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Open-source Software: Adoption and Challenges

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Abstract

Adopting open-source software (OSS) can help reduce the cost of personal computers for individuals as well as the cost of information technology infrastructure for companies. Many studies corroborated the superiority of Linux (open-source operating system) when compared to Windows. Linux, or any other open-source software, offers robustness, flexibility on top of a homogeneous solution and a support from a huge community.

The purpose of this paper is to study the adoption open source software, mainly Linux. The discussion will encompass the growth of the open source community, the horizons, and the obstacles.

The study also aims to cover the feasibility of the adoption of the open-source software at a Research and Development environment, where reducing the cost of the information technology infrastructure opens doors for more scalability and increase in performance.

Keywords: - Open source software, Linux, Distributions, Microsoft.

I. Introduction

Since the dawn of the personal computers era in the late eighties, there has been a need to make computers more affordable for students around the world and a goal to reduce the cost of the information technology infrastructure on a wider scope. The price of computers involves hardware that is becoming more affordable on day to day basis, operating systems and software. The cost is also affected by other factors like computers' life span, which is relatively short, and the cyclic software depreciation and what it involves in time and resources in upgrading when vendors decide to stop supporting their earlier versions of software.

The main operating systems used for workstations and servers are Microsoft Windows and Linux. Microsoft is the main player with the multitude of products they are offering; also as they are the initiators of the first personal computer operating system (DOS then Windows) and the dominance of their office suite and the presence of their products in most facets of information technology.

On the other hand, there has been a surge in the adoption's ratio of open source software in Europe and by government agencies in the United States, as for example, the case of Linux

distributions which allow customizing the code to even build your own distribution and have full control on the security of the system.

Linux which derived from UNIX come with many distributions mainly Debian, Ubuntu, CentOS, Red Hat, Fedora, Gentoo, SUSE, and Open SUSE. There has been many more distributions that have been elaborated with the emergence of the Raspberry Pi¹. Novell and Red Hat offer SUSE and Red Hat, enterprise versions of Linux where you could get support for their version of Linux for a fee. As a multi-use multi-task operating system, Linux could be used for servers as well as for desktops.

Also, as Microsoft adopted windows 8 to be used on phones and tablets, Ubuntu came up with M-Ubuntu for mobile phones².

II. Open source software adoption

Since we could download OSS for free from the internet, and we could modify as we wish as long as we refer correctly to the initial developer, open source software adoption's business case could be considered as an easy sell. Nowadays, most companies are interested in staying competitive and aim to reduce their TCO (Total Cost of Ownership) by eliminating the software licenses' cost and in some cases avoiding the penalties in case of the illegal use of the proprietary software, will find plausible alternative in adopting OSS. Nonetheless, there will certainly be other costs involved when adopting open source software³ mainly because of the lack of a centralized support, and the cost involved in migrating to a new platform.

Several studies corroborated the technical advantages in using Linux versus Windows. Bloor Research demonstrated in a study the prevalence of Linux when compared to Windows NT⁴.

Open source leaders have for long cherished that the adoption of OSS means outstanding reliability. There are many advantages in the adoption, mainly as it allows many passionate developers to work simultaneously on the same project and even extend it. The other main advantage is that you have many people who use the software and test it for bugs⁵.

August 2001 Netcraft conducted a study and found out that 92% of the top 50 most requested sites with the longest uptimes have platforms that are based on Apache⁶ (OSS run on web servers).

The author Ajila and Wu (2007) study concluded that software organizations that are implementing in a systematic way the reuse of the OSS components will be able to achieve outstanding economic benefits in product quality and in assuring a better productivity in developing software. Their study conclude the open source community is setting 'good practices' as OSS components are of highest quality⁷.

As for Krishnamurthy (2005) who states that OSS is no longer for hobbyists. In contrary, it is becoming more a business strategy that could be broadly applied. They viewed the OSS is bright. And they predicted at that time that OSS a larger place in all our lives and will occupy a leading position in the software's realm⁸.

A. Robustness

The author Neumann (1999) went in defining the term robust as pertaining to the following: meaningful security, reliability, availability, and system survivability⁹.

