project, called GNU, allowed individual programmers, regardless of individual or commercial interests, to contribute to the development effort. GNU stands for 'Gnu's not Unix.' In the end, users were not charged for the operating system."[11]

From this project, the GNU GPL was developed, dictated by the following restrictions as stated by Kenwood:

- "Software licensed under GNU General Public License can be copied and distributed under this same license.
- Products obtained and distributed under this license may be sold.
- Users may alter the source code, but if they distribute or publish the resulting work, they must make the software available under the same licensing terms.
- Ancillary technology can be developed, and as long as such products do not include code licensed under the GNU General Public License, they need not be licensed or made available under the terms of the GNU General Public License." [12]

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[7] Gonzalez-Barahona, Jesus M. *A Brief History of Open-source Software*. Report. http://eu.conecta.it/paper/brief_history_open_source.html (accessed March 20, 2009).

[8] Carolyn A. Kenwood, *A Business Case Study of Open-source Software*, publication no. 01B0000048, 1, http://www.mitre.org/work/tech_papers/tech_papers_01/kenwood_software/kenwood_software.pdf (accessed March 22, 2009).

[9] Ibid.

[10] Ibid

[11] Kenwood, *Business Case Study*, 1.

[12] Ibid

Stallman's intentions were to ensure that UNIX-compatible software would remain free and catalyze more collaborative programming and development. In *GNU Manifesto*, he states:

> "I consider that the golden rule requires that if I like a program I must share it with other people who like it. Software sellers want to divide the users and conquer them, making each user agree not to share with others. I refuse to break solidarity with other users in this way. I cannot in good conscience sign a nondisclosure agreement or a software license agreement."[13]

On a parallel plane, the Computer Science Research Group (CSRG) at the University of California at Berkeley built upon the proprietary UNIX system. David Wheeler, an expert in computer security and high-risk software systems, recounts, "The academic community …developed a variant called the Berkeley Software Distribution (BSD)."[14] Like GNU, the UNIX variant BSD was developed by a worldwide network of programmers and UNIX hackers who "helped debug, maintain, and improve the system."[15] Continuing in the footsteps of GNU, BSD was distributed under the BSD License making BSD another open-source alternative to UNIX. However, despite BSD's open-source nature, each user needed the proprietary AT&T license to run parts of the core operating system and utilities that made BSD a usable system.

2.3.2 Linux

Arguably the quintessential open-source project is the Linux operating system. Linux is regarded as the closest competitor to Microsoft's Windows operating system and receives continuous contributions from programmers worldwide. It was conceived in 1991 by Linus Torvalds, a student at the University of Helsinki. Dissatisfied with his school's choice of the MINIX operating system, Torvalds decided to create a free operating system based on UNIX. Kenwood writes:

> "Linus Torvalds…created the Linux operating system and gave hackers his code so they could contribute to the development. Many programmers analyzed his code and wrote improvements that Linus incorporated into Linux. Linux grew and expanded into an advanced and powerful, multi-use operating system."[16]

March 1994 marked the first official release of the Linux kernel, the foundation of modern Linux distributions. According to Michael Godfrey and Qiang Tu of the Computer Science department at the University of Waterloo, this release "contained 487 source code files comprising over 165,000 lines of code."[17] However, the most notable aspect of this release was the maintenance methodology from that point forward. Two directions were formed to help carve out future products: developmental releases and

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[13] The GNU Manifesto.

[14] David A. Wheeler, *Secure Programming for Linux and Unix HOWTO*, 1, http://www.dwheeler.com/secure-programs/Secure-Programs-HOWTO/ (accessed March 22, 2009).

[15] Brief History.

[16] Business Case Study, 1.

[17] Godfrey, Michael W. and Qiang Tu. "Evolution in Open-source Software: A Case Study." Proceedings of the IEEE Intl. Conference on Software Maintenance. ICSM, 2000. pp.

stable releases. Developmental releases contain mostly untested and experimental code, while stable releases contain updates and are relative to the previous stable release. This process has led to many new distribution releases and millions of people using the Linux operating system. In addition, companies have been formed that sell distribution copies of Linux as well as support contracts. The most notable organizations are SuSE, RedHat, Ubuntu, and Caldera.

The Linux operating system is becoming a huge competitor to Microsoft Windows in both the server and desktop arenas. An *InformationWeek* study done in January 2000 reported that Linux constituted about 4% of the respondents' operating systems and was expected to rise to 15% in two years.[18] In addition, CNET reported that "Linux grabbed 27 percent market share [of server operating systems] in 2000, up from 25 percent the previous year."[19]

2.3.3 Other Major Projects

The UNIX and Linux operating systems occupy most of the history of OSS. However, many projects have followed in their footsteps including the Apache Web server, one of the most recent successful OSS projects. Started in 1995 by Brian Behlendorf, Apache's story parallels that of UNIX, in which frustrated employees left in order to create better software. While working at the National Center for Supercomputer Applications (NCSA), Behlendorf and several other employees became frustrated "in getting the NCSA staff to respond to their suggestions."[20] In an effort to implement fixes, Behlendorf and "six other pioneering developers decided to establish a mailing list to collect and integrate the patches to the NCSA server software."[21] Apache 0.8 was released in August 1995 and named after the extensive use of "patches." The server software continued to grow, mainly due to a lack of equivalent competition. A Netcraft survey done in November 2000 found that 59.7% of websites used the Apache Web server while Microsoft's IIS only had 20.2% of the market.[22]

Sendmail is another example of open-source innovation and success. The OSS project was "originally developed in the late 1970s by Eric Allman, a graduate student in computer science at the University of California at Berkeley."[23] Faced with the incompatibility of the two networks on campus, BerkNet and Arpanet, "Allman developed…a program called 'Delivermail', which provided a way to greatly simplify the addressing problem."[24] Two years later in 1981, the software was released as 'Sendmail' which

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[18] Ricadela, Aaron. "Linux Comes Alive." *InformationWeek*, January 24, 2000.

[19] Shankland, Stephen. "Linux growth underscores threat to Microsoft." CNET News. http://news.cnet.com/2100-1001-253320.html (accessed March 22, 2009).

[20] Tirole, Jean, and Josh Lerner. "Some Simple Economics of Open-source." *Journal of Industrial Economics* 50, no. 2 (2002): 197-234. http://www.people.hbs.edu/jlerner/simple.pdf (accessed March 22, 2009).

[21] Simple Economics, 13.

[22] Simple Economics, 14.

[23] Simple Economics, 18.

[24] Ibid

"soon became the standard method of routing email on the Arpanet."[25] Sendmail continued a successful path and in 2000, "the program was estimated to handle about 75% of all Internet email traffic."[26]

A multitude of OSS projects have started, many becoming so successful that they compete in or even dominate a market filled with proprietary products and profit-seeking corporations, such as the case of the Apache Web server. Although the motivation and inspiration for programmers to participate in these projects vary greatly, one of the driving forces behind OSS development is dissatisfaction with current proprietary software. This has led to the development of a comparable OSS project for most, if not all, commercial applications. OpenOffice.org, based on the StarOffice suite started in the 1980s, is an open-standard, XML-based office productivity suite that compares to Microsoft's Office in terms of features and capabilities. In the operating system arena, Linux has been a direct competitor of Windows, both in desktops and servers. MySQL is another open-source project that is based on the Structured Query Language (SQL) and is a direct competitor of MS SQL. Finally, Microsoft's Internet Explorer is rivaled by its open-source competitor, Firefox, developed by Mozilla. Although there is constant debate as to whether Microsoft's software or comparable OSS is better, many OSS projects have succeeded in developing large market share.

2.4 ECONOMICS AND PHILOSOPHY

2.4.1 Open-source Initiative

Although the concepts of open-source have existed since the beginning of UNIX in the 1970s, the term "open-source" is relatively new. The OSI's website reads "The open-source label was invented at a strategy session held on February 3rd, 1998 in Palo Alto, California."[27] The OSI states that individuals including Linus Torvalds from Linux and Eric Raymond from Netscape:

> "decided it was time to dump the moralizing and confrontational attitude that had been associated with "free software" in the past and sell the idea strictly on the same pragmatic, business-case grounds that had motivated Netscape." [28]

Founded in February 1998 as a non-profit organization for the advocacy of OSS, the OSI focuses on the fundamentals of OSS discussed at the Free Software Summit. Kenwood describes OSI as:

> "…an unincorporated nonprofit research and educational association with the mission to own and defend the open-source trademark and advance the cause of OSS."[29]

[25] Ibid

[26] Simple Economics, 19.

[27] Open-source Initiative. http://www.opensource.org/ (accessed March 22, 2009).

[28] Ibid

[29] Business Case Study, xi

2.4.2 Economics and Motivation

The driving forces behind open-source software are truly revolutionary, especially for a largely capitalist world. Voluntary labor, free products, and unlicensed redistribution are foreign aspects to the free market. However, despite the seemingly backward strategy, open-source projects have been successful not only in terms of implementation, but also profit. Both individual contributors and large companies pour time and money into OSS projects without direct compensation. Dirk Riehle, a member of SPA Research describes:

> "The advent of open-source software has produced more than lower software costs for users. It has also caused major changes in the economic interaction among players in the software ecosystem."[30]

OSS projects can generally be classified into either of two categories: community and commercial. Community OSS is developed by networks of individual contributors who volunteer their time and skill. A group of leaders generally governs what contributions are accepted into the core source code and eventually the final releases. Commercial OSS is developed with the support and driving forces of profit-seeking companies. Riehle states that "the company maintains the copyright and determines what is accepted into the software code base and what to implement next."[31] Significant economic research has been completed on labor and monetary economics dealing with both commercial and community-supported OSS.

2.4.2.1 Gift Culture

Volunteer contributions to OSS projects are usually done without any form of immediate or direct payout. However, the individuals focus on the net benefit of the project "equal to the immediate payoff (current benefit minus current cost) plus the delayed payoff (delayed benefit minus delayed cost)."[32] The net benefit includes the abstract benefits—personal gratification and increased rapport and experience are main reasons people endure the opportunity cost and volunteer their skills. Riehle states that "developers contribute to document their technical capabilities and improve job prospects with future employers."[33] The individuals' contributions are rewarded in the long term through higher pay. Large corporations also have experienced the benefits of peer recognition through OSS participation—companies have increasingly encouraged their employees to contribute to open-source projects on company time while partially crediting the organization. Boldrin and Levine state, "Evidence shows that the source of competitive returns that pay the bills of software developers is the complementary sale of expertise."[34]

Another side deals with open-source companies that seek profit from an OSS project. Although this appears to defy the concept of open-source, the company's profits are

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[30] Riehle, Dirk. "The Economic Motivation of Open-source Software: Stakeholder Perspectives." *IEEE Computer Society* (April 2007): 25. http://www.riehle.org/computer-science/research/2007/computer-2007.pdf (accessed March 22, 2009).

[31] Ibid

[32] Simple Economics, 20.

[33] Economic Motivation, 25.

[34] Boldrin, Michele, and David K. Levine. "Open-Source Software: Who Needs Intellectual Property?" *The Freeman: Ideas on Liberty* (2007). The Freeman. http://www.thefreemanonline.org/featured/open-source-software-who-needs-intellectual-property (accessed March 20, 2009).

received through methods other than actual software licensing since the code is freely available. OSS companies often seek revenue in the form of support contracts, distribution mechanisms, and the development of proprietary enhancements to the OSS projects. Some companies focus on providing alternative distribution methods to customers for profit. In addition, upgrade services are provided by commercial companies for open-source products. Krishnamurthy describes that:

> "Enterprises can now enter into long-term agreements with distributors to ensure that they get the latest upgrade. By acting as the application service providers, distributors can help their clients get the latest version of the product seamlessly."[35]

Although the open-source business model differs greatly from that of proprietary soft-ware companies, OSS commercial enterprises still make large profits. In addition, OSS development has several clear advantages over proprietary software organizations, including the "benefits of community open-source [software]: faster adoption, free and speedy user feedback, and possibly volunteers' code contributions."[36] Arguably, this business model allows companies to develop software faster and release more thoroughly tested products. These reasons have pushed many companies to disclose their products' source code and license it under the OSI.

2.4.3 Government and OSS

Government agencies are unique entities that share characteristics with both non-profit and commercial enterprises. Public-sector departments typically have a unique set of business requirements and demands. Revenue for government agencies is generated from taxpayers, both directly and indirectly. In general, the budgets for agencies are based on tax revenue. Unlike private sector corporations, governments are unable to generate additional revenue through increased sales. In addition, government agencies are charged with providing citizens with particular services usually with tight operating budgets. Unfortunately, without a mechanism for generating additional revenue, agencies must focus on cost reduction and efficiency in order to allocate additional money to fund service improvements.

Software licensing and information technology are some of government agencies' largest costs. "In fiscal year 2003, the U.S. government budgeted more than $58 billion for IT products and services. More than 4 million desktops, laptops, and networked computers play essential roles in allowing the federal agencies to achieve their goals."[37] The public sector has taken an increased interest in OSS because of its potential cost savings.

Procurement officials in government agencies across the world are looking at the TCO of OSS in particular. In addition to the monetary savings, government agencies are interested in the compatibility and accessibility that OSS offers—an important area for an organization that serves diverse demographics. For example, Microsoft's proprietary file formats seen in its Office applications require compatible software. Various OSS office productivity

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[35] Ibid

[36] Economic Motivation, 29.

[37] Walker, Tom. *The Future of Open-source in Government.* Report. http://oss-institute.org/newspdf/walker_oss_white_paper_2292004.pdf (accessed March 22, 2009).

applications comply with an "open format" that allows other software platforms to use them without proprietary software requirements. Many OSS case studies have been followed by successful OSS deployment initiatives for nations around the world. In addition, many legislatures have developed policies regarding the use and procurement of OSS. At a minimum some policies require government agencies to investigate OSS during software procurement. Overall, several studies show the main reasons and advantages for using OSS:

- The need to reduce possible domination of a single software provider.
- Most fears of security risks in OSS are unfounded.
- OSS solutions are available to meet all the requirements in a particular area.
- Decreased total cost of ownership for software.
- Decreased initial software licensing costs.
- Maximization of return on taxpayer dollars.

2.4.3.1 Notable Government Implementations

- An extensive study was done in September 2003 regarding Canada's use of OSS and future implementation. The investigation surveyed the Canadian software landscape and analyzed the opportunities of OSS to the public and private sectors.[38]
- According to CNET News.com, "The local government of [Munich, Germany] has transferred 100 staff members in the Lord Mayor's department to a Debian configuration, and it intends to migrate 80 percent of the city's PCs by mid-2009."[39]
- The Massachusetts state government approved its Enterprise Technical Reference Model in 2005, mandating that "State agencies in the executive branch are to … migrate to OpenDocument-compliant applications by 1 January, 2007, a change that will affect about 50,000 desktop PCs."[40]
- Garden Grove, a city in southern California, began using OSS in 1995. The city's website states, "Open-source software has enabled the City to take advantage of many advanced networking capabilities … By implementing Open-source solutions in place of solutions based on Microsoft software or commercial networking appliances, City staff has saved taxpayers at least $380,557.74 in initial costs as well as $70,465.05 annually. Garden Grove's decision to embrace Open-source software has allowed it to create an IT infrastructure that has advanced features, stable performance, robustness, ease of implementation, and low cost of use."[41]

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[38] *Open-source Business Opportunities for Canada's Information and Communications Technology Sector.* Report. http://www.e-cology.ca/canfloss/report/CANfloss_Report.pdf (accessed March 22, 2009).

[39] *CNET News.com.* "Munich fires up Linux at last." September 25, 2006. http://news.cnet.com/Munich-fires-up-Linux-at-last/2100-7344_3-6119153.html (accessed August 19, 2009).

[40] LaMonica, Martin. "Massachusetts finalises open standards proposal." ZDNet Australia. http://www.zdnet.com.au/news/software/soa/Massachusetts-finalises-open-standards-proposal/0,130061733,139214476,00.htm (accessed March 22, 2009).

[41] *Local Government Embraces Open-source Technology.* http://ch.ci.garden-grove.ca.us/internet/is/linuxwhitepaper.html (accessed March 22, 2009).

2.5 TOTAL COST OF OWNERSHIP

OSS packages undoubtedly have significantly lower licensing costs than their proprietary counterparts. However, TCO is often used as the metric for determining overall software costs. Odellion Research defines TCO as "the systematic quantification of all costs generated over the lifetime of a project."[42] The TCO of a software package not only includes the initial licensing and media costs, but all recurring costs from the project's lifecycle. The lifespan of a project typically consists of the following iterative phases with recurring and initial costs at each point:

- Planning and Design
- Deployment and Installation
- Training
- Support
- Maintenance
- Retirement

Enterprise IT departments use varying TCO metrics for software projects based on particular business requirements and management viewpoints. Most notable, however, is included in a study prepared by Kenwood in part of the research project "Open-source Software in Military Systems." Kenwood provides a framework for TCO taxonomy with specific associated costs:

- Software
    - Purchase price
    - Upgrades and additions
    - Intellectual property/licensing fees
- Hardware
    - Purchase price
    - Upgrades and additions
- Internal Support Costs
    - Installation and set-up
    - Maintenance
    - Troubleshooting
    - Support tools (e.g., books, publications)
- External Support Costs
    - Installation and set-up
    - Maintenance
    - Troubleshooting
- Staffing Costs
    - Project management
    - Systems engineering/development

[42] "Total Cost of Ownership." Odellion. http://www.odellion.com/pages/online%20community/TCO/financialmodels_tco_definition.htm (accessed March 22, 2009).

        - Systems administration
        - Vendor management
        - Other administration
      - Purchasing
      - Training
    - De-installation and Disposal
    - Indirect Costs
    - Support Costs
    - Peer support
- Training
    - Casual learning
    - Formal training
- Downtime[43]

The IT industry relies extensively on TCO analysis to determine strategic purchases. However, TCO does not consider qualitative benefits such as improved user interfaces or advanced functionality. When making significant software purchases, companies also consider the TBO in addition to the TCO. Odellion Research describes the use of TCO in IT:

> "The TCO concept is widely used in Information Technology (IT) implementations where the benefits are hard to quantify and the focus is on minimizing the project costs. Companies use the TCO methodology when comparing similar products from different vendors. The product features among vendors may not be much different but the quality and support of the products may yield considerably different TCO values."[44]

Since TCO includes the initial deployment costs, including both software licensing and hardware, comparing the TCO of a prospective solution to that of an existing solution is difficult. Generally, the existing solution has no initial deployment cost while the prospective solution's TCO includes all up-front costs. Although an obvious resolution is to ignore initial deployment costs when calculating the respective TCO, this does not give an accurate answer. When calculating the TCO of an OSS solution, it is important to calculate the costs of OSS migration as well as a comparison of initial deployment of OSS and the proprietary counterpart.

2.5.1 OSS Costs

The prevailing benefit of an OSS solution is its low licensing costs. However, many criticize OSS for having high indirect costs that outweigh any licensing cost savings. In 2002, Cybersource extensively compared the TCO of Windows and Linux. As the core methodology of the TCO comparison, the research company took into consideration

[43] Business Case Study, 42.

[44] Total Cost of Ownership.

future software iterations and a longer lifecycle instead of one initial migration. Cybersource describes TCO methodology used for a software migration:

> "Most organizations will likely factor in the costs associated with a single upgrade-versus-migration cycle … Many of the costs of upgrading to newer versions of Microsoft platforms have to be borne again and again. Most of the costs of migrating to Linux are borne once, during the initial migration. Any subsequent upgrades for that Linux platform occur with no license costs or software assurance costs. Therefore, to provide a more realistic appraisal and model of this scenario, you should include two or three full refresh lifecycles, stretching over a period of 5-10 years."[45]

The best known OSS alternative to Microsoft Office is OpenOffice.org, which conforms to the OpenDocument format developed by the Organization for the Advancement of Structured Information Standards (OASIS). OpenOffice.org is very similar to Microsoft Office, including most of the same familiar features. Many organizations have migrated to the OpenOffice.org platform throughout their organization and realized a lower TCO compared to Microsoft Office.

One Microsoft Office migration was finalized by the commonwealth of Massachusetts in 2007 that switched about 50,000 desktop PCs to OpenOffice.org. Due to a state mandate from its Enterprise Technical Reference Model, all new document formats for office productivity must be OpenDocument format. A representative from the Massachusetts Technology Leadership Council said that "the state would save significantly by migrating to OpenDocument-based products rather than going with Office [2007] - on the order of US$5 million for OpenDocument versus US$50 million for Office [2007], including hardware and operating-system upgrade costs."[46]

2.5.1.1 Linux Implementation

One particular OSS implementation common among organizations aims for a lower TCO through Linux. Many organizations have experienced tremendous savings by migrating to a Linux-based desktop infrastructure compared to the proprietary Microsoft Windows setup. Studies have shown varying levels of savings by migration to Linux; however, key parts of the analysis show lower costs of maintenance and deployment.

A study done by Cybersource in 2002 "modeled an organization with 250 computer-using staff, an appropriate number of workstations, servers, with Internet connectivity, an e-business system, network cabling and hardware, standard software and salaries for IT professionals to establish and support this infrastructure and technology."[47] This study found that by using existing hardware in the organization, a three-year cost savings of using Linux approximated 34.62%, while purchasing new hardware and infrastructure resulted in a savings of 24.69%.[48]

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[45] *Linux vs. Windows: Total Cost of Ownership Comparison.* Publication. http://www.cyber.com.au/about/linux_vs_windows_tco_comparison.pdf (accessed March 22, 2009).

[46] Massachusetts.

[47] Linux vs. Windows.

[48] Ibid

Although paper-based studies are often scrutinized for their practicality, real-world situations have shown Linux to save money in an enterprise-level deployment. The city of Largo, Florida, deployed Linux to the desktops of 800 city employees and reports an annual savings of $1 million. Not only does Linux provide the city with a much lower TCO, but users report a superior overall experience compared to Windows.