As for Krishnamurthy (2005) as the diversity of the OSS community will allow for the products to be tested into different environment leading to solidify the robustness of the product⁸.

The author Mustonen (2003) went into defining the term copy-left as granting the copyright to the original programmer¹⁰.

We also have to take into consideration that the adoption of OSS results into more reliable systems Ghosh (1998) added to studies that have demonstrated the superiority of Linux when compared to Windows⁵.

Also, Comino, Manenti, and Parisi (2007) have emphasized that the strengths also come from the below traits marking the Open Source Community¹¹:

- Massive programming expertise.
- No cost for Research and development as it is assured by volunteers.
- The leadership structure is accepted by all involved.
- The OSS release rate is quicker than the proprietary software.
- The debugging is assured in parallel of the development.
- OSS code is known to be mature (Linux is based on Unix, and Unix is the first multi-Users, multi-tasks Network Operating System that was elaborated in 1969).
- Culture of sharing and giving back to the community.
- Long term accessibility.

Robustness also results from volunteers' collaboration. Traditional project management and software is known to have many flaws, the OSS development's results are mostly claimed to with superior quality when compared to the proprietary software. Due to the fact that there are "many eyeballs" developing and testing, it is claimed that the turnaround for OSS development is way faster than the traditional way. Since OSS developers only work in the fields that they are passionate about, the code is written with care and there is a lot of creativity involved in the process¹².

Even though there are no empirical studies bearing their claims, OSS proponents often state that their software is superior at many levels especially in quality, the level of support as well as insuring the homogeneity of the solutions¹².

B. Growth

Nowadays a vast and growing body of open source software (OSS) project data is publicly on the internet. Despite this public body of project data, the field of software analytics has not yet settled on a solid quantitative base for basic properties such as code size, growth, team size, activity, and project failure. Monthly code growth is obtained by calculating the absolute difference in lines of code to the previous month (if any)¹³.

According to Varian and Shapiro (2003) the US Department of Defense and the National Security Agency (NSA) have adopted Linux in their platforms. The NSA has developed a “Security Enhanced Linux” and made it available for users who require a significant level of security on their website. Many reports depicted successful adoption of Linux in the US cities and states¹⁴. Oss appears to be widely adopted in Europe. The FLOSS Report conducted a survey, in Germany, Sweden and the UK, on 1,452 public institutions and private companies. They found out that 27 percent are already using OSS or are planning to take that path in the near future. In Germany, about 44% of those who responded to the survey are already adopting OSS or planning to use it. Another survey on smaller scope on European information technology managers of 66 public sectors revealed that 63% of those who responded OSS in their operations. Around the world, there are dozens of countries that are seriously considering adopting OSS.

In France and Spain, the government institutions are very active in adopting open source software. In 2008, France’s Gendarmerie converted all of its 70,000 desktop computers to Ubuntu.

It has been adopted by other government institutions in France who are using open source software, the Directorate for the Official Gazettes, converted all its workstations (600 at the time) to Open Office instead of Microsoft Office, Ubuntu is being used by 577 members of the parliament in France, as well as the Paris city council members who are also embracing OSS.

Seven autonomous regions in Spain are actively engaged in developing their distribution of Linux (Linex). It has been installed more than 70,000 computers which are being used by 200,000 students¹⁵.

The Federal Aviation Administration has previously placed real-time runway information online on their website. The Web server runs Apache on Red Hat Linux. Part of the software is written in Perl¹⁶.

III. Horizons and Obstacles of OSS

A. Horizons

Bitzer (2004) emphasized the difference between OSS and proprietary software as a competition in the heterogeneity. They define OSS as a public product and property. On an individual level, the developer will consider joining the OSS community if the benefits that will gain will justify their efforts. Nonetheless, there is a temptation of the “free-ride” and to wait for others to develop the software¹⁷.

Licensing is the main difference in classifying a project as part of the OSS. The licenses will dictate in details what could or could not be done with the software, as well with the software’s source code and the work that will derive from it, defining the way it could be used and the rules concerning intellectual property¹⁸

The author Bitzer and Schröder (2005) determined that since the time spent in developing comes from volunteers making time horizons finite¹⁹. And so did the author Bitzer, Schrettl, and Schröder (2007) build on the same idea to characterize an individual that will benefit the public’s good²⁰.