2.5.1.2 OSS Programming and Database Environments

Open-source development platforms have also been popular in organizations looking to reduce the TCO of software programming. Programming languages such as Ruby, Python and PHP: Hypertext Preprocessor (PHP) offer the same features as costly platforms such as Microsoft's ASP.net with few or no license fees. In addition, organizations are looking toward open-source database environments to house mission-critical data. MySQL is an open-source database engine based on the SQL standard seen in Microsoft SQL. The National Aeronautics and Space Administration (NASA) has realized a lower TCO by implementing MySQL. The NASA Acquisition Internet Service (NAIS) "has grown to be a vital component of its business, saving $4 million per year by managing large acquisitions online…MySQL averaged 28% faster than their existing proprietary database." [49] NASA is not a unique case for MySQL—Cox Communications, Inc., in Atlanta, used MySQL as the back end for a large data warehouse application; 3,600 MySQL tables are in use with over 2 billion records with about "4 million inserts every two hours. By selecting MySQL, [Cox Communications, Inc.] was able to budget just $14,000 per year for license fees and maintenance compared to $300,000 for a proprietary database." [50]

2.6 OSS ADVANTAGES AND DISADVANTAGES

OSS projects and proprietary developers have differing strategies for software development lifecycles. Generally, OSS projects have a development advantage by harnessing an extensive community for knowledge and experience, whereas proprietary projects are limited to internal capabilities. Eric Raymond, an open-source enthusiast, says that good open-source projects reuse as much code from other projects as possible to avoid duplicated work, relying heavily on feedback and suggestions from users of the software and operating under the principle of "release early, release often, and listen to your customers."[51] In contrast, the proprietary software company must start at a lower level when entering a new software market since the company can not legally build upon another company's code. Additionally, Raymond states that the "intense peer review process, shared among a potentially large group of developers and testers, dings and eliminates errors in software faster than any proprietary effort could."[52] Extensive research and studies show many advantages and disadvantages between OSS and proprietary software.

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[49] *An SMB Guide to Lower Database TCO*. Technical paper. http://www.sun.com/solutions/smb/docs/mysql_smb_guide.pdf (accessed March 20, 2009).

[50] Ibid

[51] Raymond, Eric S. *The Cathedral and the Bazaar Musings on Linux and Open-source by an Accidental Revolutionary*. (Release Early, Release Often). Sebastopol: O'Reilly, 1999.

[52] Ibid

2.6.1 Customization and Modularity

OSS is notable for its ability to be customized for particular business applications. Wheeler defends the idea that possessing an application's source code inherently allows "users to tailor the product as necessary to meet their needs in ways not possible without source code."[53] Although proprietary software companies often provide tools and other resources to customize the software, there are limits as to what a developer can do without source code access. OSS products give a developer free reign to create solutions to match the exact business requirements.

In addition to base software customization, modularization is an important aspect for many users. The ability to add components that interact with an application is critical for businesses. In the proprietary software business model, modules are developed by the company based on an expected return on the investment (ROI). Companies using the software must depend on the overall market demand for a module in order to receive product modules. Without a substantially high ROI, software companies may decide not to develop the modules. However, OSS allows companies to hire developers to create new modules that the software company otherwise wouldn't. With source code access, programmers can create new modules that interact seamlessly with the OSS application.

2.6.2 Security Models

OSS security has been a continuous concern among enterprises looking to adopt open-source applications. Exposing an application's source code may appear as an inherent security risk. However, OSS developers focus on crafting very well-written programs that rely on security through code complexity and barriers rather than on the secretive model. Jaap-Henk Hoepman provides an analogy regarding OSS security:

> "Who would you trust most? A locksmith who keeps the working of his locks secret, so that thieves cannot exploit this knowledge? Or a locksmith who publishes the workings of his locks, so that everyone (including thieves) can judge how good/bad they are (so you exclusively rely on the complexity of the keys for protection)?"[54]

In the event that the source code is exposed, the proprietary software developer must rely on the secure nature of the source code to avoid intrusions—a difficult situation if the only focus was on keeping the source code secret. However, the OSS developer is prepared for an attack without relying on the secret nature of the proprietary source code. Hoepman describes further that "Even if the source remains closed, vulnerabilities of such closed-source systems will eventually be found and become known to a larger public after a while. Vulnerabilities in existing closed-source software are announced on a daily basis."[55]

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[53] Secure Programming.

[54] Hoepman, Jaap-Henk. "Increased Security Through Open-source." *COMMUNICATIONS OF THE ACM* 50, no. 1 (January 2007): 79-83.

[55] Ibid

Additionally, OSS allows potential customers to evaluate the security of the product themselves without having to solely rely on the trust of a proprietary software company. Hoepman states:

> "Open-source even enables several different and independent teams of people to evaluate the security of the system, removing the dependence on a single party to decide in favor of or against a certain system. All this does not decrease the security or exposure of the system."[56]

2.6.3 Usability and Interfacing

Oftentimes commercial software companies spend a significant allotment of product development resources to ensure the product is user friendly and appeals to individuals with experience levels of all ranges. While usability is a key feature for software, OSS development is typically focused on the core functionality of the product. General end users tend to be experienced technically and accept the "barebones" package through the motto of "by developers, for developers." Kenwood notes that a "barrier to Linux's success in the desktop market is that it is not as user-friendly as Windows."[57] Based on the current landscape, many companies are focusing on improving the user interface of Linux distributions. This is most likely due to the recent surge of less experienced computing end users who are switching to Linux.

Although the consensus is that commercial software is more user friendly, OSS typically provides for easier IT management. Kenwood states that "Linux is the easiest to manage because it is more centralized and enables features such as remote management, disk quota support, remote security, and diskless booting; with Linux a network administrator is not needed at every site."[58]

2.6.4 Software Versioning

Code fragmentation, also known as *version proliferation*, is the excessive generation of software versions with few, if any, major differences. Kenwood elaborates on the community-developed nature of OSS stating, "[Version proliferation can occur when] developers try to create alternative means for their code to play a more significant role than achieved in the base product."[59] This evolution causes confusion for determining the most current version, as well as management complications. In contrast, commercial software typically offers clear version definitions through careful market analysis. The end user can more easily determine what the latest version is and what features are included. Additionally, there is very little horizontal version proliferation—commercial application versions generally are improved upon previous versions.

2.6.5 Reliability and Support

OSS generally has support methods through two models: community- and business-offered. Many companies thrive on supporting OSS products for other businesses.

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[56] Ibid

[57] Business Case Study, 34.

[58] Business Case Study, 50.

[59] Business Case Study, xiv.

Although OSS may be free in terms of licensing, companies may choose to purchase support contracts through a third party to ensure that problems can be resolved in a timely manner. Another support model, the community method, depends on a wide network of volunteers and developers that provides support for OSS products. This method usually takes the form of Internet forums and news groups where issues can be discussed online. The reliability of this support is argued to be fleeting at best. However, many IT professionals use forums and other Internet communities as a sole method of problem solving even for commercial software.

2.7 SUMMARY

The concept of allowing free access to a software application's source code is at the origin of software programming. During the first stages of operating system development, source code was shared among developers to enhance a collaborative environment among organizations. However, companies realized the potential profit and claimed intellectual property rights over developed source code. The software market has since shifted to a proprietary development model through closed-source code. In the last decade, there has been a revitalization of open-source projects that compete directly with proprietary applications.

The research discussed here outlines the development models for both proprietary and open-source software. The process of community-based development and intense peer review are summarized along with the motivations for individual contributors. This process, compared to the proprietary method, exposes both advantages and disadvantages in the open-source development lifecycle including the ability to harness contributions from a diverse range of programmers from across the world

OSS is increasingly being viewed as a viable alternative to commercial software for large-scale implementation. One of the main motivating factors for OSS is the perceived lower TCO. Several studies outlined in this literature review demonstrate the lower TCO of OSS applications. Most notable, the combination of Linux and OpenOffice.org has been deployed among several large organizations, demonstrating extensive cost savings. As seen in multiple case studies, a multitude of government agencies have migrated to various OSS products from comparable proprietary versions with great success. Research shows key points for the promotion of OSS by government entities. The largest factor is the maximization of return on taxpayers' dollars. Governments striving to justify extensive software costs may find reprieve with the cost savings associated with OSS.

Although many case studies show migration success from commercial software to OSS, research shows that success is attributed to proper planning as well as a proper analysis of business needs. The TBO of a product needs to be investigated in addition to the functional requirements of an organization. Through proper planning and organizational research, OSS can be implemented successfully and achieve added benefits and lower costs.

3.0 EXTERNAL AGENCY SOFTWARE SURVEY

3.1 INTRODUCTION

One focus of this study was to gain an understanding of the collective software use of state DOTs. A survey was created to explore software use by these agencies. The survey investigated current proprietary and open-source software use, planned implementations, and reasoning behind and against OSS implementation. This survey had three overall goals:

- Gain insight into the overall use and perception of proprietary and open-source software among DOTs and investigate future software implementations.
- Discover DOTs that have experience with OSS implementations that may serve as continued resources and provide useful data.
- Provide an avenue for other state DOTs to benefit from the research done for this study.

3.2 SURVEY METHODOLOGY

3.2.1 Development

The survey was designed to be completed by the IT leadership of each DOT in conjunction with appropriate team members across the organization. An introduction was included in the survey describing the overall objectives as well as the background of the research study. A brief list of definitions was given in the introduction to ensure consistency of question perception. The survey had 25 questions divided into the following categories: server/mainframe computing, desktop computing, and development and general OSS questions. All questions required an answer, excluding open-ended responses. The Technical Advisory Committee (TAC) reviewed the survey and provided suggestions and revisions prior to its distribution. The entire set of survey questions is included in Appendix B.

The online service SurveyMonkey was used to design and manage the online version of the survey. SurveyMonkey was chosen to provide an intuitive, reliable, and secure way of distributing the online survey as well as collecting responses. Moreover, SurveyMonkey provided tools to assist in summarizing and analyzing the survey. In order to provide a concise URL for participants to access the survey, a domain alias, http://survey.opensourcestudy.com, was created to replace the long and difficult-to-remember SurveyMonkey URL.

3.2.2 Distribution

A series of initial emails was sent out to a list of contacts from a survey conducted in 2005 as well as email addresses that were found on respective DOT websites. The email introduced the survey and requested that the recipient respond with a preferred method of survey distribution. A copy of the initial email is in Appendix D. The survey was also offered via phone, internet, mail, and fax. In addition, a printable survey was available online at http://www.opensourcestudy.com/print_survey.pdf[60] and could be used as a reference in conjunction with the online survey. A total of 27 agencies replied with a preferred method of survey distribution with 25 requesting a link to the online survey and two requesting that the survey be faxed.

On 11/11/2007, the survey was sent out to the 27 agencies. A copy of this email is in Appendix E. The remaining DOTs were contacted by phone, mail, or fax and were given instructions on how to access the online version of the survey. The DOT's of the District of Colum-

[60] The survey was only available online for the duration of the study, but can also be found in the Appendix.

bia and the other 49 states excluding Arizona were sent the survey and given until 1/10/2008 to complete it. Biweekly reminders were sent to the agencies that had not responded. A final reminder was sent on 1/2/2008 that indicated the 1/10/2008 survey close date.

The online survey did experience two minor technical issues during collection. One participant could not access the survey on his desktop computer, while another participant's Web browser would crash while attempting to complete the survey. Neither problem could be resolved or replicated, however both participants completed the survey at another workstation. These issues seemed to be isolated to those users and did not prevent them from submitting the survey.

3.3 SURVEY RESULTS

A total of 26 completed responses were received from the state DOTs, in which was a 53% response rate; 24 were received online and two were received via fax. Results were downloaded from SurveyMonkey's database into several spreadsheets. The entire set of raw survey results is in Appendix A.

3.3.1 Statistical Overview

With the release of both Microsoft's newest operating system (OS) and office productivity suite, an important objective of this survey was to discover what plans DOTs had regarding Windows Vista and Office 2007. Eighteen survey respondents stated that a deployment/ upgrade to Windows Vista was a possibility but no plans had been made. Five respondents answered that Windows Vista was currently being deployed, or that they planned to deploy it within one year. Figure 1 shows a graphical representation of the Microsoft Office 2007 deployment status.

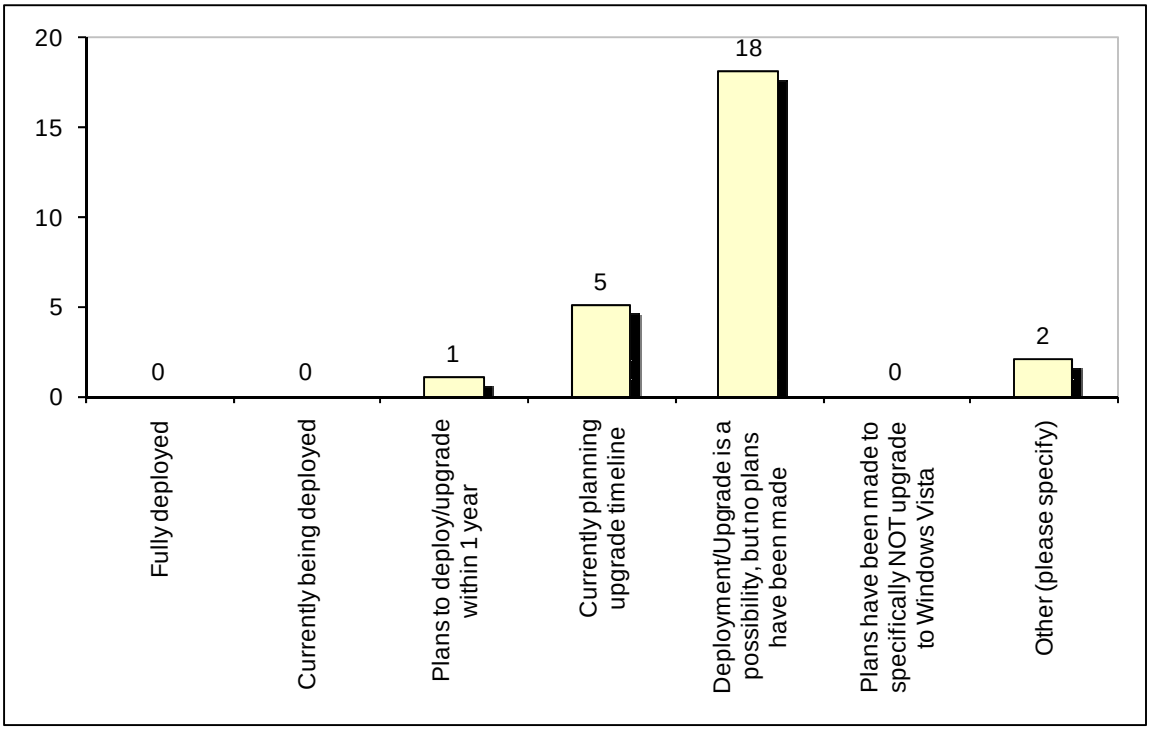

Figure 1: External Agency Survey Question: "What is your department's current status regarding a Windows Vista deployment?"

The same question involving Office 2007 had a similar response; 11 respondents stated that a deployment/upgrade to Office 2007 was a possibility, but that no plans had been made. Figure 2 shows a graphical representation of the Microsoft Office 2007 deployment status.

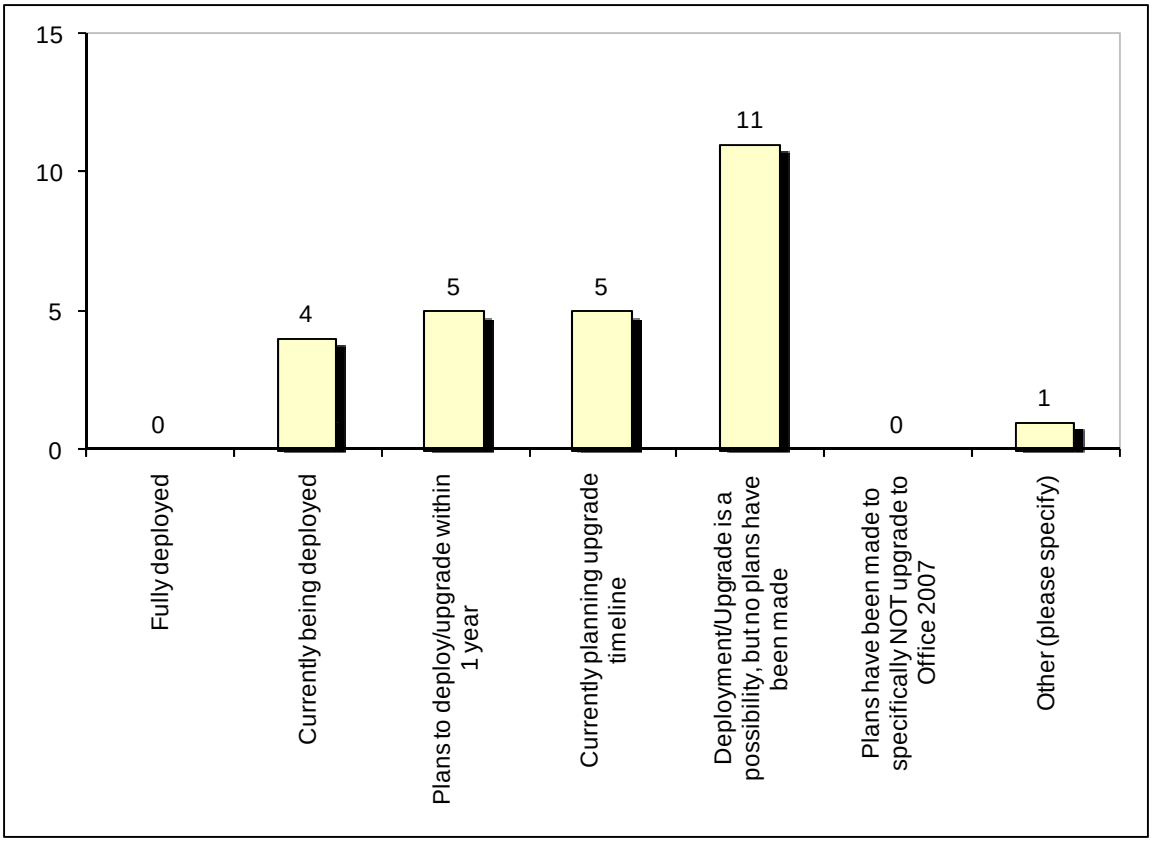

Figure 2: External Agency Survey Question: "What is your department's current status regarding a Microsoft Office 2007 deployment?"

All respondents said that they do not use an OSS office suite; however, the Wisconsin DOT responded that it has implemented an OSS OS. Eight DOTs responded that they have officially deployed OSS applications to their organization, while the remaining 18 DOTs have not deployed OSS.

Another question asked whether the agency had a policy regarding OSS in the procurement of software. Twenty-three DOTs said no, while three said they did have a policy. Another important statistic was that when both an OSS and proprietary application are being reviewed for procurement and holding all things equal, 18 agencies would choose the proprietary software while only eight would choose the OSS counterpart. A quantitative summary of the survey results may be found in Appendix B. Questions that asked for only open-ended responses are excluded from this summary.

3.3.2 Qualitative Findings

An important goal of this survey was to glean open-ended responses from state agencies regarding their use of proprietary and open-source software in conjunction with drawing overall conclusions. One discovery was that several state DOTs seem to be limited in the decisions they can make regarding software and IT purchases and changes. Tennessee DOT reported that it is governed by a state standards group that has not approved the use of OSS. The Michigan DOT stated that the selection of an office productivity suite is managed by the Michigan Department of Information Technology.

An overall conclusion that can be drawn from this survey is that DOTs are concerned about a lack of support with OSS. Several commented that a lack of internal support was an issue for them. Additionally, many stated that training for internal support would be a large cost that would outweigh the benefits of OSS. An important open-ended question asked DOTs to provide any additional information regarding OSS that may be useful for this study. Several states responded with useful comments.

California
"We expect 'system software' to be supported; that is, we want someone to complain to if there's a problem. For instance, we 'license' Linux through Novell, and they respond to problems we might have with it."

Connecticut
"Participating in open-source projects is a great benefit to IT professionals, stimulating their creativity and reducing their deployment time and effort. This realizes both a lower TCO and affords greater opportunities for the users."

Oregon
"Oregon did a study of what OSS we have. While we do not have policies regarding its acquisition there was some that developers used for their own purposes. We would like to bring more OSS in, however, it requires retooling our workforce and a new model of how to do business. We have not yet been able to make the business case for this as yet."

Tennessee
"TDOT is eager to explore the OSS possibilities, but is prohibited from doing so due to the Standards Setting Group from our Centralized IT Department."

Kansas
"Open-source is a choice of a strategic direction. We get better solutions when we can share open designs and patterns and allow each agency [to] choose their preferred deployment model."

South Carolina
"If an organization has a capable staff and can support an application developed by others, OSS is ideal. For those organizations with less-than-capable technical staffs, OSS is not a good idea because taking complete ownership of an application requires quick learning and a will to become responsible for the work of others. Some places just cannot do that."

Maine

"State of Maine currently has an OSS Feasibility Study underway. They started by looking at OSS Office and client OS. We will likely deploy an OSS Office by loading that and MS Office. User agencies can elect to turn on either, but they pay for MS Office."

3.4 SUMMARY

Overall, this survey had a successful response rate while achieving each objective, although the survey did not generate as many open-ended responses as desired. However the responses did provide useful information about software procurement processes. Moreover, few agencies appear to have extensive experience with OSS. Maine DOT appears to be a great resource for additional information regarding OSS; the agency currently has an OSS study going on and stated that it will most likely deploy an open-source office productivity suite. This agency would be a good contact when planning OSS procurement. Many DOTs are also interested in continued involvement in this study. Fifteen DOTs indicated that they would like to receive the results of the survey, and 17 DOTs want to receive a copy of the final study.

4.0 OPENOFFICE CHALLENGE

4.1 INTRODUCTION

Microsoft's newest office productivity suite, Office 2007, represents a dramatic change in usability as Microsoft designed an entirely new user interface for this version. The Ribbon interface introduced in Office 2007 provides a unique method of navigating office functions by grouping tools into bands across the application's interface. Additionally, the use of new XML-based file formats introduces compatibility issues with previous Office versions, as well as other third-party software.

The OpenOffice Challenge™ seeks a comparison of the overall usability between Office 2007 and OpenOffice.org 3. Participants in the OpenOffice Challenge™ were fully aware of which software suite they were using; however due to their inexperience with both applications, participants could approach the pilot test with objectivity.

This pilot test investigated usability by seeking answers for the following questions:

- **User Interface:** How efficient and easy to use are the user interfaces? Are commands, functions, and tools easy to find and access?
- **Functionality:** Do the office suites offer all the necessary functionality to complete required tasks?
- **Learning:** How easy is it to get accustomed to the user interface? What is the learning curve for each office suite?

4.2 PILOT TEST METHODOLOGY

4.2.1 Key Objectives

- Record how current Microsoft Office 2003 users viewed usability in both Office 2007 and OpenOffice.org 3 to provide insight on user-preferred software.
- Determine the feasibility of using OpenOffice.org 3 as an alternative Office 2003 upgrade in place of Office 2007.
- Investigate any possible critical restrictions against using either office suite as a replacement for Office 2003.

4.2.2 Pilot Test Format

The OpenOffice Challenge™ tested each application's usability and functionality in comparison to Office 2003. The objective was to give participants a wide range of tasks that typically would be completed in Office 2003 throughout daily and weekly use. The OpenOffice Challenge™ provided a controlled computing environment for participants to reduce interference and subjectivity. With the assistance of the University Technology

Office at Arizona State University, a conference room with sufficient laptops was used to conduct the pilot test. Each computer was imaged with Windows XP,[61] including Office 2007 and OpenOffice.org 3. The imaging process ensured that every participant used the exact same software and also reduced the risk of unexpected technical issues. Additionally, the image provided a baseline setup with only the necessary software and files to complete the pilot test.

Participants were each given an instruction set corresponding to the respective assigned application category: word processing, spreadsheet, database, and presentation. The tasks were completed on both Office 2007 and OpenOffice.org 3 with the appropriate application. Approximately half of the participants started with Office 2007 then transitioned to OpenOffice.org 3, while the other half started with OpenOffice.org 3 and then moved to Office 2007.

The timeline of the pilot test went as follows:

- Assigned instruction set on the first application – 30 Minutes.
- Assigned instruction set on the second application – 30 Minutes.
- Exit survey – 15 Minutes.
- Focus group discussion – 15 Minutes.

The instruction sets were printed out for each participant to follow. All tasks were generalized and did not provide details or specific steps on how they should be completed. This stratagem was intended to give participants the opportunity to learn new functionality and familiarize themselves with the applications. However, each participant had access to built-in help menus for additional resources to complete the task. Participants were told to refrain from asking questions related to tasks, although they were encouraged to seek technical assistance should any issues arise.

4.2.3 Participant Selection

The OpenOffice Challenge™ was advertised on various social networking platforms as well as by word of mouth for approximately three weeks before the pilot test. The solicitations stated that ideal participants should have little or no prior experience using either Office 2007 or OpenOffice.org 3 but should have a working knowledge of Microsoft Office 2003. Volunteers were filtered based on informal questioning to determine experience level and pilot test qualifications. Additionally, participants were selected based on their capabilities for completing tasks in the pilot test applications, with advanced volunteers assigned to the more complex database and spreadsheet applications.

[61] Windows XP was used as the pilot test operating system to achieve a computing environment most similar to that of the Arizona Department of Transportation.

4.3 DATA COLLECTION

To effectively analyze participants' experiences, an exit survey was designed to collect data on predetermined areas, and a focus group was convened to glean open-ended responses on the applications.

4.3.1 Exit Survey

The online survey seen in Appendix K was created using SurveyMonkey and completed by participants after the pilot test. The survey focused on collecting quantifiable data regarding usability of pilot test applications. Specifically, the survey questions were designed to accomplish the following objectives:

- Understand which office suite provides the greater level of usability.
- Find out which office suite users find easier to learn.
- Investigate which office suite users believe has more features and capabilities.
- Find out which office suite users felt more productive using.

4.3.2 Focus Group Discussion

Following the survey, a focus group discussion was conducted to discuss participant experiences. The open-ended nature of the discussion encouraged unstructured responses and collaboration to elicit overall group opinions. All unique discussion highlights were recorded, including conflicting opinions and opposite viewpoints. The discussion minutes seen in Appendix F provide qualitative insight into the pilot test on a broad level; however, it was clear that generalized conclusions could not be drawn directly from the discussion minutes due to their unstructured nature.

4.4 RESULTS AND ANALYSIS

The OpenOffice Challenge™ was conducted on Saturday, November 8, 2008, in Arizona State University's Coor Hall. Fourteen individuals participated in the pilot test, exit survey, and group discussion. The participants reported no technical issues, and proved they were engaged by offering extensive contributions, thus making the OpenOffice Challenge™ a great success.

Based on observational data and prior research from the literature review[62], the expected outcome of the pilot test was that data would support the claim that Office 2003 is more similar to OpenOffice.org 3 than to Office 2007, and OpenOffice.org 3 provides a greater level of usability than Office 2007. To capture the overall opinion of which aspects are important in software, participants were asked to identify the most important feature of office applications. As shown in Figure 3, 71.4% of participants answered that *Usability/Efficiency* was most important. This result further demonstrates the relevance of the survey results.

[62] A literature review was completed before the pilot test to investigate OpenOffice.org and open-source software in general.

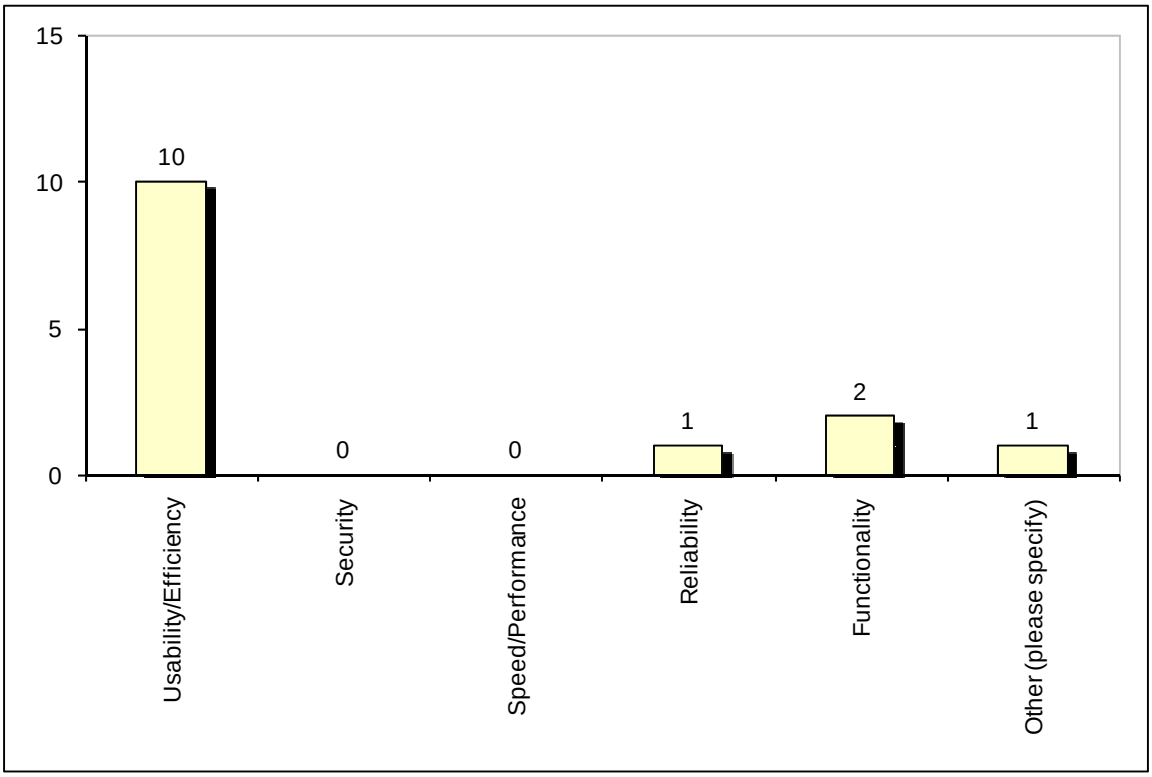

Figure 3: OpenOffice Challenge Survey Question: "What feature do you find most important in office applications?"

4.4.1 Statistical Analysis

Several questions in the OpenOffice Challenge™ invited a comparison between OpenOffice.org 3 and Office 2007 using a numeric scale of 1 to 5 to rank qualitative attributes. These questions particularly allowed for analysis to show whether each set of data was significantly different than the other; i.e., if participants favored one application over the other in regard to the question. Based on the following characteristics of the four ranking questions, the Wilcoxon Signed-Rank Test[63] was used to analyze the data and determine significance of difference.

- Two related sets of data were collected from the exact same sample.
- The results are presumed to be non-parametric[64] and do not represent a normal Gaussian population distribution.

[63] The Wilcoxon Signed-Rank Test analyzes data for two related data sets or repeated measurements on a single sample. It is one of the most popular non-parametric statistical analysis methods. An extensive explanation and set of examples can be reviewed at: http://business.fullerton.edu/isds/zgoldstein/361b/Extensions/Wilcoxon/Wilcoxon%20signed%20rank.doc.

[64] Non-parametric analysis assumes that data interpretation does not depend on the generalized population fitting a Gaussian distribution or "bell curve" over the possible ranked values.

- No clear control group exists and both sample tests are independent.
- The sample size is less than 20.

4.4.1.1 Applying the Wilcoxon Signed-Rank Test

The Wilcoxon Signed-Rank Test starts with determining the differences between related values of the results set. Differences are then ranked based on an absolute-value scale, ignoring all differences with a value of zero. Like differences are assigned a common average rank to replace actual ranks, and the signs of the differences are reapplied to the rankings. Finally, the sums of the positive and negative ranks are calculated to determine the critical T^+ and T^- values representing the positive and negative sums, respectively.

To show significance, the statistical T value[65] is compared to a standard Wilcoxon Signed-Rank Table in Appendix J of upper and lower-boundary values, T_U or T_L, respectively, for the given sample size *n*.[66] If the test statistic, either T^+ or T^- depending on the alternative hypothesis, is outside the range of T_U and T_L, the results are significant for the corresponding one-tail significance level, and the null hypothesis is rejected. An alpha value of 0.05 (5% significance level) is used to determine if these data are significant.

The null hypothesis H_0 is structurally the same for all questions to which the Wilcoxon Signed-Rank Test is applied.

> H_0: No significant difference exists between the resulting ranked data of OpenOffice.org 3 and Office 2007.

The null hypothesis is either validated or rejected based on the level of significance. In case of rejection, the alternate hypothesis is accepted. For the following four survey questions, an alternative hypothesis was developed, along with tabular results from applying the Wilcoxon Signed-Rank Test.

[65] Either the T^+ or T^- value is chosen as the statistical T value depending on the alternative hypothesis.

[66] n is a common variable used in statistics to represent the sample size of a test.

4.4.1.2 Question 6 Analysis

For the survey question, *"Please rate the ease of menu navigation with each application,"* an alternative hypothesis was made based on the higher mean value of the OpenOffice.org 3 rankings.

H_1: OpenOffice.org has a greater ease of menu navigation.

Table 2 shows the differences, ranks, Common Average Ranks (CAR),[67] and resulting T^+ and T^- values. Since the alternative hypothesis presumes that OpenOffice.org 3 has a higher mean value and the OpenOffice.org 3 values are to the right, T^+ must be significantly small and less than T^-; i.e., T^+ must be less than the critical value T_L. By looking at the Wilcoxon Signed-Rank Table, T_L and T_U are 26 and 79, respectively, for a sample size of 14. Since T^+ is not less than the value of T_L, there is not sufficient evidence to reject the null hypothesis. Therefore, there is no significant difference in ease of menu navigation between the applications.

Table 2. OpenOffice Challenge Survey Question 6 results ordered by absolute difference.

Microsoft Office	OpenOffice.org	Difference	|Difference|	Rank	CAR	Signed CAR
4	**4**	0	0			
2	**2**	0	0			
2	**3**	-1	1	1	3.5	-3.5
3	**2**	1	1	2	3.5	3.5
4	**3**	1	1	3	3.5	3.5
3	**4**	-1	1	4	3.5	-3.5
3	**4**	-1	1	5	3.5	-3.5
3	**4**	-1	1	6	3.5	-3.5
2	**4**	-2	2	7	9.0	-9.0
2	**4**	-2	2	8	9.0	-9.0
2	**4**	-2	2	9	9.0	-9.0
2	**4**	-2	2	10	9.0	-9.0
4	**2**	2	2	11	9.0	9.0
4	**1**	3	3	12	12.0	12.0

T- 50 **T+** 28

[67] Common Average Rank (CAR) is used to calculate an average rank for rankings of the same value. The formula based on the series of rankings with similar values is: (Lowest Rank + Highest Rank)/2

4.4.1.3 Question 7 Analysis

For the survey question *"Please rate the ease of learning features and functionality with each application"* an alternative hypothesis was made based on the higher mean value of the OpenOffice.org 3 rankings.

H_1: OpenOffice.org is easier to learn features and functionality on.

Table 3 shows the resulting values from applying the Wilcoxon-Signed Rank Test. Similarly to the previous investigation, the alternative hypothesis presumes that OpenOffice.org 3 has higher rankings. In order to show significance, T^+ must be less than T^-, and T^+ has to be smaller than the critical value T_L. Since T^+ is less than 26, sufficient evidence exists to favor the assumption that OpenOffice.org 3 is easier to learn features and functionality on.

Table 3: OpenOffice Challenge Survey Question 7 results ordered by absolute difference.

Microsoft Office	OpenOffice.org	Difference	|Difference|	Rank	CAR	Signed CAR
4	**4**	0	0			
4	**4**	0	0			
4	**4**	0	0			
3	**3**	0	0			
3	**3**	0	0			
5	**5**	0	0			
4	**4**	0	0			
3	**4**	-1	1	1	2.5	-2.5
3	**2**	1	1	2	2.5	2.5
2	**3**	-1	1	3	2.5	-2.5
5	**4**	1	1	4	2.5	2.5
2	**4**	-2	2	5	5.5	-5.5
4	**2**	2	2	6	5.5	5.5
1	**4**	-3	3	7	7	-7.0

T- 17.5 **T+** 11

4.4.1.4 Question 8 Analysis

For the survey question *"Please rate the efficiency of each application; i.e. how quickly were you able to accomplish tasks?"* an alternative hypothesis was made based on the slightly higher mean value of the Microsoft Office 2007 rankings.

H_1: Microsoft Office 2007 has greater efficiency.

Table 4 shows the resulting values from applying the Wilcoxon Signed-Rank Test. This investigation takes a different approach since the Office 2007 values are presumed to be higher than the OpenOffice.org 3 values and are to the left. In order to show significance in this scenario, T^+ must be significantly *large* and greater than T^-. The latter condition is satisfied; however, T^+ must be larger than the upper-bound critical value, T_U. Since T^+ is not greater than 79, there is not sufficient evidence to reject the null hypothesis. Thus, it is assumed that there is no significant difference between the efficiencies of Office 2007 and OpenOffice.org 3.

Table 4: OpenOffice Challenge Survey Question 8 results ordered by absolute difference.

Microsoft Office	OpenOffice.org	Difference	|Difference|	Rank	CAR	Signed CAR
4	**4**	0	0			
4	**4**	0	0			
4	**4**	0	0			
4	**4**	0	0			
4	**4**	0	0			
2	**3**	-1	1	1	3.5	-3.5
3	**4**	-1	1	2	3.5	-3.5
3	**2**	1	1	3	3.5	3.5
3	**4**	-1	1	4	3.5	-3.5
3	**2**	1	1	5	3.5	3.5
5	**4**	1	1	6	3.5	3.5
4	**2**	2	2	7	8.0	8.0
2	**4**	-2	2	8	8.0	-8.0
4	**2**	2	2	9	8.0	8.0

T- 18.5 **T+** 27

4.4.1.5 Question 11 Analysis

For the survey question, *"Please rate what you expect your personal learning curve to be with each application,"* an alternative hypothesis was made based on the higher mean value of the OpenOffice.org rankings.[68]

H_1: OpenOffice.org has a lower expected personal learning curve

Table 5 shows the resulting values from applying the Wilcoxon Signed-Rank Test. Since the alternative hypothesis presumes that OpenOffice.org 3 has higher rankings, to show significance T^+ must be less than or equal to T^- and T^+ has to be smaller than the critical value T_L. Since T^+ is less than 26 and less than the T^- value of 26, evidence supports the alternative hypothesis that OpenOffice.org has the lower expected personal learning curve.

Table 5: OpenOffice Challenge Survey Question 11 results ordered by absolute difference.

Microsoft Office	OpenOffice.org	Difference	|Difference|	Rank	CAR	Signed CAR
3	**3**	0	0			
4	**4**	0	0			
3	**3**	0	0			
4	**4**	0	0			
2	**2**	0	0			
3	**4**	-1	1	1	3	-3
3	**4**	-1	1	2	3	-3
3	**2**	1	1	3	3	3
2	**3**	-1	1	4	3	-3
2	**3**	-1	1	5	3	-3
2	**4**	-2	2	6	7	-7
4	**2**	2	2	7	7	7
3	**5**	-2	2	8	7	-7
5	**2**	3	3	9	9	9

T- 26 **T+** 19

4.4.2 Analysis Summary

One survey question investigated a comparison of the applications to Office 2003. This step satisfied the pilot test objective of seeking the most comparable application to Office 2003. The results of the survey in Figure 4 below show that a large majority, 78.6%, thought that OpenOffice.org 3 was more comparable to Office 2003 than was Office 2007.

[68] For this question, a higher ranking signifies a lower expected personal learning curve.

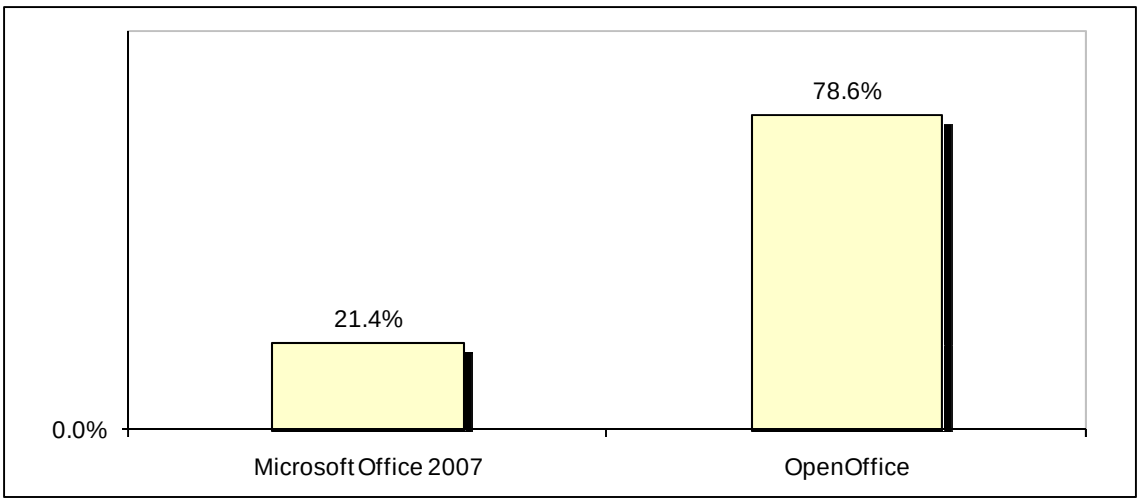

Figure 4: OpenOffice Challenge Survey Question: "Which application do you think is most comparable to Microsoft Office 2003?"

To further investigate the comparison to Office 2003, participants were asked to choose an aspect that is most similar to Office 2003 for the application they chose as more comparable. Interestingly, *Functionality/Features* and *Navigation* both received 50% of the responses. This result aligns with Figure 3, which shows that usability is the most important software attribute. Figure 5 below shows a graph of the results.

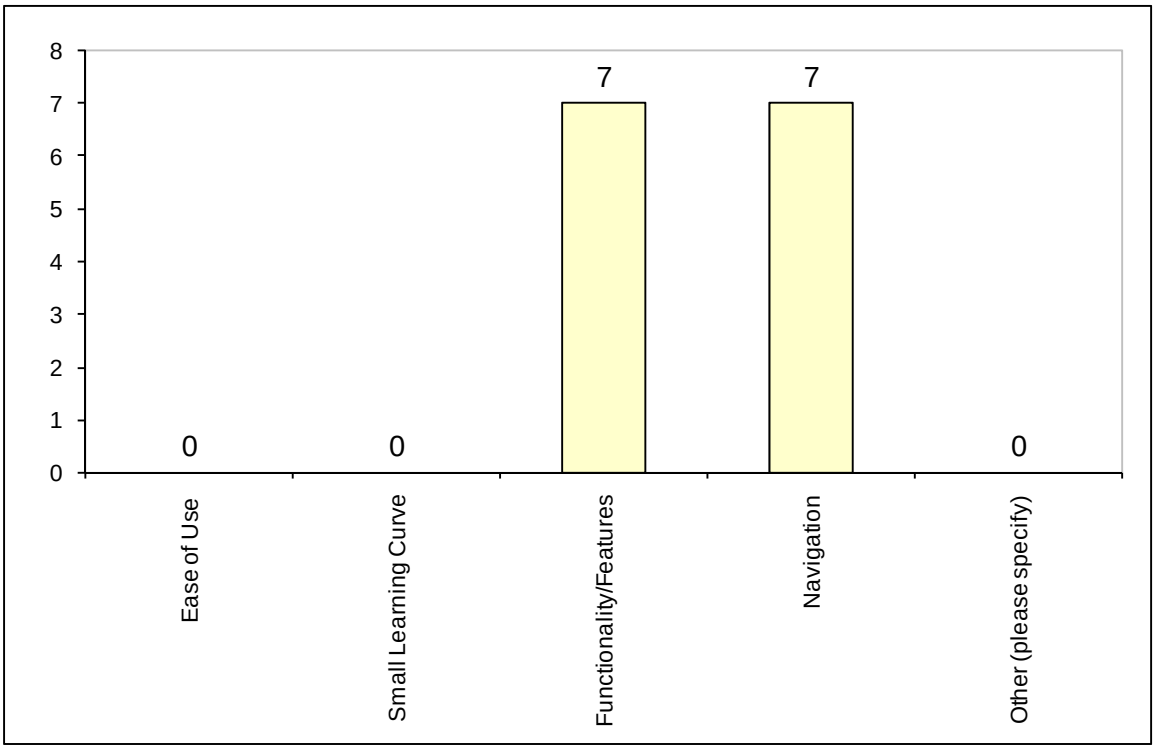

Figure 5: OpenOffice Challenge Survey Question: "For the application you find most similar to Microsoft Office 2003, which aspect do you think is most similar?"