On the other hand, Bessen (2006) inquired about the limits of effective proprietary provision based on why firms contribute to OSS development²¹.

We also have to take into consideration the heterogeneity in competition discussed by Bitzer (2004) as well how the license will regulate what can be done with the software and what cannot introduced^{17, 22}.

The authors Bouras et al. (2014) stated that OSS is more and more getting in a strategic position within the knowledge economy²³.

Steinmacher, Graciotto Silva, Gerosa, and Redmiles (2015) studied the newcomer behavior and came up with four different classes, the study considered the interaction of the new comers with the core members and how the resulting interactions will grow, then reported that “ the new comers who join at the individual level, will react differently following separate growth patterns. Their research suggested a certain heterogeneity in their socialization trajectories²⁴.

B. Obstacles

Some of the biggest obstacles associated with OSS include the fact that there is no centralized support due to ‘open’ ownership, compatibility issues with skills and tasks and poor documentation. As OSS is not ‘owned’ by a software provider who can provide support and training, users frequently have to source support from multiple channels, re-train IT staff, and change related applications after OSS adoption²⁵.

The authors Gallego, Luna, and Bueno (2008) conducted a study on the factors of success along with the obstacles in diffusing fully adopting solutions and platforms based on OSS²⁶.

On the other hand Marsan and Paré (2013) went into defining the main obstacles to OSS growth is people's ignorance²⁷.

Drury, Conboy, and Power (2012) went into defining the obstacles that are faced while making decisions in an agile development environment as critical and not well understood²⁸.

The authors Steinmacher et al. (2015) emphasized on how newcomers have difficulties in setting up their environment²⁴.

As for Immonen and Palviainen (2007) brought the case that the software integrators will not be able to guaranty the quality of each component²⁹.

Added to the obstacles mentioned above, one of the early attempts to bring suit to restrict free software occurred when The SCO Group, which owns the UNIX operating system trademark, sued IBM, claiming that IBM was trying to destroy the value of UNIX (licensed from SCO) by its increased use of Linux¹⁶. SCO filed for bankruptcy and the ruling was to drop charges. This resulted in the OSS community becoming even stronger by having pro bono lawyers joining the cause³⁰.

IV. Linux vs Windows

As of 2006, Microsoft started finding out that their dominance in the operating systems for personal computers as well as in networking is being challenged by the increasing adoption of Linux. In 2005, Linux had only 3% of desktop operating system worldwide, however its share of the server market was 20%³¹, and it did not stop growing since then.

Figure 1 shows a shift from Microsoft as a single vendor dominating the desktop market to Apple (whose operating system Mac OS is based on UNIX) Google and Linux starting 2005 (according to IDC, Goldman Sachs Research).

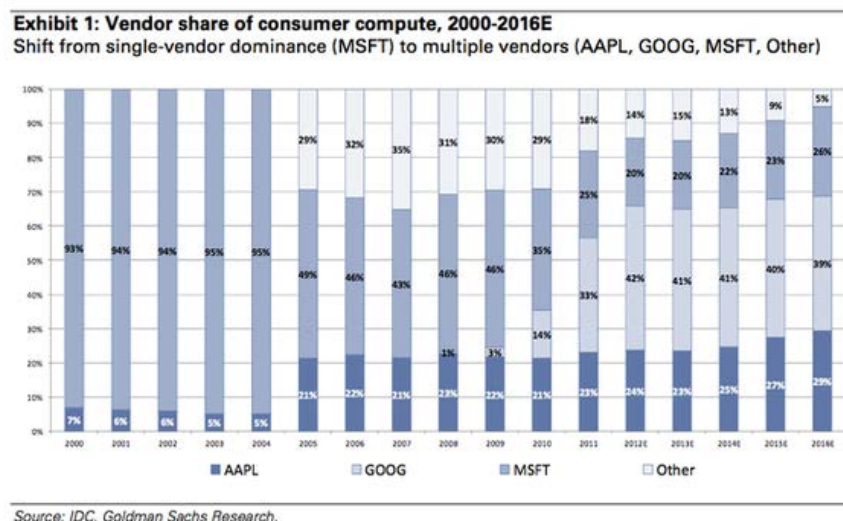


Figure 2: Vendor Share of Consumer Computers

Over the last two decades, Linux started gaining a good share of the Supercomputer Operating System market according to top500.org.