4.5 OPEN-ENDED RESPONSES

Many participants provided comments for survey questions. Additionally, participants gave generalized comments at the end of the survey expressing their opinions of the two applications.

4.5.1 Application Efficiency

When asked about the efficiency of the applications, several participants reported that the efficiency was generally the same between the two applications. These comments align with the statistical finding that there is no significance between the two applications after analyzing the rankings.

One participant reported that "*Both are efficient if you know what you are looking for and don't have to find it/figure it out.*" Another participant stated, "*Both were about equally efficient—I ran into snags equally.*"

4.5.2 Comparison to Microsoft Office 2003

Participants seemed to agree that OpenOffice.org 3 was the more comparable when asked which application was more similar to Office 2003. When referencing his or her answer that OpenOffice.org 3 is more similar, one participant stated that *"Everything is mostly in the same places and uses the same symbols."*

Additionally, when comparing Microsoft Office 2007 and 2003, participants stated:

> "The new Microsoft Office is very different from the old Microsoft Office."
>
> "The change in menu style from 2003 to 2007 is large and can be confusing."

4.5.3 Office 2007 Overall Experience

Participants provided feedback when asked to describe their overall experience with Office 2007. Based on the comments received, most users agree that menu navigation presented significant difficulty:

> "The menus were extremely difficult to navigate. [I] had to resort to using the help feature [multiple] times in order to complete certain tasks."
>
> "Very pleasant appearance but often difficult to find functions due to the navigation set up. Keyboard and automatic shortcuts I managed to find were extremely handy."

However, some users reported that, with continued use, they might learn to use the menu navigation better. This aligns with the findings that Office 2007 has a significantly higher learning curve than OpenOffice.org 3.

> "…I don't like the new menu system in Word 2007 but if I used it more I would probably be able to use it to the same level as 2003, I just don't want to take the time to use it right now."
>
> "I think my learning curve for OpenOffice.org would be less [than] for Office 2007, because of my knowledge of Office 2003…"
>
> "I hate the new way it's set up, but for all I know, after using it for a little, I could get to like it better."

4.5.4 OpenOffice.org 3 Overall Experience

In agreement with previous survey results that showed OpenOffice.org 3 was more similar to Office 2003 than to Office 2007, most comments described OpenOffice.org 3 as very similar to Office 2003.

> "Similar to Office 2003 (the version of Office that I have used the most). Menus were not very difficult to navigate as well as finding certain functions."
>
> "Open office was very, very similar to the old Microsoft Word that I am used to. It was easy to use and learning the different commands was simple and quick."
>
> "OpenOffice.org is very familiar to me, so I had no problems using it. It is very similar to the products I have been using for years now, so it was familiar."

However, several participants did not like the basic user interface and found frustration in navigating through menus.

> "There was a little difficulty on some task like importing data is a pain. In addition the user interface is really basic"
>
> "I had an ok time with it—some things were easier, like the headers and footers—but I was kind of frustrated with finding functions because I'm used to Microsoft Office and had to re-create motor pathways because the functions were stored under different headings or you had to go through a totally different channel to get what you want."

4.6 CONCLUSIONS

Based on the survey results, applied statistical analysis, and open-ended responses, several conclusions and generalizations can be made. These conclusions provide answers to key pilot test objectives defined during the design of the OpenOffice Challenge™.

4.6.1 Office 2003 Alternatives

Throughout the pilot test results, there was constant favoring of OpenOffice.org 3 over Office 2007 as an "easier-to-learn" application. For both questions 7 and 11, which investigated application learning curves, evidence showed OpenOffice.org 3 to have the significantly shallower learning curve. Additionally, none of the four questions that used ranking scales favored Office 2007. Considering the results from the statistical analyses and open-ended responses favoring OpenOffice.org 3, the OpenOffice.org 3 application should be considered a reasonable alternative to Microsoft Office 2003 in terms of usability, efficiency, and functionality.

4.6.2 Office 2003 Comparison

Another critical objective of the OpenOffice Challenge™ was to determine which application, OpenOffice.org 3 or Office 2007, participants considered most similar to Office 2003. Extensive comments stated that OpenOffice.org 3 was very similar to Office 2003, and a large majority of participants responded that OpenOffice.org 3 was more comparable to Office 2003 than was Office 2007. These results lead us to conclude that in terms of usability and functionality, Office 2003 more closely compares to OpenOffice.org 3 than to its own successor, Office 2007.

4.6.3 Possible Restrictions

The final pilot test objective was to investigate possible restrictions that would prevent implementing Office 2007 or OpenOffice.org 3. No critical restrictions were found in the pilot test, although some minor usability difficulties prevented participants from performing all tasks. These difficulties could each be resolved with training, since all tasks were possible to complete. However, one participant did encounter a possible complication with file formats. Since OpenOffice.org 3 uses entirely different file format architecture, Microsoft Office is unable to open OpenOffice.org files natively. However, a plug-in[69] available from Sun Microsystems allows Microsoft Office (versions 2000 and up) to read the OpenOffice.org Open Document Format (ODF), providing backward compatibility. The reverse is not true; OpenOffice.org 3 is able to open and save Microsoft Office file formats without additional software. This disparity presents potential obstacles for a possible migration, but the challenges can be mitigated through a proper implementation.

Overall, based on the various results of the OpenOffice Challenge™, OpenOffice.org 3 provides a more user-accepted office productivity suite than Office 2007. Additionally, OpenOffice.org 3 is a viable alternative and an acceptable upgrade to Office 2003. OpenOffice.org 3 should be strongly considered as an option when considering upgrading to a new office productivity suite.

[69] The ODF plug-in for Microsoft Office is available at: http://www.sun.com/software/star/odf_plugin/

5.0 CONCLUSION

5.1 RESEARCH SUMMARY

OSS presents a huge change in the traditional commercial software model for organizations. With the decentralized development methodology and seeming lack of commercial support, OSS is often disregarded by organizations as experimental and not suitable for large organizational implementations. However, continued growth of the open-source community and support from large organizations, including the FSF and the OSI, have positioned open-source software as a strong competitor to commercial applications. This research investigated reasons organizations refrain from open-source adoption by providing a comparable analysis of open-source and commercial development methodologies, sustainable support plans, and total cost of ownership. Specifically, the OpenOffice Challenge™ demonstrated that OpenOffice.org 3 is a more user-accepted application than Microsoft Office 2007 in terms of usability and general functionality.

5.1.1 Software Trends

Several trends are identified in the current software landscape based on the literature review and external agency survey. One trend is a gradual cultural shift from an exclusively commercial-based software licensing scheme to a mixed-use model where OSS is used among commercial applications to solve specific problems or provide benefits where commercial software can't. These benefits vary among organizations as well as particular uses of software; however, the most common motivating factors for adopting OSS are:

- Need to adopt and support open file formats.
- Lower licensing costs.
- Reduced risks from vendor lock-in.

Particularly, some governments and public-sector organizations have migrated to using OpenOffice.org as their primary office productivity suite. With government organizations, information accessibility is a key concern that has grown with the standardization of digital documents. However, providing information to the public in proprietary formats that require commercial software ignores the goal of complete accessibility. Requiring costly software to read public information excludes people without the means to obtain the appropriate applications. The philosophies of free software provide an open method for distributing digital documents and also provide formats in which other applications can interoperate.

Another trend identified among public-sector entities is the reluctance to deploy Microsoft's newest applications including Office 2007 and Windows Vista. The external agency survey showed that 42% of respondents did not have plans to deploy Office 2007 while nearly 70% had no plans to deploy Windows Vista. Numerous reasons may be the cause of this implementation delay including recent OSS success, usability and compatibility concerns, and extensive hardware requirements. However, many organizations have looked toward OSS to solve these problems.

5.1.2 Hybrid Internet Model

The 1990s marked the Internet Age and "dot-com" era, defined partially by a shift of organizations toward utilizing Web applications as opposed to traditional desktop software. However, despite the outstanding promises of Web-based computing, desktop applications including Microsoft Office continued to be the organizational standard after the era passed. Interoperability and file formats are a huge concern among organizations, enforcing the reluctance to adopt Web-based office software. However, the traditional model of installing an application and saving files to a local computer is archaic and obsolete. The past several years have seen a revival of Web-based software through cloud computing,[70] described by Geva Perry as a mechanism that "allows [organizations to] develop, deploy and run applications that can easily grow capacity (scalability), work fast (performance), and never—or at least rarely—fail (reliability), all without any concern as to the nature and location of the underlying infrastructure."[71] Cloud computing, Software-as-a-Service (SaaS), and the concept of social media and online interaction are often collectively referred to as "Web 2.0." This shift has demonstrated a clear separation between data and applications that process the data. Instead of enforcing a cohesive relationship between an application and the data it produces in a file, open formats, application programming interfaces (API) and the Internet cloud[72] allow distributed access to data, solving the following critical flaws of desktop computing:

- Lack of universal accessibility.
- Specific application installation requirements.

Services such as Google Docs and Zoho promise access to data anywhere in the world without software requirements other than a standard Web browser. Most importantly, such services offer backward compatibility and interoperability with desktop application file formats such as Microsoft Office and OpenOffice.org. This distributed model of open architecture is the core aspect allowing the hybrid Internet to fulfill the promises of the 1990s. Data continually shifts to the Internet cloud where access is open to an array of applications, services, and APIs allowing the end user to bypass the critical problems of desktop computing. Most importantly, the hybrid Internet provides user choice in accessing data, thus allowing OSS, commercial applications, SaaS, etc. to coexist without a complete shift to any particular architecture.

Surely the biggest fallacy of Web 2.0 and cloud computing is that SaaS applications will eventually conquer desktop computing by providing encompassing access to data via Web applications, making traditional open-source and commercial software obsolete. On the contrary, the hybrid Internet model will allow for distributed access to cloud data through open APIs, giving the user the choice of what software to use. Open-source

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[70] Cloud computing is a term used to describe computing power that is provided as an effervescent service, rather than by a tangible collection of hardware and software.

[71] Perry, Geva. "How Cloud & Utility Computing Are Different." GigaOM. http://gigaom.com/2008/02/28/how-cloud-utility-computing-are-different/ (accessed March 29, 2009).

[72] The Internet cloud is used to describe the intangible collection of cloud computing services that provide seamless interconnectivity and abstraction over physical software and hardware, as well as a generic entity to which users of Software-as-a-Service connect to.

applications, commercial desktop software, or a Web browser will be available to a user, thus fulfilling the needs of a particular situation and set of preferences.

5.2 DEPARTMENT RECOMENDATIONS

An important goal of this research study is to provide specific recommendations to ADOT regarding OSS. Three recommendations are given below that offer distinct benefits to ADOT but are structured as generic guides that other departments may adapt.

5.2.1 OpenOffice.org Implementation

This research recommends that the current version of OpenOffice.org be introduced as an *alternative* to Microsoft Office. The OpenOffice Challenge™ demonstrated that users find OpenOffice.org 3 more comparable to Office 2003 than Office 2007 is to Office 2003. Additionally, participants showed that Office 2007 had a steeper learning curve than OpenOffice.org 3. The current ADOT infrastructure mostly encompasses computers running Windows XP and Office 2003. Microsoft Office 2007 represents a huge shift in usability and interface along with compatibility which may cause productivity loss and frustration among users.

5.2.1.1 Proposed Deployment Methodology

When Microsoft Office 2007 is deployed to the department at a large scale, OpenOffice.org should also be included as an alternative office suite in the computer image.[73] However, it is important that OpenOffice.org not be immediately deployed as a replacement to Microsoft Office, but instead as an additional option for users. Also, the deployment should occur during normal computer imaging cycles.[74] This process provides multiple advantages over an immediate migration to OpenOffice.org:

- Deployment costs associated with releasing OpenOffice.org are mitigated by combining them with Office 2007. Implementing OpenOffice.org immediately across ADOT would represent significant costs associated with reimaging computers. By waiting to deploy OpenOffice.org in conjunction with the normal reimaging cycle, nominal cost is added to the deployment process.
- Migrating from the Microsoft platform to OpenOffice.org represents a cultural shift that takes time for user acceptance. Although a migration to Office 2007 presents an array of user acceptance problems because of the drastically changed user interface, switching platforms may introduce unforeseen problems associated with the software architecture. For instance, macros and other custom programs are likely to have been developed using Visual Basic for Applications (VBA) exclusively for Microsoft products. These customizations may provide business critical functions and represent years of development. By providing OpenOffice.org as an alternative to Office 2007, potential incompatibilities can be discovered without immediate risk to business continuity. Additionally, having OpenOffice.org as an alternative to Office 2007, instead of being the sole application, will catalyze user acceptance of the open-source

[73] A computer image is defined as the set of software, operating system and settings that is used as a standard for computer setup.

[74] A computer imaging cycle is defined as the periodic deployment of a computer image to a subset of an organization's computers.

platform. If OpenOffice.org were forced on users in a large scale deployment, any complications would be exhibited through reluctance to accept OpenOffice.org. However, by providing OpenOffice.org as a second choice, users frustrated with the usability of Office 2007 may switch to OpenOffice.org, drastically improving acceptance rates. As OpenOffice Challenge™ results show, OpenOffice.org is a more usable application with a smaller learning curve than Office 2007.

- Finally, an immediate deployment of OpenOffice.org 3 in place of Microsoft Office 2007 would not provide any initial license cost savings. As seen in Appendix L, the current ADOT license contract with Microsoft does not end until 2011 and also includes Office 2007. By deploying both office suites together, additional comparative data can be analyzed to determine if cancelling Microsoft licensing in favor of OpenOffice.org 3 is suitable for the department.

5.2.1.2 Estimated Cost Savings

An important goal of this research study is to provide an estimated cost savings model for implementing candidate open-source applications. In particular, cost savings of implementing OpenOffice.org 3 in place of Microsoft Office 2007 is an important metric. It is important to note that licensing costs do not represent the TCO typically used in IT software cost analysis. The recommendation of dual deployment helps mitigate indirect costs associated with training, support and productivity loss.

Currently, ADOT spends approximately $410,000 annually on Microsoft Office licensing. This represents about $82 for each of the 5000 workstations. By switching to OpenOffice.org and eliminating the costs of Microsoft Office, the department would save $410,000 in licensing costs given that OpenOffice.org has no licensing costs whatsoever. A detailed outline of annual Microsoft licensing costs can be seen in Appendix M. However, to realize any cost savings, the indirect costs associated with switching to OpenOffice.org must be less than current Microsoft Office licensing costs. Deployment often represents exorbitant costs since IT retooling and training may be required, in addition to outside consultants for planning and migration analysis. Continued costs associated with training and productivity loss offset potential cost savings as well. Microsoft Office 2007 represents the larger learning curve compared to OpenOffice.org 3, while OpenOffice.org 3 more closely resembles Office 2003, which is currently the standard at ADOT. This positions OpenOffice.org 3 as a likely contender to lower the TCO for office productivity suites.

It should also be noted that licensing contracts are often negotiated and costs are dependent on additional software included in the plan. By excluding Microsoft Office in the consecutive Microsoft licensing contract, cost associated with other software may increase. By deploying OpenOffice.org 3 across ADOT as an alternative to Microsoft Office 2007, more negotiating power is given to ADOT to reduce future costs.

5.2.1.3 Other Intrinsic Benefits

In addition to cost savings, qualitative benefits exist from implementing OpenOffice.org and inherently from implementing open-source software. Specifically, open formats such as the OpenDocument Format included with OpenOffice.org 3 encourage increased

accessibility. Government agencies naturally focus on disseminating information to the public through ensuring universal access. Proprietary file formats inherently exclude people without the means to obtain the commercial software. Since no specific commercial software is required with open formats, individuals are free to access information with readily available free software.

5.2.2 Software Procurement Process

Throughout this research study, many benefits of OSS have been observed. Furthermore, the past decade has seen open-source applications becoming positioned as comparable contenders to commercial software. On this basis, an additional recommendation for ADOT is to implement a policy to require the consideration of OSS in addition to commercial applications during software procurement and in requests for proposals (RFP). This practice will encourage the investigation of open-source alternatives that may reduce the TCO of the software as well as provide qualitative benefits such as open formats. The literature review showed that several government agencies have adopted similar policies and have thereby implemented many OSS applications. Additionally, this policy will help dispel the notion that only commercial software is acceptable for organizational implementation by ensuring future comparative analysis of commercial and open-source software.

5.2.3 Encourage Open-Source Proliferation

A final recommendation to ADOT is to encourage open-source proliferation by offering IT support of open-source tools and applications that users may find and start using. By offering support for new OSS, ADOT will shift towards finding methods for a lower TCO. Overall, software adopted from the user base in a bottom-up approach is shown to be more successful than a top-down implementation without user consent. The alternative approach is to deny official IT support for rogue applications users may find. However, this approach stunts innovation and the ability to rapidly gain user adoption of a particular tool or application.

Additionally, the department should offer support for developers who contribute to open-source projects. Similar in concept to Google's innovative "20% time,"[75] ADOT should offer developers a portion of their time at work to work on OSS if they wish. This provides many benefits, such as continued education and technical training for developers, while allowing ADOT to reap the benefits of developers continuously surveying the open-source landscape.

[75] Google's "20% time" is a program that allows Google engineers to spend one day a week working on projects of their choice outside their job description.

APPENDIX A: EXTERNAL AGENCY SURVEY INDIVIDUAL RESULTS

State	Name	Title	Email	Phone
Alaska	Brian J. Idzik	System Programmer III	brian.idzik@alaska.gov	907-465-8964
Arkansas	Bryan Stewart	Division Head - Computer Services	bryan.stewart@arkansashighways.com	501-569-2436
California	Doug Kempster	Chief, IT Solutions Division	Doug.Kempster@dot.ca.gov	916-654-2614
Connecticut	Katherine Trudeau	Business Systems Manager	katherine.trudeau@po.state.ct.us	860-594-3549
Kansas	Bill Roth	Enterprise IT Architect	billr@ksdot.org	785-296-0941
Kentucky	Connie Egbers	IT Branch Manager	connie.egbers@ky.gov	502-564-8900 ext. 3533
Louisiana	Warren Huffty	PC Support Supervisor	whuffty@dotd.la.gov	225-379-1813
Maine	Nancy Armentrout	IT Director	nancy.armentrout@maine.gov	207-624-3209
Maryland	Chuck Bristow	MD Dept. of Transportation CIO	cbristow@mdot.state.md.us	410-865-1040
Michigan	Sudhakar Ramaswamy	Enterprise Architect	ramaswamys@michigan.gov	517-241-4009
Minnesota	John Moreland	IT Infrastructure Manager	john.moreland@dot.state.mn.us	651-366-5646
Missouri	Madalynn Bell	IS Manager	Madalynn.Bell@modot.mo.gov	573-751-6909
Montana	Mike Bousliman	Division Administrator	mbousliman@mt.gov	406-444-6158
New Jersey	Richard Jablonski	Acting Manager Applications Development	Richard.Jablonski@dot.state.nj.us	609-530-2399
New Mexico	Robert Ashmore	CIO	robert.ashmore@state.nm.us	505-827-3270
North Dakota	Erv Zimprich	IT Manager	ezimpric@nd.gov	701-328-3229
Oregon	Virginia Alster	Manager, Technology Management	Virginia.M.Alster@odot.state.or.us	503-986-3196
Pennsylvania	Joyce Black	Chief, Operations Division	joblack@state.pa.us	717-705-1388
Rhode Island	Mary Gelardi	Administrator of MIS	mgelardi@dot.ri.gov	401-222-6935 ext. 4470
South Carolina	Jose Valdivieso	software development	ValdivieJL@scdot.org	803-737-1003
Tennessee	Vic Mangrum	IT Director	Vic.Mangrum@state.tn.us	615-741-3576
Texas	Frank R. Bushong, P.E.	Director of IT Architecture	fbushon@dot.state.tx.us	512-465-7713
Utah	Greg Jackson	IT Manager	gregjackson@utah.gov	801-965-4036
Vermont	Tom Hurd	CIO	tom.hurd@state.vt.us	802-828-3426
West Virginia	Candice Prince	Manager PC/LAN applications	cprince@dot.state.wv.us	304-558-9527
Wisconsin	John Hoskins	IT Strategy & Architecture	john.hoskins@dot.state.wi.us	608-266-6929

1. Please approximate the percentage of servers in your department that use each of the following environments.

State	Mainframe	Unix	Linux	Windows Server 2003	Windows Server 2000	Mac OS Server	Other
Alaska		10		85	5		
Arkansas	1			86	10		3
California							100
Connecticut	1	4		40	54		1
Kansas	1		2	97			
Kentucky	1	2		59	36		2
Louisiana	1		4	65	30		
Maine	10	1		80	9		
Maryland	40			60			
Michigan		16		40	10		34
Minnesota		1	11	74	14		
Missouri	1	12	2	26	58		1
Montana	5		10	5			80
New Jersey				100			
New Mexico				100			
North Dakota	20		10	60	10		
Oregon	1	2	9	88			
Pennsylvania				63	27		10
Rhode Island	5			95			
South Carolina				100			
Tennessee	5			90	5		
Texas	1	1	1	57			40
Utah		1	5	60	5		29
Vermont	1			99			
West Virginia	75			25			
Wisconsin	1	1	2	96			

2. Please approximate the percentage of desktops in your department that use each of the following environments.

State	Unix	Linux	Mac OS X	Windows 2000	Windows XP	Windows Vista	Thin Client	Other
Alaska	1			1	98			
Arkansas				21	79			
California								100
Connecticut				3	97			
Kansas					100			
Kentucky				1	99			
Louisiana				15	85			
Maine					100			
Maryland				75	25			
Michigan				2	98			
Minnesota				3	97			
Missouri				98	2			
Montana					100			
New Jersey					98	2		
New Mexico					100			
North Dakota				25	75			
Oregon					99			1
Pennsylvania					100			
Rhode Island				20	80			
South Carolina					99	1		
Tennessee				1	98			1
Texas			1		99			
Utah				35	65			
Vermont				100				
West Virginia					100			
Wisconsin					99			1

3. Please approximate the percentage of desktops or users in your department that use each of the following office productivity suites.

State	Google Docs and Spreadsheets	Microsoft Office 2000	Microsoft Office 2002/XP	Microsoft Office 2003	Open Office	Corel WordPerfect	Star Office	Other
Alaska			99		1			
Arkansas		88		12				
California								100
Connecticut		3		97				
Kansas				98		2		
Kentucky		1		99				
Louisiana		5	5	85		5		
Maine			80	20				
Maryland		100						
Michigan				100				
Minnesota		5	95					
Missouri		99		1				
Montana				100				
New Jersey				100				
New Mexico		40		60				
North Dakota			90					10
Oregon			60	40				
Pennsylvania			100					
Rhode Island		20		80				
South Carolina		1		99				
Tennessee			2	98				
Texas				100				
Utah		45	35	18	2			
Vermont		100						
West Virginia			100					
Wisconsin		100						

4. What is your department's current status regarding a Windows Vista deployment?

State	Response	Comments
Alaska	Deployment/Upgrade is a possibility, but no plans have been made	
Arkansas	Deployment/Upgrade is a possibility, but no plans have been made	
California	Deployment/Upgrade is a possibility, but no plans have been made	
Connecticut	Currently planning upgrade timeline	
Kansas	Currently planning upgrade timeline	
Kentucky	Other (please specify)	The KY Commonwealth Office of Technology determines OS updates and schedules
Louisiana	Deployment/Upgrade is a possibility, but no plans have been made	
Maine	Currently planning upgrade timeline	
Maryland	Deployment/Upgrade is a possibility, but no plans have been made	
Michigan	Deployment/Upgrade is a possibility, but no plans have been made	
Minnesota	Deployment/Upgrade is a possibility, but no plans have been made	
Missouri	Deployment/Upgrade is a possibility, but no plans have been made	
Montana	Deployment/Upgrade is a possibility, but no plans have been made	
New Jersey	Currently planning upgrade timeline	
New Mexico	Deployment/Upgrade is a possibility, but no plans have been made	
North Dakota	Plans to deploy/upgrade within 1 year	
Oregon	Deployment/Upgrade is a possibility, but no plans have been made	
Pennsylvania	Currently planning upgrade timeline	
Rhode Island	Other (please specify)	Hold off until Division of IT approves
South Carolina	Deployment/Upgrade is a possibility, but no plans have been made	
Tennessee	Deployment/Upgrade is a possibility, but no plans have been made	
Texas	Deployment/Upgrade is a possibility, but no plans have been made	
Utah	Deployment/Upgrade is a possibility, but no plans have been made	
Vermont	Deployment/Upgrade is a possibility, but no plans have been made	
West Virginia	Deployment/Upgrade is a possibility, but no plans have been made	
Wisconsin	Deployment/Upgrade is a possibility, but no plans have been made	

5. What is your department's current status regarding a Microsoft Office 2007 deployment?

State	Response	Other (please specify)
Alaska	Deployment/Upgrade is a possibility, but no plans have been made	
Arkansas	Plans to deploy/upgrade within 1 year	
California	Deployment/Upgrade is a possibility, but no plans have been made	
Connecticut	Currently planning upgrade timeline	
Kansas	Currently being deployed	
Kentucky	Deployment/Upgrade is a possibility, but no plans have been made	
Louisiana	Currently planning upgrade timeline	
Maine	Currently planning upgrade timeline	
Maryland	Deployment/Upgrade is a possibility, but no plans have been made	
Michigan	Deployment/Upgrade is a possibility, but no plans have been made	
Minnesota	Currently planning upgrade timeline	
Missouri	Deployment/Upgrade is a possibility, but no plans have been made	
Montana	Deployment/Upgrade is a possibility, but no plans have been made	
New Jersey	Currently being deployed	
New Mexico	Deployment/Upgrade is a possibility, but no plans have been made	
North Dakota	Currently being deployed	
Oregon	Deployment/Upgrade is a possibility, but no plans have been made	
Pennsylvania	Currently planning upgrade timeline	
Rhode Island	Other (please specify)	Division of IT has ordered departments to hold off, not to upgrade to date
South Carolina	Plans to deploy/upgrade within 1 year	
Tennessee	Currently being deployed	
Texas	Deployment/Upgrade is a possibility, but no plans have been made	
Utah	Deployment/Upgrade is a possibility, but no plans have been made	
Vermont	Plans to deploy/upgrade within 1 year	
West Virginia	Plans to deploy/upgrade within 1 year	
Wisconsin	Plans to deploy/upgrade within 1 year	

6. If your department currently does not use an Open-source Software (OSS) office suite, has your department considered OpenOffice.org or another OSS office suite (informally or formally)?

State	Yes	No	Please briefly describe your decision and rationale.
Alaska		X	
Arkansas		X	Long term user of Microsoft Office Suite with a current Enterprise Agreement. The amount of training it would cost to change to another suite.
California		X	
Connecticut	X		Informal at present because state standards are legislated.
Kansas	X		We always consider alternatives, but our stability for support and interoperability is critical.
Kentucky		X	
Louisiana		X	
Maine	X		we are considering making an alternate offering, pre-loaded onto PCs
Maryland	X		
Michigan		X	Direction comes from Office Automation group that is part of Michigan Department of Information Technology.
Minnesota		X	
Missouri	X		
Montana		X	
New Jersey		X	We are part of a Statewide Enterprise Agreement
New Mexico		X	
North Dakota		X	
Oregon	X		
Pennsylvania		X	Standard for the Commonwealth of PA is MS Office
Rhode Island		X	
South Carolina		X	
Tennessee	X		Although we have considered it, we are governed by a State Standards Group that has not approved such.
Texas		X	TxDOT uses the Microsoft Office product suite. The cost of change (training, conversion, etc) to an open-source application would far outweigh any perceived cost savings.
Utah		X	
Vermont		X	
West Virginia		X	
Wisconsin		X	

7. If your department currently does not use an OSS desktop operating system, has your department considered Linux or another OSS operating system (informally or formally)?

State	Yes	No	Already use an OSS operating system	Please briefly describe your decision and rationale.
Alaska		X		
Arkansas		X		Lack of experience with an OSS operating system.
California		X		
Connecticut	X			Informal at present because state standards are legislated.
Kansas		X		
Kentucky		X		
Louisiana		X		
Maine	X			Will not deploy OSS OS at this time but are considering moving the application layer in that direction to position us to look at OSS OS in the future.
Maryland	X			
Michigan		X		Direction comes from Office Automation group that is part of Michigan Department of Information Technology.
Minnesota		X		
Missouri	X			
Montana		X		
New Jersey		X		
New Mexico		X		
North Dakota		X		
Oregon	X			
Pennsylvania		X		Standard for the Commonwealth of PA is MS Windows
Rhode Island		X		
South Carolina		X		
Tennessee	X			Although we have considered it, we are governed by a State Standards Group that has not approved such.
Texas		X		The cost of change would be too high.
Utah		X		
Vermont		X		
West Virginia		X		
Wisconsin			X	

8. What is the primary application development environment used by your department?

State	Environment	Comments
Alaska	Java	
Arkansas	ASP.NET	
California	Java	
Connecticut	ASP.NET	
Kansas	ASP.NET	
Kentucky	Other (please specify)	C#.Net and ASP.Net
Louisiana	ASP.NET	
Maine	Other (please specify)	Oracle PL/SQL
Maryland	ASP.NET	
Michigan	Java	
Minnesota	Java	
Missouri	Java	
Montana	Other (please specify)	Oracle tools
New Jersey	Classic ASP	
New Mexico	ASP.NET	
North Dakota	ASP.NET	
Oregon	ASP.NET	
Pennsylvania	Java	
Rhode Island	Other (please specify)	VB, PL/SQL
South Carolina	ASP.NET	
Tennessee	ASP.NET	
Texas	ASP.NET	
Utah	Other (please specify)	Oracle Tools
Vermont	ASP.NET	
West Virginia	ASP.NET	
Wisconsin	Java	

9. What other application development environments are used by your department? Select all that apply

State	PHP	ASP/ ASP.NET	Mono	Ruby	Rails	Perl	Java	Python	Please list any others
Alaska				X		X			ColdFusion MX7
Arkansas		X					X		CA - Ideal on the mainframe primarily for maintenance.
California	X	X					X	X	Oracle Forms and Reports
Connecticut									
Kansas							X		
Kentucky		X							
Louisiana		X				X	X		
Maine		X				X	X		
Maryland							X		
Michigan		X							Adobe ColdFusion
Minnesota		X						X	Oracle Forms, Access
Missouri	X	X	X	X	X	X		X	DreamWeaver, Visual Basic, Lotus Domino, Eclipse
Montana	X	X				X	X		Oracle
New Jersey		X							
New Mexico	X								
North Dakota							X		
Oregon		X					X		Cold Fusion
Pennsylvania		X							
Rhode Island		X							
South Carolina									Oracle 10g forms and reports.
Tennessee		X							PowerBuilder, Oracle for Applications, Visual Basic 6
Texas							X		
Utah		X							
Vermont							X		
West Virginia		X							VB.NEt
Wisconsin									Cobol, CoolGen for non-web apps

10. What is the primary enterprise database environment currently being used by your department? Select only one

State	Environment	Other (please specify)
Alaska	Oracle	
Arkansas	Microsoft SQL	
California	Oracle	
Connecticut	Oracle	
Kansas	Oracle	
Kentucky	Oracle	
Louisiana	IBM DB2	
Maine	Oracle	
Maryland	Oracle	
Michigan	Oracle	
Minnesota	Oracle	
Missouri	Oracle	
Montana	Oracle	
New Jersey	Microsoft SQL	
New Mexico	Oracle	
North Dakota	Microsoft SQL	
Oregon	IBM DB2	
Pennsylvania	IBM DB2	
Rhode Island	Microsoft SQL	
South Carolina	Microsoft SQL	
Tennessee	Oracle	
Texas	Oracle	
Utah	Oracle	
Vermont	Microsoft SQL	
West Virginia	Microsoft SQL	
Wisconsin	IBM DB2	

11. What other enterprise database environments are used by your department? Select all that apply

State	My SQL	MS SQL	Postgre SQL	Sybase	IBM DB2	Oracle	Microsoft Access	Filemaker Pro	dBase	Please list any others
Alaska		X								
Arkansas	X	X					X		dBase	CA - DataCom on the mainframe.
California	X	X					X	X		
Connecticut		X								
Kansas		X			X		X			
Kentucky		X								
Louisiana		X				X	X			
Maine							X			
Maryland		X			X		X			
Michigan				X			X			Foxpro
Minnesota		X					X			
Missouri	X				X		X			
Montana		X			X	X	X			
New Jersey						X				
New Mexico		X								
North Dakota							X			
Oregon	X				X		X			
Pennsylvania		X				X				IMS
Rhode Island						X				
South Carolina						X	X			Software AG ADABAS (mainframe based)
Tennessee		X								
Texas		X								
Utah	X	X					X			
Vermont						X				ADBASE
West Virginia					X		X			
Wisconsin						X	X			

12. What is the primary enterprise email system currently being used by your department?

State	System	Other (please specify)
Alaska	Microsoft Exchange 2003	
Arkansas	Microsoft Exchange 2003	
California	Lotus Domino	
Connecticut	Microsoft Exchange 2000	
Kansas	Microsoft Exchange 2003	
Kentucky	Microsoft Exchange 2003	
Louisiana	Lotus Domino	
Maine	Microsoft Exchange 2003	
Maryland	Microsoft Exchange 2003	
Michigan	Other (please specify)	Novell Groupwise
Minnesota	Other (please specify)	Novell Groupwise
Missouri	Lotus Domino	
Montana	Microsoft Exchange 2007	
New Jersey	Other (please specify)	Novell Groupwise
New Mexico	Microsoft Exchange 2003	
North Dakota	Microsoft Exchange 2003	
Oregon	Microsoft Exchange 2003	
Pennsylvania	Microsoft Exchange 2000	
Rhode Island	Microsoft Exchange 2003	
South Carolina	Microsoft Exchange 2003	
Tennessee	Other (please specify)	Novell Groupwise
Texas	Other (please specify)	Novell Groupwise
Utah	Other (please specify)	Novell GroupWise
Vermont	Microsoft Exchange 2003	
West Virginia	Microsoft Exchange 2003	
Wisconsin	Other (please specify)	Exchange 5.5

13. Does your department have any officially deployed OSS applications?

State	Yes	No
Alaska		X
Arkansas		X
California	X	
Connecticut		X
Kansas		X
Kentucky		X
Louisiana		X
Maine	X	
Maryland		X
Michigan	X	
Minnesota		X
Missouri	X	
Montana		X
New Jersey		X
New Mexico		X
North Dakota		X
Oregon	X	
Pennsylvania		X
Rhode Island		X
South Carolina	X	
Tennessee		X
Texas		X
Utah	X	
Vermont		X
West Virginia		X
Wisconsin	X	

14. How long has OSS been used officially department wide?

State	Duration
Alaska	
Arkansas	
California	Greater than 3 years
Connecticut	
Kansas	
Kentucky	
Louisiana	
Maine	Greater than 3 years
Maryland	
Michigan	Greater than 3 years
Minnesota	
Missouri	1 to 3 years
Montana	
New Jersey	
New Mexico	
North Dakota	
Oregon	6 Months to 1 Year
Pennsylvania	
Rhode Island	
South Carolina	Greater than 3 years
Tennessee	
Texas	
Utah	1 to 3 years
Vermont	
West Virginia	
Wisconsin	6 Months to 1 Year

15. Please list known OSS applications being used below, and briefly describe your overall satisfaction with them.

State	Response
Alaska	
Arkansas	
California	Apache Web server, Tomcat app server, STRUTS development framework for Java. Considering Plone for Web Content management.
Connecticut	
Kansas	
Kentucky	
Louisiana	
Maine	Just one in CGI/Perl, on the Intranet Is stable, works well, but only one person can maintain
Maryland	
Michigan	Eclipse Development Platform CFEclipse Subclipse CVS Subversion TortoiseSVN AnkhSVN for Visual Studio Wireshark (formerly Ethereal) Apache Web Server Apache Jakarta Tomcat Filezilla Cygwin Putty openSSH Fully satisfied with the above. Not using CVS anymore. The others are part of day to day business.
Minnesota	
Missouri	wiki good
Montana	
New Jersey	
New Mexico	
North Dakota	
Oregon	Linux OS deployed on servers for Motor Carrier customers. They seem to work well.
Pennsylvania	
Rhode Island	
South Carolina	Highway Maintenance Management System(Booz-Allen-Hamilton product), SCARPS (Bentley Systems Product). SCDOT purchased a COTS product then received the code and table structures and took [full] responsibility for maintenance and enhancements.
Tennessee	
Texas	
Utah	Nagios
Vermont	
West Virginia	
Wisconsin	OpenCMS

16. What is the primary way OSS applications are introduced to the department?

State	Response	Other (please explain)
Alaska		
Arkansas		
California	OSS applications are deployed to introduce new functionality and provide solutions that previous software did not have	
Connecticut		
Kansas		
Kentucky		
Louisiana		
Maine	OSS applications are used ad hoc among individual users without official deployment	
Maryland		
Michigan	Other (please explain)	It is a combination of replacement and providing new functionality the path being start at providing new functionality and then look at replacement.
Minnesota		
Missouri	OSS applications are deployed to introduce new functionality and provide solutions that previous software did not have	
Montana		
New Jersey		
New Mexico		
North Dakota		
Oregon	OSS applications are deployed to replace a proprietary application	
Pennsylvania		
Rhode Island		
South Carolina	OSS applications are deployed to introduce new functionality and provide solutions that previous software did not have	
Tennessee		
Texas		
Utah	OSS applications are deployed to replace a proprietary application	
Vermont		
West Virginia		
Wisconsin	OSS applications are deployed to introduce new functionality and provide solutions that previous software did not have	

17. If your department has ever deployed an open-source application to replace a proprietary application, what were the most important reasons for the migration? Select up to 3 choices

State	OSS provided a lower TCO than previous system	Maintenance was easier	Greater reliability	Greater security	Greater performance	More features/ functionality	Needed to upgrade anyways	Have not deployed OSS to replace a proprietary application	Other (please specify)
Alaska									
Arkansas									
California	X					X			
Connecticut									
Kansas									
Kentucky									
Louisiana									
Maine								X	
Maryland									
Michigan	X	X							
Minnesota									
Missouri								X	
Montana									
New Jersey									
New Mexico									
North Dakota									
Oregon							X		
Pennsylvania									
Rhode Island									
South Carolina		X							
Tennessee									
Texas									
Utah			X			X			
Vermont									
West Virginia									
Wisconsin								X	

18. If your department has ever deployed OSS to provide new functionality that didn't exist in a previous system, what are the most important reasons for selecting the OSS application over a proprietary solution? Select up to 3 choices

State	OSS provided a lower TCO than proprietary counterpart.	Maintenance was easier	Greater reliability	Greater security	Greater performance	More features/ functionality	No comparable proprietary software existed/ reviewed	Have not deployed OSS to provide new functionality	Other (please specify)
Alaska									
Arkansas									
California	X	X				X			
Connecticut									
Kansas									
Kentucky									
Louisiana									
Maine	X								
Maryland									
Michigan	X			X					
Minnesota									
Missouri						X	X		
Montana									
New Jersey									
New Mexico									
North Dakota									
Oregon								X	
Pennsylvania									
Rhode Island									
South Carolina	X	X				X			
Tennessee									
Texas									
Utah					X	X			
Vermont									
West Virginia									
Wisconsin	X	X							

19. What is the primary reason why your department has not implemented any open-source solutions? Select only one.

State	Reason	Other (please specify)
Alaska	Resistance from management to use OSS	
Arkansas	Other (please specify)	The long term viability of various OSS platforms is still uncertain at this time.
California		
Connecticut	Other (please specify)	Standards are formal here in CT and Open-source is still before the legislature.
Kansas	Lack of external support for OSS	
Kentucky	Other (please specify)	Hasn't been considered.
Louisiana	Lack of external support for OSS	
Maine		
Maryland	Lack of external support for OSS	
Michigan		
Minnesota	Migration costs from a proprietary application to the OSS counterpart	
Missouri		
Montana	Other (please specify)	No business need to do so
New Jersey	Other (please specify)	Both migration costs and lack of external support.
New Mexico	No lower Total Cost of Ownership for OSS applications	
North Dakota	Migration costs from a proprietary application to the OSS counterpart	
Oregon		
Pennsylvania	Other (please specify)	concerns regarding ongoing support
Rhode Island	Migration costs from a proprietary application to the OSS counterpart	
South Carolina		
Tennessee	Other (please specify)	Governed by State Standards Group that prohibits us.
Texas	Migration costs from a proprietary application to the OSS counterpart	
Utah		
Vermont	No lower Total Cost of Ownership for OSS applications	
West Virginia	No lower Total Cost of Ownership for OSS applications	
Wisconsin		

20. Does your department have a policy regarding open-source software during software procurement? For example, an open-source policy may include requirements to never consider open-source software or to always review a minimum number of open-source applications.

State	Yes	No
Alaska	X	
Arkansas		X
California		X
Connecticut		X
Kansas		X
Kentucky		X
Louisiana		X
Maine		X
Maryland		X
Michigan		X
Minnesota		X
Missouri		X
Montana		X
New Jersey		X
New Mexico	X	
North Dakota		X
Oregon		X
Pennsylvania		X
Rhode Island		X
South Carolina		X
Tennessee		X
Texas		X
Utah		X
Vermont		X
West Virginia		X
Wisconsin		X

21. Consider a software procurement in which two applications are being reviewed. One is an OSS application and the other is a proprietary or commercial application. Assume all aspects for both products are equal; the TCO, benefits and disadvantages are the same for both products. Which of the products would your department be more inclined to implement?