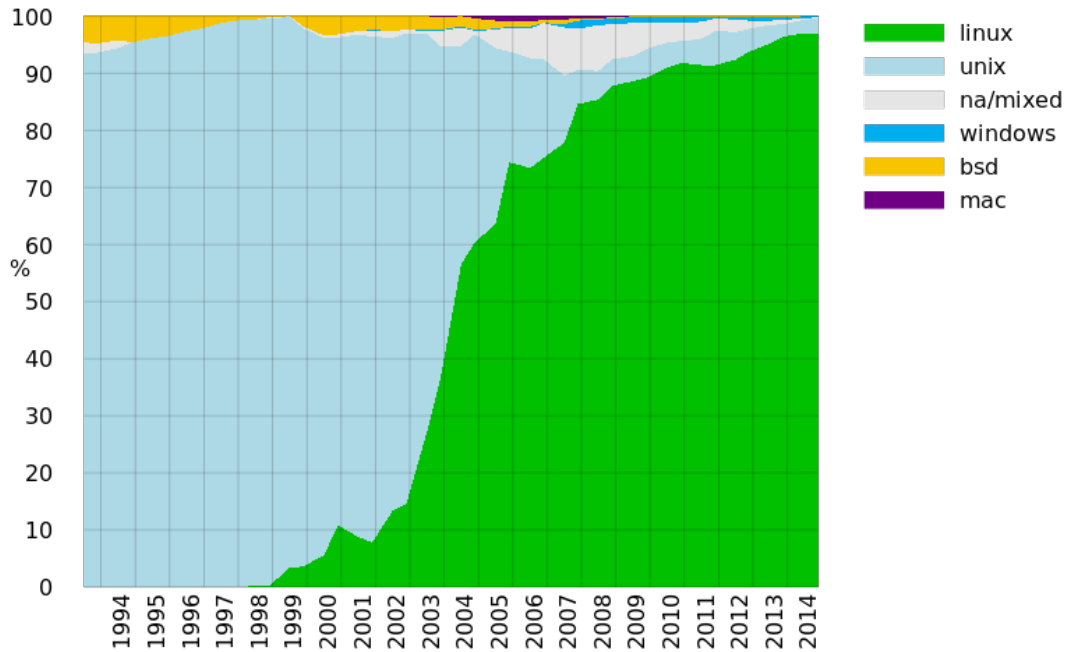


Figure2: Supercomputer OS family - 1994-2014 systems share

V. Conclusion – OSS adoption in R&D environment

Many companies nowadays opt on eliminating R&D from their structure and just pay for elaborated innovations as they emerge in the market. The OSS adoption in R&D environment results allowing scalability in their infrastructure growth and allowing a faster processing of the data and an overall increase of performance in their systems.

OSS adoption optimizes the total cost of (TCO) as the software is free and even if we opt for the enterprise version, it is always cheaper than any proprietary software which licensing is generally per host added to expensive security add-ons and tools. On the other hand, OSS developers test their software on universal hardware (vendor independent) which is generally less expensive hardware, leading to a better TCO and return on investment (ROI).

Linux systems were designated from start to be multi-users, where access to administrative privileges is limited to root or administrator user; which keeps the system modular and protected and thus less susceptible to malware and viruses. Hence, as all Linux configuration changes

could be implemented while the system is running with no effect on unrelated tasks and services, Linux based systems are known to be more stable, and do not require as many security updates nor to reboot the system frequently as for the case of Windows,.

Last and not least, comes the homogeneity of the solution since we could build a complete information technology infrastructure as there are elaborated OSS for operating systems, database management, mail servers, mail servers, high availability, and system monitoring. There are some tools like RRD tools and Net-SNMP that allow for companies to customize their monitoring systems. On the other hand, the use of UNIX - Linux programming (bash and Perl) allows to easily contribute to the homogeneity of the infrastructure through scripting and customize its proactive evolution in parallel of the company's projected growth.

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