State	OSS	Proprietary Software
Alaska		X
Arkansas		X
California		X
Connecticut		X
Kansas		X
Kentucky		X
Louisiana		X
Maine		X
Maryland		X
Michigan	X	
Minnesota	X	
Missouri	X	
Montana		X
New Jersey		X
New Mexico		X
North Dakota		X
Oregon		X
Pennsylvania	X	
Rhode Island	X	
South Carolina	X	
Tennessee	X	
Texas		X
Utah		X
Vermont		X
West Virginia		X
Wisconsin	X	

22. In your professional opinion, what are the major strengths and benefits of OSS compared to proprietary software? Select up to 3 choices

State	Lower TCO	Easier maintenance	Reliability	Security	Performance	Scalability	Support	Functionality and features	Other (please specify)
Alaska			X		X				standards based
Arkansas									I am not convinced that there are provable strengths and benefits of OSS compared to proprietary software.
California	X							X	
Connecticut	X					X	X		
Kansas									I don't see any of these as better than proprietary, just different
Kentucky									We have not engaged in OSS therefore we cannot verify any of the above.
Louisiana					X			X	
Maine	X	X							not driven by vendor upgrade schedules
Maryland	X								
Michigan	X			X					Adherence to Open Standards
Minnesota		X	X			X			
Missouri	X							X	
Montana									There are pros and cons with both
New Jersey									
New Mexico									
North Dakota								X	
Oregon									you have the code
Pennsylvania	X								
Rhode Island					X	X	X		
South Carolina	X	X				X			
Tennessee	X	X							No Vendor Lock-In
Texas	X			X					
Utah	X	X							
Vermont	X								
West Virginia									
Wisconsin	X								

23. In your professional opinion, what are the major weaknesses and disadvantages of OSS compared to proprietary software? Select up to 3 choices

State	Higher/ Unproven TCO than proprietary software	Harder maintenance	Licensing and Legal Restrictions	Reliability	Lack of Support	Security	Performance	Scalability	Functionality and features	Other (please specify)
Alaska										Management & resistance
Arkansas	X	X								Lack of user and support staff training and education in the use of OSS.
California					X					
Connecticut				X		X				
Kansas				X		X			X	
Kentucky										We have not participated in OSS therefore we cannot verify the above.
Louisiana	X				X					compatibility
Maine					X					
Maryland					X	X				
Michigan		X	X		X					
Minnesota	X				X					
Missouri					X					
Montana					X	X				
New Jersey				X	X				X	
New Mexico					X					
North Dakota					X					
Oregon	X		X						X	
Pennsylvania	X		X		X					
Rhode Island			X							
South Carolina	X									
Tennessee					X					Lack of ONE primary source of support
Texas					X				X	
Utah				X	X					
Vermont		X		X	X					
West Virginia		X		X	X					
Wisconsin					X		X		X	

24. Please feel free to include any additional information regarding findings on OSS that you think would benefit this study.

State	Comments
Alaska	
Arkansas	
California	We expect "system software" to be supported; that is, we want someone to complain to if there's a problem. For instance, we "license" Linux through Novell, and they respond to problems we might have with it.
Connecticut	Participating in open-source projects is a great benefit to IT professionals, stimulating their creativity and reducing their deployment time and effort. This realizes both a lower TCO and affords greater opportunities for the users.
Kansas	Open-source is a choice of a strategic direction. We get better solutions when we can share open designs and patterns and allow each agency choose their preferred deployment model.
Kentucky	I would like to know what the goal of this survey is?
Louisiana	
Maine	State of Maine currently has an OSS Feasibility Study underway. They started by looking at OSS Office and client OS. We will likely deploy an OSS Office by loading that and MS Office. User agencies can elect to turn on either, but they pay for MS Office.
Maryland	
Michigan	
Minnesota	In the GIS area, commercial products offer better integration for the Enterprise.
Missouri	
Montana	
New Jersey	
New Mexico	
North Dakota	
Oregon	Oregon did a study of what OSS we have. While we do not have policies regarding its acquisition there was some that developers used for their own purposes. We would like to bring more OSS in, however, it requires retooling our workforce and a new model of how to do business. We have not yet been able to make the business case for this as yet.
Pennsylvania	
Rhode Island	
South Carolina	If an organization has a capable staff and can support an application developed by others, OSS is ideal. For those organizations with less-than-capable technical staffs, OSS is not a good idea because taking complete ownership of an application requires quick learning and a will to become responsible for the work of others. Some places just cannot do that.
Tennessee	TDOT is eager to explore the OSS possibilities, but is prohibited from doing so due to the Standards Setting Group from our Centralized IT Department.
Texas	
Utah	
Vermont	
West Virginia	
Wisconsin	

25. Would you like further information regarding this study?

State	I would like to receive the results of this survey.	I would like to receive a copy of the final report.
Alaska		
Arkansas	X	X
California		X
Connecticut		X
Kansas	X	X
Kentucky		X
Louisiana		X
Maine	X	X
Maryland	X	X
Michigan	X	X
Minnesota	X	
Missouri	X	X
Montana		X
New Jersey		X
New Mexico		
North Dakota		
Oregon	X	
Pennsylvania	X	
Rhode Island		X
South Carolina	X	X
Tennessee	X	
Texas	X	X
Utah	X	
Vermont	X	X
West Virginia		X
Wisconsin	X	

APPENDIX B: EXTERNAL AGENCY SURVEY SUMMARY

1. Please approximate the percentage of servers in your department that use each of the following environments.

	Response Average
Mainframe	**9.4%**
Unix	**3.6%**
Linux	**4.3%**
Windows Server 2003	**70.0%**
Windows Server 2000	**18.2%**
Mac OS Server	**0.0%**
Other (Please Specify)	**25.0%**

2. Please approximate the percentage of desktops in your department that use each of the following environments.

	Response Average
Unix	**0.3%**
Linux	**0.0%**
Mac OS X	**0.3%**
Windows 2000	**28.6%**
Windows XP	**83.7%**
Windows Vista	**0.6%**
Thin Client	**0.0%**
Other (Please Specify)	**14.7%**

3. Please approximate the percentage of desktops or users in your department that use each of the following office productivity suites.

	Response Average
Google Docs and Spreadsheets	**0.0%**
Microsoft Office 2000	**46.7%**
Microsoft Office 2002/XP	**51.2%**
Microsoft Office 2003	**67.1%**
OpenOffice.org	**0.6%**
Corel WordPerfect	**1.4%**
Star Office	**0.0%**
Other (Please Specify)	**27.5%**

4. What is your department's current status regarding a Windows Vista deployment?

	Response Percent	Response Count
Fully deployed	**0.0%**	**0**
Currently being deployed	**0.0%**	**0**
Plans to deploy/upgrade within 1 year	**3.8%**	**1**
Currently planning upgrade timeline	**19.2%**	**5**
Deployment/Upgrade is a possibility, but no plans have been made	**69.2%**	**18**
Plans have been made to specifically NOT upgrade to Windows Vista	**0.0%**	**0**
Other (please specify)	**7.7%**	**2**

5. What is your department's current status regarding a Microsoft Office 2007 deployment?

	Response Percent	Response Count
Fully deployed	**0.0%**	**0**
Currently being deployed	**15.4%**	**4**
Plans to deploy/upgrade within 1 year	**19.2%**	**5**
Currently planning upgrade timeline	**19.2%**	**5**
Deployment/Upgrade is a possibility, but no plans have been made	**42.3%**	**11**
Plans have been made to specifically NOT upgrade to Office 2007	**0.0%**	**0**
Other (please specify)	**3.8%**	**1**

6. If your department currently does not use an Open-source Software (OSS) office suite, has your department considered OpenOffice.org or another OSS office suite (informally or formally)?

	Response Percent	Response Count
Yes	**26.9%**	**7**
No	**73.1%**	**19**
Already use an OSS office suite	**0.0%**	**0**

7. If your department currently does not use an OSS desktop operating system, has your department considered Linux or another OSS operating system (informally or formally)?

	Response Percent	Response Count
Yes	**23.1%**	**6**
No	**73.1%**	**19**
Already use an OSS operating system	**3.8%**	**1**

8. What is the primary application development environment used by your department?

	Response Percent	Response Count
PHP	**0.0%**	**0**
Classic ASP	**3.8%**	**1**
ASP.NET	**50.0%**	**13**
Mono	**0.0%**	**0**
Ruby and/or Rails	**0.0%**	**0**
Perl	**0.0%**	**0**
Java	**26.9%**	**7**
Python	**0.0%**	**0**
No “In House” Development is done	**0.0%**	**0**
Other (please specify)	**19.2%**	**5**

9. What other application development environments are used by your department?

	Response Percent	Response Count
PHP (Hypertext Preprocessor)	**15.4%**	**4**
ASP/ASP.NET	**61.5%**	**16**
Mono	**3.8%**	**1**
Ruby	**7.7%**	**2**
Rails	**3.8%**	**1**
Perl	**19.2%**	**5**
Java	**42.3%**	**11**
Python	**11.5%**	**3**

10. What is the primary enterprise database environment currently being used by your department?

	Response Percent	Response Count
MySQL	**0.0%**	**0**
Microsoft SQL	**26.9%**	**7**
PostgreSQL	**0.0%**	**0**
Sybase	**0.0%**	**0**
IBM DB2	**15.4%**	**4**
Oracle	**57.7%**	**15**
Microsoft Access	**0.0%**	**0**
Filemaker Pro	**0.0%**	**0**
dBase	**0.0%**	**0**
No “In House” databases are used	**0.0%**	**0**
Other (please specify)	**0.0%**	**0**

11. What other enterprise database environments are used by your department? Select all that apply.

	Response Percent	Response Count
MySQL	**19.2%**	**5**
Microsoft SQL	**57.7%**	**15**
PostgreSQL	**0.0%**	**0**
Sybase	**3.8%**	**1**
IBM DB2	**23.1%**	**6**
Oracle	**30.8%**	**8**
Microsoft Access	**61.5%**	**16**
Filemaker Pro	**3.8%**	**1**
dBase	**3.8%**	**1**

12. What is the primary enterprise email system currently being used by your department?

	Response Percent	Response Count
Lotus Domino	**11.5%**	**3**
Microsoft Exchange 2003	**50.0%**	**13**
Microsoft Exchange 2007	**3.8%**	**1**
Microsoft Exchange 2000	**7.7%**	**2**
Google Gmail	**0.0%**	**0**
SendMail	**0.0%**	**0**
Other (please specify)	**26.9%**	**7**

13. Does your department have any officially deployed OSS applications?
If the answer is "no" the respondent moved to question 19. If the answer is "yes" the respondent moved to question 14.

	Response Percent	Response Count
Yes	**30.8%**	**8**
No	**69.2%**	**18**

14. How long has OSS been used officially department wide?
A total of 8 responses were recorded for this question based on the requirement of Question 13.

	Response Percent	Response Count
Greater than 3 years	**50.0%**	**4**
1 to 3 years	**25.0%**	**2**
6 Months to 1 Year	**25.0%**	**2**
Less than 6 Months	**0.0%**	**0**
I am not sure the exact length, but at least:	**0.0%**	**0**

16. What is the primary way OSS applications are introduced to the department?
A total of 8 responses were recorded for this question based on the requirement of Question 13.

	Response Percent	Response Count
OSS applications are deployed to replace a proprietary application	**25.0%**	**2**
OSS applications are deployed to introduce new functionality and provide solutions that previous software did not have	**50.0%**	**4**
OSS applications are used ad hoc among individual users without official deployment	**12.5%**	**1**
Other (please explain)	**12.5%**	**1**

17. If your department has ever deployed an open-source application to replace a proprietary application, what were the most important reasons for the migration? Select up to 3 choices.
A total of 8 responses were recorded for this question based on the requirement of Question 13.

	Response Percent	Response Count
OSS provided a lower TCO than previous system	**25.0%**	**2**
Maintenance was easier	**25.0%**	**2**
Greater reliability	**12.5%**	**1**
Greater security	**0.0%**	**0**
Greater performance	**0.0%**	**0**
More features/functionality	**25.0%**	**2**
Needed to upgrade anyways	**12.5%**	**1**
Have not deployed OSS to replace a proprietary application	**37.5%**	**3**
Other (please specify)	**0.0%**	**0**

18. If your department has ever deployed OSS to provide new functionality that didn't exist in a previous system, what are the most important reasons for selecting the OSS application over a proprietary solution? Select up to 3 choices.
A total of 8 responses were recorded for this question based on the requirement of Question 13.

	Response Percent	Response Count
OSS provided a lower TCO than proprietary counterpart.	**62.5%**	**5**
Maintenance was easier	**37.5%**	**3**
Greater reliability	**0.0%**	**0**
Greater security	**12.5%**	**1**
Greater performance	**12.5%**	**1**
More features/functionality	**50.0%**	**4**
No comparable proprietary software existed/reviewed	**12.5%**	**1**
Have not deployed OSS to provide new functionality	**12.5%**	**1**
Other (please specify)	**0.0%**	**0**

19. What is the primary reason why your department has not implemented any open-source solutions?

A total of 18 responses were recorded for this question based on the requirement of Question 13.

	Response Percent	Response Count
Legal constraints from Open-source licenses. e.g. if the source code is modified, it must be released to the public	**0.0%**	**0**
Resistance from management to use OSS	**5.6%**	**1**
Migration costs from a proprietary application to the OSS counterpart	**22.2%**	**4**
Lack of external support for OSS	**16.7%**	**3**
No lower Total Cost of Ownership for OSS applications	**16.7%**	**3**
Other (please specify)	**38.9%**	**7**

20. Does your department have a policy regarding open-source software during software procurement? For example, an open-source policy may include requirements to never consider open-source software or to always review a minimum number of open-source applications.

	Response Percent	Response Count
Yes	**7.7%**	**2**
No	**92.3%**	**24**

21. Consider a software procurement in which two applications are being reviewed. One is an OSS application and the other is a proprietary or commercial application. Assume all aspects for both products are equal; the TCO, benefits and disadvantages are the same for both products. Which of the products would your department be more inclined to implement?

	Response Percent	Response Count
OSS	**30.8%**	**8**
Proprietary Software	**69.2%**	**18**

22. In your professional opinion, what are the major strengths and benefits of OSS compared to proprietary software? Select up to 3 choices

	Response Percent	Response Count
Lower TCO	**50.0%**	**13**
Easier maintenance	**19.2%**	**5**
Reliability	**7.7%**	**2**
Security	**7.7%**	**2**
Performance	**11.5%**	**3**
Scalability	**15.4%**	**4**
Support	**7.7%**	**2**
Functionality and features	**15.4%**	**4**
Other (please specify)	**38.5%**	**10**

23. In your professional opinion, what are the major weaknesses and disadvantages of OSS compared to proprietary software? Select up to 3 choices.

	Response Percent	Response Count
Higher/Unproven TCO than proprietary software	**23.1%**	**6**
Harder maintenance	**15.4%**	**4**
Licensing and Legal Restrictions	**15.4%**	**4**
Reliability	**23.1%**	**6**
Lack of Support	**69.2%**	**18**
Security	**15.4%**	**4**
Performance	**3.8%**	**1**
Scalability	**0.0%**	**0**
Functionality and features	**19.2%**	**5**
Other (please specify)	**19.2%**	**5**

APPENDIX C: EXTERNAL AGENCY SOFTWARE USE SURVEY

The *Arizona Department of Transportation* (ADOT) is examining the issue of open-source software use by transportation agencies. As part of this process, we have commissioned this survey by Sean Coleman, a student at Arizona State University.

We would appreciate your response to the following questions. This information will be used to assist ADOT in making decisions regarding the use of open-source software.

This survey is also available for online submission at:
http://survey.opensourcestudy.com

Person completing this survey: _____

Title: _____ State: _____

Phone: _____ E-mail: _____

Please take a moment to read over the definitions for specific terms used in this survey. If you have any questions while completing this survey, please contact
Sean Coleman (480-603-8850) or sean.m.coleman@asu.edu

Survey Definitions

- OSS – Open-source Software
- Server Environment – Operating system used by the server or a mainframe system.
- Desktop Environment – Operating system used by individual desktop computers or workstations, or thin clients.
- Thin Client – A "dumb" computer or terminal that requires a connection to a server to operate and run applications.
- Officially Deployed Software – Any application or software that is supported and has been deployed by the IT department. This does not include any software the individuals decide to use on a per case basis.
- TCO – Total Cost of Ownership. This includes all costs associated with the entire lifecycle of the software including planning, deployment, support and retirement.

1. **Mainframe/Server Computing Environment:** Please approximate the percentage of servers in your department that use each of the following environments.
   Total should add to 100%
   - Mainframe
   - Unix
   - Linux
   - Windows Server 2003
   - Windows Server 2000
   - Mac OS Server
   - Other (*Please Specify)*

2. **Desktop Computing Environment:** Please approximate the percentage of desktops in your department that use each of the following environments.
   Total should add to 100%
   - Unix
   - Linux
   - Mac OS X
   - Windows 2000
   - Windows XP
   - Windows Vista
   - Thin Client
   - Other (*Please Specify)*

3. Please approximate the percentage of desktops or users in your department that use each of the following office productivity suites.
   Total should add to 100%
   - Google Docs and Spreadsheets
   - Microsoft Office 2000
   - Microsoft Office 2002/XP
   - Microsoft Office 2003
   - OpenOffice.org
   - Corel WordPerfect
   - Star Office
   - Other *(Please Specify)*

4. What is your department's current status regarding a Windows Vista deployment.
   - Fully deployed
   - Currently being deployed
   - Plans to deploy/upgrade in 1 year
   - Currently planning upgrade timeline
   - Deployment/Upgrade is a possibility, but no plans have been made
   - Plans have been made to specifically NOT upgrade to Windows Vista
   - Other *(please specify)*

5. What is your department's current status regarding a Microsoft Office 2007 deployment.
   - Fully deployed
   - Currently being deployed
   - Plans to deploy/upgrade in 1 year
   - Currently planning upgrade timeline
   - Deployment/Upgrade is a possibility, but no plans have been made
   - Plans have been made to specifically NOT upgrade to Office 2007
   - Other *(Please Detail)*

6. If your department currently does not use an Open-source Software (OSS) office suite, has your department considered OpenOffice.org or another OSS office suite (informally or formally)? Please briefly describe your decision and rationale.
   - Yes
   - No
   - Already use an OSS office suite

7. If your department currently does not use an OSS desktop operating system, has your department considered Linux or another OSS operating system (informally or formally)? Please briefly describe your decision and rationale.
   - Yes
   - No
   - Already use an OSS operating system

Programming and Web Development

8. What is the **primary** application development environment used by your department?
   Select only one
   - PHP
   - Classic ASP
   - ASP.NET
   - Mono
   - Ruby and/or Rails
   - Perl
   - Java
   - Python
   - No "In House" Development is done
   - Other *(Please Specify)*

9. What other application development environments are used by your department?
   Select all that apply
   - PHP (Hypertext Preprocessor)
   - ASP/ASP.NET
   - Mono
   - Ruby

- Rails
- Perl
- Java
- Python

Please list any others

10. What is the **primary** enterprise database environment currently being used by your department?
Select only one
- MySQL
- Microsoft SQL
- PostgreSQL
- Sybase
- IBM DB2
- Oracle
- Microsoft Access
- Filemaker Pro
- dBase
- No “In House” databases are used
- Other *(Please Specify)*

11. What other enterprise database environments are used by your department?
Select all that apply
- MySQL
- Microsoft SQL
- PostgreSQL
- Sybase
- IBM DB2
- Oracle
- Microsoft Access
- Filemaker Pro
- dBase

Please list any others

12. What is the **primary** enterprise email system currently being used by your department?
Select only one
- Lotus Domino
- Microsoft Exchange 2003
- Microsoft Exchange 2007
- Microsoft Exchange 2000
- Google Gmail
- SendMail
- Other *(Please Specify)*

General Open-source Questions

13. Does your department have any officially deployed OSS applications?
    - Yes
    - No

If you answered no to Question 13, please skip to Question 19

14. How long has OSS been used officially department wide.
    - Greater than 3 years
    - 1 to 3 years
    - 6 Months to 1 Year
    - Less than 6 Months
    - I am not sure the exact length, but at least:

15. Please list known OSS applications being used below, and briefly describe your overall satisfaction with them.

16. What is the **primary** way OSS applications are introduced to the department?
    Select only one
    - OSS applications are deployed to replace a proprietary application.
    - OSS applications are deployed to introduce new functionality and provide solutions that previous software did not have.
    - OSS applications are used *ad hoc* among individual users without official deployment.
    - Other *(Please Detail)*

17. If your department deployed an open-source application to replace a proprietary application, what are the most important reasons for the migration?
    *Select **up to 3** choices*
    - OSS provided a lower TCO than previous system
    - Maintenance was easier
    - Greater reliability
    - Greater security
    - Greater performance
    - More features/functionality
    - Needed to upgrade anyways
    - Have **not** deployed OSS to replace a proprietary application
    - Other *(please specify)*

18. If your department deployed OSS to provide new functionality that didn't exist in a previous system, what are the most important reasons for selecting the OSS over a proprietary solution?
    *Select **up to 3** choices*
    - OSS provided a lower TCO than proprietary counterpart.
    - Maintenance was easier
    - Greater reliability

- Greater security
- Greater performance
- More features/functionality
- No comparable proprietary software existed/reviewed
- Have **not** deployed OSS to provide new functionality
- Other *(please specify)*

Only answer question 19 if you answered **no** to Question 13.

19. What is the **primary** reason why your department has not implemented any open-source solutions?
Select only one
    - Legal constraints from Open-source licenses such as the case if the source code is modified, it must be released to the public.
    - Resistance from management to use OSS.
    - Migration costs from a proprietary application to the OSS counterpart.
    - Lack of external support for OSS
    - No lower Total Cost of Ownership for OSS applications.
    - Other *(Please Specify)*

20. Does your department have a policy regarding open-source software during software procurement? *For example, an open-source policy may include requirements to never consider open-source software or to always review a minimum number of open-source applications.*
    - Yes
    - No

21. Consider a software procurement in which two applications are being reviewed. One is an OSS application and the other is a proprietary or commercial application. Assume all aspects for both products are equal; the TCO, benefits and disadvantages are the same for both products. Which of the products would your department be more inclined to implement?
    - OSS
    - Proprietary Software

22. In your professional opinion, what are the major strengths and benefits of OSS compared to proprietary software?
*Select **up to 3** choices*
    - Lower TCO
    - Easier maintenance
    - Reliability
    - Security
    - Performance
    - Scalability
    - Support
    - Functionality and features
    - Other *(Please Specify)*

23. In your professional opinion, what are the major weaknesses and disadvantages of OSS compared to proprietary software?
*Select **up to 3** choices*
- Higher/Unproven TCO than proprietary software
- Harder maintenance
- Licensing and Legal Restrictions
- Reliability
- Lack of Support
- Security
- Performance
- Scalability
- Functionality and features
- Other *(Please Specify)*

24. Please feel free to include any additional information regarding findings on OSS that you think would benefit this study.

25. Would you like further information regarding this study?
- I would like to receive the results of this survey
- I would like to receive a copy of the final report.

Thank you.

John Semmens
Project Manager
Arizona Transportation Research Center
Arizona Department of Transportation
206 S. 17th Ave., MD 075R
Phoenix, AZ 85007
Ph. 602-712-3137
e-mail jsemmens@ADOT.gov

APPENDIX D: EXTERNAL AGENCY SURVEY REQUEST LETTER

To Whom It May Concern:
My name is Sean Coleman and I am conducting a study on the use of Open-source Software in transportation agencies on behalf of the Arizona Department of Transportation. You were listed as an appropriate technology contact to complete a survey regarding your agency's use of commercial and open-source software.

Before sending the survey, I wanted to verify that you would be an appropriate recipient and if so, let you decide the method to receive the survey. If you aren't an appropriate recipient for the survey, I appreciate any contact information for someone who you think would be a good fit. I also want to thank you in advance for taking the time to fill out the survey. Feel free to reply to this email with an 'X' next to the method in which to receive the survey.

__ Via Email/Online Form - (A hyperlink to the online survey will be sent via email)
__ Via Fax
__ Via USPS Mail
__ Via Phone - (I can schedule a time to administer the survey over the phone. The survey will take approximately 30 minutes)

If you have any questions, feel free to reply to this email or call me at (480) 603-8850.

Thank you,

Sean Coleman
Phone: (480) 603-8850
Email: sean.m.coleman@asu.edu

Please contact the project manager, Mr. John Semmens for authenticity verification if needed.

John Semmens
Project Manager
Arizona Transportation Research Center
Arizona Department of Transportation
206 S. 17th Ave., MD 075R
Phoenix, AZ 85007
Ph. 602-712-3137
E-mail jsemmens@ADOT.gov

APPENDIX E: EMAIL WITH ONLINE EXTERNAL AGENCY SURVEY

To Whom It May Concern:
As requested, I am sending the hyperlink to the online survey for the ADOT Open-source Software Study. The survey is comprised of 4 pages and takes approximately 30 minutes to complete. Some questions may require additional time in order to research the correct response. You cannot save your survey once you begin, but may start over at any time if you have not yet submitted the survey. I want to thank you in advance for your time and the ADOT appreciates your responses.
You may access the survey online at http://survey.opensourcestudy.com with any web browser. Alternatively you may go to http://www.surveymonkey.com/s.aspx?sm=AtwcNmHfmy3GwuTJwRrhLw_3d_3d if you have problems with the other hyperlink.
Since many questions may require additional research, you may download a printable PDF of the survey at http://www.opensourcestudy.com/print_survey.pdf for use as a guide. If you encounter any technical issues, please contact me (Sean Coleman) at sean.m.coleman@asu.edu or by phone (480) 603-8850.
Thank you,
Sean Coleman
Please contact the project manager, Mr. John Semmens for authenticity verification if needed.

John Semmens
Project Manager
Arizona Transportation Research Center
Arizona Department of Transportation
206 S. 17th Ave., MD 075R
Phoenix, AZ 85007
Ph. 602-712-3137
E-mail jsemmens@ADOT.gov

APPENDIX F: OPENOFFICE CHALLENGE™ DISCUSSION

- Microsoft Office 2007 was aesthetically pleasing; looked more like a Mac application.
- Microsoft Office 2007 was more useable.
- Participants debated between OpenOffice.org 3 and Microsoft Office 2007 icons and which were more confusing.
- Many participants thought OpenOffice.org 3 was easier to use because you know what to do in the application more so than Microsoft Office 2007.
- A majority of the participants found OpenOffice.org 3 more similar to Microsoft Office 2003 than Microsoft Office 2007.
- Importing data was very difficult in OpenOffice.org 3 because there was no built in import function; you must copy and paste the data.
- OpenOffice.org 3 was easier to implement the mail merge because it told you each step as you went through the process.
- If a company were to only use OpenOffice.org 3 or Microsoft 2007, there would be problems because people who save their documents in different versions cannot open them. The company must make sure different versions are compatible.
- Participants had great difficulty with conditional formatting in both OpenOffice.org 3 and Microsoft Office 2007.
- It's obvious that companies should take advantage of the free OpenOffice.org 3 software to save money in comparison to Microsoft Office 2007.

APPENDIX G: OPENOFFICE CHALLENGE™ INSTRUCTIONS

Thank you for participating in the OpenOffice Challenge™. The Arizona Department of Transportation is examining the use of Open-source Software as an alternative to commercial products. This pilot test consists of completing a series of tasks for two similar applications. The entire pilot test should take no longer than 90 minutes.
You will be given an instruction set of tasks to complete for each of the two applications. You will work through the tasks in the same instruction set for 30 minutes with each application. The instruction sets are much longer than the allotted 30 minutes; do not focus on completing the tasks. The goal of the pilot test is for you to use each product for a reasonable amount of time to gain a good feel for the product's usability. Please work through the tasks at your own pace; if you do not know how to complete a task, attempt it but move on to additional tasks if you are unable to complete it in a few minutes.
After you have worked through the tasks for 30 minutes, please stop the tasks and switch to the other application. You will then start the instruction set over with the remaining application completing the same tasks at your own pace for 30 minutes.

Assigned Instruction Set: **Instruction Set**
Assigned Starting Application: **Application**

Once you have finished the pilot test portion, please complete the online survey at: http://survey.opensourcestudy.com. Thank you gain for participating in this pilot test, your time is greatly appreciated.

WORD PROCESSING INSTRUCTION SET

1. Launch the application *Microsoft Word* or *OpenOffice.org.org Writer* located on the desktop. **Please start with the assigned application.**
2. Go to "File" then "Open" and open the file "*Word Processing – Document"* located in the folder named *Data* on the desktop.
3. Determine the number of words and pages in the document.
4. Replace all instances of "TCO" with "Total Cost of Ownership".
5. At the beginning of the document, before the introduction, create a numbered list of definitions using Roman numerals with the following items and sub items.

   TCO: Total Cost of Ownership
   OSS: Open-source Software
   COTS: Commercial Off-the-shelf Software
   - Generalized term for software that must be purchased.
   - Includes any form of proprietary software and source code.

   GNU: GNU's Not Unix
   - A recursive acronym for the open-source organization

   OSI: Open-source Initiative
6. In the first footnote, make the text *http://turingmachine.org/opensource/papers/lerner2002.pdf* a hyperlink and verify that the link works.
7. Find the block quote that starts with "This project, called GNU" and create an endnote reference with the following citation:

   Kenwood, Carolyn A. A Business Case Study of Open-source Software. MITRE. 2001.
8. Create a comment/note for the heading "Other Major OSS Projects" stating "This section will be divided into subsections with specific OSS projects."
9. Locate the paragraph that begins with "The Linux operating system is becoming a huge competitor to Microsoft Windows" and insert a table below the paragraph with four rows and two columns.
10. Add a 4pt blue border on the outside of the table and 1pt black borders on all inside borders.
11. In the first column, insert the values Windows, UNIX, Linux, and Solaris in each consecutive cell and change the font style to 14 pt bold.
12. In the second column, insert the values 25%, 30%, 15%, and 30% with right justification.
13. Go to page 4 and insert the image file *image.gif* located in the folder named *Data* below the heading "History of Open-source"

14. Open the file "*Word Processing – Data"* located in the folder named *Data* using Microsoft Excel.
15. Copy the cells with data and paste into the document below the picture.
16. Create a document header with your name left justified and a footer that has today's date left justified and the page number right justified.
17. Modify the document properties Title and Subject with text of your choice.
18. Save the document as *Document_Lastname_Firstname* (using your name) in the folder on the desktop named *Results*.
19. Close this document and create a new blank document.
20. Change the size to a #10 Envelope in landscape mode.
21. Create a mail merge using the "*Word Processing – Mail Merge"* spreadsheet located in the folder named *Data* as the recipient addresses. Insert a static return address using your name and address.
22. Finish the mail merge and save the document as *Mail_Merge_Lastname_Firstname* in the folder named *Results* located on the desktop.

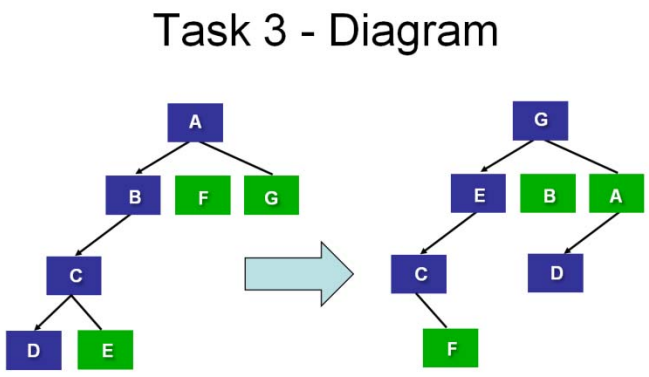
SPREADSHEET INSTRUCTION SET

1. Launch the application *Microsoft Excel* or *OpenOffice.org.org Calc* located on the desktop. **Please start with the assigned application.**
2. Go to "File" then "Open" and open the file "*Spreadsheet – Data"* located in the folder named *Data* on the desktop.
3. Change the top row to have the following properties:
    a. **Font:** Times New Roman, Bold
    b. **Fill Color:** Light Blue
    c. **Row Height:** 25
4. Change the cell G1 from "Total:" to "Average:"
5. Change the formula in the cell H1 to calculate the average instead of the sum of column B.
6. Create a column next to the "Price" column and name it "Sales Tax".
7. For each cell in the column (excluding the header), calculate the sales tax based on a 7% sales tax rate.
8. Make all cells in this column protected.
9. Create another column named "Total" next to "Sales Tax" and calculate the sum of the price and sales tax for each product.
10. Create a conditional format for the total column with the following properties:
    a. If price is less than $25, fill the cell in green.
    b. If price is within $25 and $100, color the text yellow.
    c. If price is greater than $100, fill the cell in red.
11. Change the "Price" and "Sales Tax" column to display currency with two decimal places.
12. Go to the "Items" sheet and sort the "Data" column in ascending order.
13. Create a calculated cell to determine the number of elements in the data column.
14. Create a calculated cell of the standard deviation of the data column.
15. Remove all duplicate values in the data column.
16. Return to the "Products" sheet and select cell H2 and make an absolute reference to the cell with the standard deviation in it from the "Items" sheet.
17. Copy the "Items" sheet to a new sheet labeled "Items – Copy".
18. Create a bar graph based on the prices and products (from the products sheet). Include a custom title, legend, and appropriate scale.
19. Create a new sheet named "Bar Graph" and move the graph to this sheet.
20. Save the spreadsheet as *Spreadsheet_Lastname_Firstname* in the folder on the desktop named *Results*.

PRESENTATION INSTRUCTION SET

1. Launch the application *Microsoft PowerPoint* or *OpenOffice.org.org Impress* located on the desktop. **Please start with the assigned application.**
2. Create a new blank presentation and save it as *Presentation_Lastname_Firstname* in the folder on the desktop named *Results*.
3. Select a template theme of your choice and apply it to the presentation.
4. Change the background to the image file *background.jpg* located in the folder named *Data* located on the desktop.
5. On the first slide create a title "Pilot Test Results" using the following properties:
    a. **Font:** Verdana, Bold
    b. **Size:** 24pt
6. Create three new blank slides after slide 1.
7. Go to slide 4 and create a bulleted list with these three lines:

    Literature Review
    External Government Agency Survey
    Pilot Test
8. Copy slide 4 and insert it before slide 2.
9. Go to slide 2, and create a 4x3 table. Fill in each cell with any text of your choice.
10. Change the formatting of the table to have a thick outer border and a thinner inner border around each cell.
11. Open the file "*Presentation – Data"* located in the folder named *Data* on the desktop using Microsoft Excel.
12. Copy the all the data into slide 2 below the table. Make sure both items do not overlap.
13. Go to slide 3 and draw the following diagram using the available drawing tools:



14. Insert the picture named *photo.jpg* located in the folder named *Data*, into a new slide.

15. Add a background shadow and white border to the photo.
16. Center and enlarge the photo to fill about 90% of the slide.
17. Create a header on each slide with your name and the respective slide number.
18. Change the background of the slides to a solid blue color.
19. Set the resolution of the presentation to 1024x768.
20. Create the following transitions between slides.
    a. **Slide 1 and 2:** Vertical Wipe, fast transition, on mouse click
    b. **Slide 2 and 3:** Dissolve, slow transition, Automatic
21. View the slide show and cycle through each slide to check transitions.
22. Save the presentation as *Presentation_Lastname_Firstname* in the folder named *Results* on the desktop.

DATABASE INSTRUCTION SET

1. Launch the application *Microsoft Access* or *OpenOffice.org.org Base* located on the desktop. **Please start with the assigned application.**

2. Create a new empty database.
3. Create the following tables with the respective fields listed below.
    a. Cars

        car_make – text
        car_model – text
        year – decimal
        category_id – int

    b. Categories

        category_id - int
        category_name – text
        category_description – text

    c. People

        person_id – int
        person_first_name – text
        person_last_name - text

4. Import the Microsoft Excel document named "*Database – Data,"* located in the folder *Data* on the desktop, into the database mapping the appropriate fields.
5. Add three new records/rows to the "cars" table with any data.
6. Create a one-to-many relationship between products and categories respectively based on the category _id.
7. Remove the "person_name" field in the People table and replace it with "person_first_name" and "person_last_name"
8. Create a query to return all cars with a year newer than 2005 and are either in the sedan, sports, or luxury car categories.
9. Export all the returned data to a spreadsheet and save the spreadsheet as *Database_Lastname_Firstname* in the folder *Results* located on the desktop.
10. Create a report with a table view based on the previously created query.
11. Create a form based on the cars table to allow for easy data entry of new cars and also includes a drop-down list of available categories to choose from.

APPENDIX H: OPENOFFICE CHALLENGE™ INDIVIDUALIZED RESULTS

1. Which instruction set did you work through?

Participant 1	**Database** - Microsoft Access and OpenOffice.org Base
Participant 2	**Spreadsheet** - Microsoft Excel and OpenOffice.org Calc
Participant 3	**Word Processing** - Microsoft Word and OpenOffice.org Writer
Participant 4	**Spreadsheet** - Microsoft Excel and OpenOffice.org Calc
Participant 5	**Word Processing** - Microsoft Word and OpenOffice.org Writer
Participant 6	**Presentation** - Microsoft PowerPoint and OpenOffice.org Impress
Participant 7	**Database** - Microsoft Access and OpenOffice.org Base
Participant 8	**Word Processing** - Microsoft Word and OpenOffice.org Writer
Participant 9	**Presentation** - Microsoft PowerPoint and OpenOffice.org Impress
Participant 10	**Database** - Microsoft Access and OpenOffice.org Base
Participant 11	**Database** - Microsoft Access and OpenOffice.org Base
Participant 12	**Word Processing** - Microsoft Word and OpenOffice.org Writer
Participant 13	**Word Processing** - Microsoft Word and OpenOffice.org Writer
Participant 14	**Presentation** - Microsoft PowerPoint and OpenOffice.org Impress

2. In which order did you use the applications?

	Order
Participant 1	First **OpenOffice.org**, then **Microsoft Office**
Participant 2	First **Microsoft Office**, then **OpenOffice.org**
Participant 3	First **OpenOffice.org**, then **Microsoft Office**
Participant 4	First **Microsoft Office**, then **OpenOffice.org**
Participant 5	First **OpenOffice.org**, then **Microsoft Office**
Participant 6	First **OpenOffice.org**, then **Microsoft Office**
Participant 7	First **Microsoft Office**, then **OpenOffice.org**
Participant 8	First **OpenOffice.org**, then **Microsoft Office**
Participant 9	First **Microsoft Office**, then **OpenOffice.org**
Participant 10	First **OpenOffice.org**, then **Microsoft Office**
Participant 11	First **Microsoft Office**, then **OpenOffice.org**
Participant 12	First **OpenOffice.org**, then **Microsoft Office**
Participant 13	First **Microsoft Office**, then **OpenOffice.org**
Participant 14	First **OpenOffice.org**, then **Microsoft Office**

3. Please rate your overall experience and knowledge of computer applications.
(1 - No Experience, 5 - Extensive Experience)

	Experience Level
Participant 1	4
Participant 2	4
Participant 3	2
Participant 4	3
Participant 5	2
Participant 6	4
Participant 7	5
Participant 8	5
Participant 9	4
Participant 10	5
Participant 11	5
Participant 12	4
Participant 13	3
Participant 14	3

4. Please rate your overall experience and skill level with Microsoft Office and OpenOffice.org.
(1 - No Experience, 5 - Extensive Experience)

	Microsoft Office	OpenOffice.org
Participant 1	4	2
Participant 2	4	1
Participant 3	2	1
Participant 4	1	1
Participant 5	3	2
Participant 6	5	1
Participant 7	4	4
Participant 8	5	5
Participant 9	4	2
Participant 10	4	4
Participant 11	3	3
Participant 12	4	4
Participant 13	4	1
Participant 14	3	1

5. What feature do you find most important in office applications?

	Usability Efficiency	Security	Speed/Performance	Reliability	Functionality	Other
Participant 1	X					
Participant 2	X					
Participant 3					X	
Participant 4	X					
Participant 5				X		
Participant 6					X	
Participant 7	X					
Participant 8	X					
Participant 9	X					
Participant 10	X					
Participant 11						Compatibility
Participant 12	X					
Participant 13	X					
Participant 14	X					

6. Please rate the ease of menu navigation with each application.
(1 - Very Difficult, 5 - Very Easy)

	Microsoft Office 2007	OpenOffice.org	Additional Comments
Participant 1	2	4	
Participant 2	2	4	
Participant 3	2	3	
Participant 4	3	2	
Participant 5	2	4	
Participant 6	4	4	
Participant 7	4	3	
Participant 8	2	4	I have hardly ever used Office 2007. If we were using 2003 I would have had a much easier time.
Participant 9	4	1	In Open Office it was very hard to try to select a background for all slides, which should be a pretty simple thing to do. It was also hard to select picture options of any type, background shadow- there is just not usability features for it. Also, both applications fail in trying to resize the large data set. not really sure why. Both applications make it hard to set inside/outside borders of the table. Apparently it's really easy to set both outside borders, but if you want to do inside, well then it will take some creative thought.
Participant 10	3	4	
Participant 11	2	2	Neither was all that intuitive
Participant 12	3	4	Open Office is much more similar to the version of Office I use at home (Microsoft Office XP) than Microsoft Office 2007, so it took me a while to get used to the menus. But in MSO, once I got used to the menus they made a lot of sense. I liked how they were organized somewhat intuitively.
Participant 13	4	2	never found out how to add page numbers on Open Office! Some functions just seemed hidden to me.
Participant 14	3	4	This might just be because I hate the setup of the new Powerpoint in Microsoft Office--I'm so used to drop down menus that it's hard to adjust.

7. Please rate the ease of learning features and functionality with each application.
(1 - Very Difficult, 5 - Very Easy)

	Microsoft Office 2007	OpenOffice.org	Additional Comments
Participant 1	2	4	
Participant 2	3	4	
Participant 3	4	4	
Participant 4	3	2	
Participant 5	1	4	
Participant 6	4	4	
Participant 7	4	4	
Participant 8	3	3	There are a ton of features. Normally I would google it.
Participant 9	4	2	
Participant 10	2	3	
Participant 11	3	3	I had to use OpenOffice.org's help files in order to figure out how to import data. However, I was unable to retain IDs when importing in Access.
Participant 12	5	5	
Participant 13	5	4	
Participant 14	4	4	

8. Please rate the efficiency of each application; i.e. how quickly were you able to accomplish tasks?

(1 - Not Efficient Whatsoever, 5 - Very Efficient)

	Microsoft Office 2007	OpenOffice.org	Additional Comments
Participant 1	2	3	
Participant 2	3	4	
Participant 3	4	4	While these are overall grades, I feel that the efficiency varied considerably between tasks on each application.
Participant 4	3	2	
Participant 5	3	4	
Participant 6	4	4	
Participant 7	4	4	
Participant 8	4	4	Both are efficient if you know what you are looking for and don't have to find it/figure it out.
Participant 9	4	2	
Participant 10	2	4	
Participant 11	3	2	
Participant 12	5	4	I had to look up how to do some things in the help file during the first session (Open Office for me), so it took me a bit longer, but overall it was easy and quick.
Participant 13	4	2	
Participant 14	4	4	Both were about equally efficient--I ran into snags equally.

9. Which application do you think is most comparable to Microsoft Office 2003?

	Microsoft Office 2007	OpenOffice.org	Additional Comments
Participant 1		X	
Participant 2		X	
Participant 3		X	
Participant 4	X		
Participant 5		X	
Participant 6	X		everything is mostly in the same places and uses the same symbols
Participant 7		X	
Participant 8		X	The change in menu style from 2003 to 2007 is large and can be confusing.
Participant 9		X	
Participant 10		X	
Participant 11		X	
Participant 12		X	As I said before, the menus were more similar in Open Office. I like the "new" style of 2007, but it would take some getting used to before I was as proficient with it as I am with Open Office and older versions of Microsoft Office.
Participant 13	X		
Participant 14		X	The new Microsoft Office is very different from the old Microsoft Office.

10. For the application you find most similar to Microsoft Office 2003, which aspect do you think is most similar?

	Ease of Use	Small Learning Curve	Functionality/Features	Navigation	Other (please specify)
Participant 1				X	
Participant 2				X	
Participant 3				X	
Participant 4			X		
Participant 5			X		
Participant 6			X		
Participant 7			X		
Participant 8			X		
Participant 9			X		
Participant 10				X	
Participant 11				X	
Participant 12				X	
Participant 13			X		
Participant 14				X	

11. Please rate what you expect your personal learning curve to be with each application.

(1 - Large Learning Curve, 5 - No Learning Curve)

	Microsoft Office 2007	OpenOffice.org
Participant 1	2	4
Participant 2	3	4
Participant 3	3	4
Participant 4	3	2
Participant 5	3	3
Participant 6	4	4
Participant 7	3	3
Participant 8	4	4
Participant 9	4	2
Participant 10	2	3
Participant 11	2	3
Participant 12	3	5
Participant 13	5	2
Participant 14	2	2

12. Please describe your overall experience with Microsoft Office 2007.

	Comments
Participant 1	The menus were extremely difficult to navigate. Had to resort to using the help feature multiple times in order to complete certain tasks.
Participant 2	It is difficult to navigate through the icons.
Participant 3	Very pleasant appearance but often difficult to find functions due to the navigation set-up. Keyboard and automatic shortcuts I managed to find were extremely handy.
Participant 4	Confusing but had good information in the help menu. Was difficult.
Participant 5	I did not like it very much. If I was simply writing a paper for a class it would have been simple to use, however, the creation of a box, among other slightly more complex functions was difficult.
Participant 6	It was pretty easy since I had used Microsoft Office before
Participant 7	Well over all the experience was pretty good, just had to get use to the user interface
Participant 8	I hate the new menu system. It does not seem as intuitive to me and there are more places to have to look to find items.
Participant 9	I really liked Microsoft PowerPoint presentation 2007. There was lots of awesome options like smart graphics for the charts. I struggled trying to create a hierarchical chart in Open Office.. Additionally important is that I started to like Office the more I got to discover all the cool features. I mean there few a few areas in Office where something simple could be confusing like the table borders, but I also found this confusing in Open Office
Participant 10	It was easier to find the different database views, but not much seemed to work how I wanted it to.
Participant 11	Glossy and error-free though sometimes wizards frustratingly limited options without explaining what was going on. Specifically, importing data. What was that?? Very confusing. Only had success importing to a new table then copy-pasting.
Participant 12	I really liked it. The interface is very user-friendly, and after getting used to the organization of the menus it was easy to navigate.
Participant 13	Pretty easy to find things though the style of the toolbars were different. Different look, but the tools were stored in the same places.
Participant 14	I hate the new way it's set up, but for all I know, after using it for a little, I could get to like it better.

13. Please describe your overall experience with OpenOffice.org.

	Comments
Participant 1	Similar to Office 2003 (the version of Office that I have used the most). Menus were not very difficult to navigate as well as finding certain functions.
Participant 2	The layout is very similar to Microsoft Office 2003.
Participant 3	Extremely easy to find functions, but occasionally difficult to control them efficiently. Not as pretty as Office, but every bit as functional.
Participant 4	Looked more like what I was used to, but could not find certain buttons/applications. Was difficult.
Participant 5	Open Office was very very similar to the old Microsoft Word that I am used too. It was easy to use and learning the different commands was simple and quick.
Participant 6	About the same as Office, but was a little difficult to get use to
Participant 7	There was a little difficult on some task like importing data is a pain. In addition the user interface is really basic
Participant 8	I like OpenOffice.org because its menu system is similar to 2003 which is what I am used to using.
Participant 9	I was pretty frustrated with Open Office. It made me so frustrated that I stopped about 5 minutes before completion at this activity. It just seems like some simple things I could not figure out how to do. Like change the background setting to blue. All the backgrounds were all like Open Office templates and crap. It was just very very frustrating
Participant 10	I couldn't find the relationships view, but everything else went pretty smoothly.
Participant 11	Received quite a few error messages but was able to work through all of them. Once I appeared to reach a weird state in which an edit to a table was not saved, but the design window was closed, and I could not add any more records to the table. Re-opening the edit table window and saving seemed to do the trick.
Participant 12	OpenOffice.org is very familiar to me, so I had no problems using it. It is very similar to the products I have been using for years now, so it was familiar.
Participant 13	I had an ok time with it - some things were easier, like the headers and footers - but I was kind of frustrated with finding functions because I'm used to Microsoft Office and had to re-create motor pathways because the functions were stored under different headings or you had to go through a totally different channel to get what you want.
Participant 14	The experience with OpenOffice.org was great. Very navigable.

14. Describe any frustrations or difficulties you had with using each pilot test application.

	Microsoft Office 2007	OpenOffice.org
Participant 1	Understanding placement of functions in the top section.	Importing an excel spreadsheet and moving it into the database.
Participant 2	It was difficult to find the icon that I wanted.	I could not figure out how to protect one column of data.
Participant 3	word count, adding borders to table	hyperlink, numbered list
Participant 4		Conditional Formatting easy, but putting the colors in was extremely hard.
Participant 5	I could not find what I wanted to do because of the redesigned tabs and menus.	Simple, Easy, Effective
Participant 6		Finding tools
Participant 7	one too many in the relationship, data importing could be better	one too many in the relationship, importing data is a pain
Participant 8	Navigating the menus	None.
Participant 9	setting table borders, and resizing data tables	setting background colors, table borders, resizing data tables, I GOT LESS INTERESTED
Participant 10	Complex display	Too many windows
Participant 11	Importing data. And the query designer. Not clear the grouping of “or” operator. Incorrect query at first.	Not sure why no results were returned from my query. Confident a bit more time and I would have figured it out.
Participant 12		The envelope formatting was kind of difficult
Participant 13	Weird to adjust to pictures, style of toolbar/menu	Hard to find where the function I wanted was. Had to go to help a couple times, and that worked. I would have probably gone back to help if time hadn’t been up, because I was having trouble even inserting page numbers! It seemed like you had to click around more to get what you want, but maybe that’s just because I’m relatively used to Microsoft Office.
Participant 14	You can’t even find the help button right away! And the menus are so confusing	It was difficult to draw the diagram, because I couldn’t find where the toolbar was--then I realized it was at the bottom of the screen.

15. Describe any features or functionality that you couldn't find in each office product.

	Microsoft Office 2007	OpenOffice.org
Participant 1	Certain relationship attributes (many to one) options.	No easy option to import external information into databases.
Participant 2	deleting duplicates	protecting a column of data and a formula to delete duplicates
Participant 3	word count, end notes,	
Participant 4		average/sum buttons. Had to create my own formula.
Participant 5		
Participant 6	slide transitions	none
Participant 7	not really	data importing beside copy and pasting which the help actually tell you to do
Participant 8	I couldn't find a graceful way to get the footer to have a left and right justified item on the same line.	I couldn't find a graceful way to get the footer to have a left and right justified item on the same line.
Participant 9	everything was there well table border	background colors, picture options like shadow
Participant 10	I think I found everything, but none of it worked	Relationships view
Participant 11	Import arbitrary columns of Excel data into existing tables	Interactive designer for conditions in the query designer
Participant 12	4 pt borders - only had 3 and 4.5pt.	
Participant 13	I got stuck on modifying the document properties, but I'm not sure what that means still - the thing at the top? Never found out how/what that was.	freakin' page numbers. The border thing was harder to find too.
Participant 14	My final presentation (with following the instructions) looked awful at the end of this.	

16. Please provide any additional comments you may have on the OpenOffice Challenge and pilot test applications.

	Comments
Participant 1	
Participant 2	
Participant 3	
Participant 4	Both were difficult. Spent more time on OpenOffice.org looking for things. Found what I was looking for on Microsoft, but spent more time figuring out how to use it.
Participant 5	Fun time.s
Participant 6	
Participant 7	
Participant 8	I used to use OpenOffice.org extensively before I purchased a copy of Word 2003 so I am very familiar with its features and where they are located in the menu system. I don't like the new menu system in Word 2007 but if I used it more I would probably be able to use it to the same level as 2003, I just don't want to take the time to use it right now.
Participant 9	Okay the bottom line here for me during this session, is that I was impressed by Office 2007 sets of features. The ribbon option at the top made it very easy to use and thus made me engaged and interested to finish the project. I got very disinterested on Open Office and then became frustrated and consequently gave up. It just does not compare at all.
Participant 10	I think my learning curve for OpenOffice.org would be less then for Office 2007, because of my knowledge of Office 2003 and almost all of other computer applications.
Participant 11	OO.o could use some more UI polish, including avoiding error messages by doing things automatically or suggesting an appropriate course of action. And hey, does OO.o input/export a superset of formats supported by Office? Wicked.
Participant 12	
Participant 13	I liked the Microsoft Office better, overall. It was more fun, and prettier. The Open Office seemed like something I could get used to, but it wasn't pretty and seemed more difficult.
Participant 14	I think OpenOffice.org and Microsoft Office are very similar--they both have strengths and weaknesses, but since OpenOffice.org is free, it's a no-brainer that companies should be using it instead of paying for Microsoft Office, which isn't any better or worse, really.

APPENDIX I: OPENOFFICE CHALLENGE™ SUMMARIZED RESULTS

1. Which instruction set did you work through?

	Response Percent	Response Count
Word Processing - Microsoft Word and OpenOffice.org Writer	**35.7%**	**5**
Spreadsheet - Microsoft Excel and OpenOffice.org Calc	**14.3%**	**2**
Presentation - Microsoft PowerPoint and OpenOffice.org Impress	**21.4%**	**3**
Database - Microsoft Access and OpenOffice.org Base	**28.6%**	**4**

2. In which order did you use the applications?

	Response Percent	Response Count
First Microsoft Office, then OpenOffice.org	**42.9%**	**6**
First OpenOffice.org, then Microsoft Office	**57.1%**	**8**

3. Please rate your overall experience and knowledge of computer applications.

	No Experience				*Extensive Experience*	
	1	**2**	**3**	**4**	**5**	**Rating Average**
Experience Level	0	2	3	5	4	**3.79**

4. Please rate your overall experience and skill level with Microsoft Office and OpenOffice.org.

	No Experience				*Extensive Experience*	
	1	**2**	**3**	**4**	**5**	**Rating Average**
Microsoft Office	1	1	3	7	2	**3.57**
OpenOffice.org	6	3	1	2	1	**2.15**

5. What feature do you find most important in office applications?

	Response Percent	Response Count
Usability/Efficiency	**71.4%**	**10**
Security	**0.0%**	**0**
Speed/Performance	**0.0%**	**0**
Reliability	**7.1%**	**1**
Functionality	**14.3%**	**2**
Other (please specify)	**7.1%**	**1**

6. Please rate the ease of menu navigation with each application.

	Very Difficult				*Very Easy*	
	1	**2**	**3**	**4**	**5**	**Rating Average**
Microsoft Office 2007	0	6	4	4	0	**2.86**
OpenOffice.org	1	3	2	8	0	**3.21**

7. Please rate the ease of learning features and functionality with each application.

	Very Difficult				*Very Easy*	
	1	**2**	**3**	**4**	**5**	**Rating Average**
Microsoft Office 2007	1	2	4	5	2	**3.36**
OpenOffice.org	0	2	3	8	1	**3.57**

8. Please rate the efficiency of each application; i.e. how quickly were you able to accomplish tasks?

	Not Efficient Whatsoever				*Very Efficient*	
	1	**2**	**3**	**4**	**5**	**Rating Average**
Microsoft Office 2007	0	2	4	7	1	**3.50**
OpenOffice.org	0	4	1	9	0	**3.36**

9. Which application do you think is most comparable to Microsoft Office 2003?

	Response Percent	Response Count
Microsoft Office 2007	**21.4%**	**3**
OpenOffice.org	**78.6%**	**11**

10. For the application you find most similar to Microsoft Office 2003, which aspect do you think is most similar?

	Response Percent	Response Count
Ease of Use	**0.0%**	**0**
Small Learning Curve	**0.0%**	**0**
Functionality/Features	**50.0%**	**7**
Navigation	**50.0%**	**7**
Other (please specify)	**0.0%**	**0**

11. Please rate what you expect your personal learning curve to be with each application.

	Large Learning Curve				*No Learning Curve*	
	1	**2**	**3**	**4**	**5**	**Rating Average**
Microsoft Office 2007	0	4	6	3	1	**3.07**
OpenOffice.org	0	4	4	5	1	**3.21**

APPENDIX J: WILCOXON SIGNED-RANK TEST TABLE

Wilcoxon Signed-Rank Test Critical Values Table	
alpha = 0.05 for one-tail analysis	
alpha = 0.10 for two-tail analysis	
TL	**TU**
2	19
4	24
6	30
8	37
11	44
14	52
17	61
21	70
26	79
30	90
36	100
41	112
47	124
54	136
60	150
68	163
75	178
83	193
92	208
101	224
110	241
120	258
130	276
141	294
152	313

Source:
http://*business.fullerton.edu/isds/zgoldstein/361b/Extensions/Wilcoxon/Wilcoxon%20signed%20rank.doc*

APPENDIX K: OPENOFFICE CHALLENGE™ EXIT SURVEY

Thank you for participating in the OpenOffice Challenge. The Arizona Department of Transportation (ADOT) is examining the use of Open-source Software as an alternative to commercial products. This exit survey is designed to gain an understanding of the usability of OpenOffice.org and Microsoft Office 2007 as well as gain insight to the opinions of Microsoft Office users. Please take the next 10-15 minutes to complete the brief series of questions.

1. **Please enter your contact information.**
2. **Which describes you best?**

   College Student
   Work Full Time
   Retired
   Other
3. **Which instruction set did you work through?**

   Word Processing - Microsoft Word and OpenOffice.org Writer
   Spreadsheet - Microsoft Excel and OpenOffice.org Calc
   Presentation - Microsoft PowerPoint and OpenOffice.org Impress
   Database - Microsoft Access and OpenOffice.org Base
4. **In which order did you use the applications?**

   First Microsoft Office, then OpenOffice.org
   First OpenOffice.org, then Microsoft Office
5. **Please rate your overall experience and knowledge of computer applications.**

No Experience				**Extensive Experience**
1	2	3	4	5

6. **Please rate your overall experience and skill level with Microsoft Office and OpenOffice.org.**

	No Experience				**Extensive Experience**
	1	2	3	4	5
Microsoft Office					
OpenOffice.org					

7. What feature do you find most important in office applications?

Usability/Efficiency
Security
Speed/Performance
Reliability
Functionality
Other (please specify)

8. Please rate the ease of menu navigation with each application.

	Very Difficult				**Very Easy**
	1	2	3	4	5
Microsoft Office 2007					
OpenOffice.org					

Additional Comments:

9. Please rate the ease of learning features and functionality with each application.

	Very Difficult				**Very Easy**
	1	2	3	4	5
Microsoft Office 2007					
OpenOffice.org					

Additional Comments:

10. Please rate the efficiency of each application; i.e. how quickly were you able to accomplish tasks?

	Not Efficient Whatsoever				**Very Efficient**
	1	2	3	4	5
Microsoft Office 2007					
OpenOffice.org					

Additional Comments:

11. Which application do you think is most comparable to Microsoft Office 2003?

Microsoft Office 2007
OpenOffice.org
Additional Comments:

12. For the question above, which aspect do you find most similar?

Ease of Use
Small Learning Curve
Functionality/Features
Navigation
Other (please specify)

13. Please rate what you expect your personal learning curve to be with each application.

	Large Learning Curve				**No Learning Curve**
	1	2	3	4	5
Microsoft Office 2007					
OpenOffice.org					

Additional Comments:

14. Please describe your overall experience with Microsoft Office 2007.

15. Please describe your overall experience with OpenOffice.org.

16. Describe any frustrations or difficulties you had with using each pilot test application.

Microsoft Office 2007:
OpenOffice.org 2007:

17. Describe any features or functionality that you couldn't find in each office product.

Microsoft Office 2007:
OpenOffice.org 2007:

18. Please provide any additional comments you may have on the OpenOffice Challenge and pilot test applications.

APPENDIX L: MICROSOFT LICENSING QUESTIONNAIRE

The following information was provided on February, 9 2009 by Bianka Lee, an ADOT employee knowledgeable in client-side Microsoft licensing for the department. The questions are in regard to Microsoft licensing contracts with ADOT.
All Microsoft licensing questions refer only to desktop/workstation software contracts; please exclude server software licensing.

1. **What is the typical fiscal year (or longer duration) for Microsoft licensing contracts?**
   3 years

2. **What is the duration and expiration date of the current Microsoft licensing contract?**
   Start Date: August, 1 2008
   End Date: July 31, 2011

3. **Are there any other applications typically included in the Microsoft licensing plan other than Windows and Office software?**
   We add server software products that support our email, such as Exchange Client and Exchange Server, We also purchase SQL Cal, and for our software programmers we include Visual Studio with MSDN

4. **Please give a description of how costs are determined for licensing plans (outside of software choice)?**
   We work closely with a contracted third party and directly with our MS reps if needed. Microsoft Enterprise Subscription Agreement is a software volume licensing program designed for corporate customers, with 250 or more desktops, who prefer to subscribe to — rather than purchase — Microsoft software licenses. We have the ability to standardize the enterprise by licensing Microsoft Enterprise products (Microsoft Office Professional, Microsoft Windows® Professional Upgrade, and Core Client Access License) at discounted prices. Additional products available under subscription offer a broad selection including Visio, Project, Windows servers and Exchange servers.

5. **How does the number of users/employees affect cost, i.e. are there ranges for the number of users that determine cost, or is the plan simply dependent on the total number of users?**
   Numbers are a major factor determining discount costs for our agency. The Enterprise Agreement (EA) provides us a way to acquire the latest Microsoft technology, standardize IT across the enterprise, simplify license management and get maintenance benefits. EA supports organizations with 250 or more desktops. With Enterprise, you get lower total cost of ownership, annual payments over the three-year term and improved workplace productivity by standardizing on Microsoft software. And with Software Assurance, you get eligibility for the latest upgrades, deployment support and training for all enrolled products.

6. **Please give a description of the current Microsoft licensing plan:**
   State agencies with a minimum of 250 desktops that wish to license 100% of their qualified desktops for a three-year period can initiate a subscription. Non-perpetual software use rights provide temporary use of software with an option to buy out software licenses for permanent use rights. An annual PC count enables an organization to shape software license acquisition needs around fluctuations in the enterprise. Annual payments for the three-year enrollment term keep budgeting predictable, with a renewal option of one or three years they are both part of the licensing plan but you can order according to what is needed.

7. **Does the current licensing plan umbrella over both Windows and Office, or are they handled as separate licensing plans?**
   Supports both.

8. **Which Office applications are included in the current licensing plan for general users?**
   Word, Excel, Power Point, Access, One Note

9. **If there are any Office applications not included in the licensing plan in general, how is licensing handled when they are needed?**
   There [is] a per instance licensing charge for situations where non-standard application such as [Microsoft] Project is needed.

10. **Which versions are covered in the current licensing plan for each application?**
    Windows – XP, Vista and/or current
    Office – 2003 and 2007 or current

11. **How does the current licensing plan handle multiple versions of the same software? *e.g. if Windows 2000 and XP are both deployed across the department.***
    Our agency just completed an agency-wide upgrade to Windows XP. We have the ability to upgrade to Vista any time. Same with Office 2003, [it] is our current standard, but [we] have moved some to Office 2007. It is whatever is supported by our technical staff.

12. **What is the additional cost (if any) for including multiple versions of the same software?**
    Our contracted price is quoted.

13. **Include any other significant details about the licensing plan that may be useful for the study.**
    By adding Software Assurance, you get automatic access to software upgrades plus tools, training and support to help your organization deploy and use software efficiently.

14. **Does the current Microsoft licensing plan include Office 2007?**
    Yes

15. If so, what is the cost (if any) of having this in addition to Office 2003?
No cost.

16. If so, are there any restrictions for deploying Office 2007, *i.e. any limit to the number of users who may use it?*
The limit is determined on the contracted quantity set by our agency. If we end up with more desktops, than we need to do a trueup[76] and that can be done at any time, or beginning of each fiscal year. We cannot reduce the number of original contract until the contract expires.

17. If not, what is the plan (if any) to add Office 2007 to the current of future licensing plans?
We may use terminal services and have server process the application. PCs are too old to upgrade.

18. How many ADOT users does the current Microsoft licensing plan cover, or if there isn't a limit how many ADOT users were estimated to be covered under the licensing plan?
Current plan covers 5500 desktops.

[76] A true-up, in the context of Microsoft licensing, is a census of computer hardware and software used to determine the difference in the number licenses that are supported by an Enterprise Agreement (EA) and the number of licenses that are actually being used. At this point in time, the EA is realigned to match the number of actively used licenses.

APPENDIX M: ADOT ANNUAL MICROSOFT LICENSING COSTS

The following information was provided on February, 9 2009 by Bianka Lee, an ADOT employee knowledgeable in client-side Microsoft licensing for the department. The data are in regard to Microsoft licensing contracts with ADOT.

Renewal Quote	**Cost**	**Quantity**	**Total**
Office Pro SA	$81.97	5000	$409,850.00
Windows Vista OS SA	$32.13	5000	$160,650.00
Exchange Std Cal SA	$10.75	5000	$53,750.00
Windows Std Cal SA	$4.66	5000	$23,300.00
Exchange Ent Edit Cal SA w/Srvs Device SA	$14.98	5000	$74,900.00
SQL Cal SA	$24.62	5000	$123,100.00
Line of Business Machine Licenses			
Windows Vista OS SA only	$32.13	300	$9,639.00
Windows Vista OS Upgrade and Software Assurance	$48.58	200	$9,716.00
Windows Std Cal SA only	$4.66	300	$1,398.00
Windows Std Cal License and SA	$32.72	200	$6,544.00
SQL Cal SA Only	$24.62	300	$7,386.00
SQL Cal License and SA	$51.59	200	$10,318.00
Windows Trmnl Svcs Cal SA	$12.90	300	$3,870.00
Windows Std Srv SA	$116.54	303	$35,311.62
Windows DataCenter Srv SA	$386.39	20	$7,727.80
Windows ENT Srv SA	$378.75	16	$6,060.00
Exchange Std Srv SA	$112.24	39	$4,377.36
Exchange Ent Srv SA	$642.63	11	$7,068.93

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