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# OPEN SOURCE SOFTWARE FOR ECONOMICALLY DEVELOPING COUNTRIES: A FREE IT SOLUTION FOR SUCCESS?

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## Abstract

*The cost of licensing proprietary or Closed Source Software (CSS) can be prohibitively high for Economically Developing Countries (EDCs). In contrast, Open Source Software (OSS), which is free of charge, is often touted as a panacea for bridging the digital divide between EDCs and industrialized nations. This paper reviews the literature to identify determinant factors for OSS adoption in industrialized nations and identifies OSS adoption differences between EDCs and industrialized nations using three case studies from Ethiopia. The paper concludes that while the OSS movement holds potential for EDCs, the determinant factors for its adoption are different from those in industrialized nations; if the potential of OSS is to be realized for EDCs, further study is needed to understand the full extent of these differences.*

**Keywords:** Open Source Software, Free Software, Economically Developing Countries, Closed Source Software

## Introduction

Licensing proprietary software, e.g. Microsoft Windows operating system or Microsoft Office, is prohibitively expensive for Economically Developing Countries (EDCs). One clear indicator is the meager Gross Domestic Product (GDP) per capita in EDCs; a software cost can be equal to several months of a person's salary or, in many cases, more than the annual salary of an individual in an EDC (Ghosh, 2003). In contrast, Open Source Software (OSS), such as the Linux operating system, OpenOffice.Org, Apache HTTP web server, and PHP web programming language, has no associated license fee. Many national policy makers recognize these cost-effective features, and tout OSS as a potential solution for bridging the digital divide between EDCs and industrialized nations (van Reijswoud & Topi, 2003; Wright, 2006). One may be led to believe that EDCs would adopt OSS in large numbers. In fact, as Wright noted, while some EDCs such as South Africa and Namibia are employing positive discrimination policies in favor of OSS, adoption across EDCs is not yet widespread; a view supported by our case studies from Ethiopia, in which we observed resistance to OSS adoption.

Research on Open Source Software has gained momentum over the past several years as commercial interest in the use of these software solutions has increased (Feller & Fitzgerald, 2000; Jin, Robey, & Boudreau, 2007; Koch & Schneider, 2002). The term "Open Source" itself has been the topic of debate among researchers since there does not seem to be a universally accepted definition (Wang & Wang, 2001); it should be noted however, that it is distinct from "Freeware Software" (Johnson-Eilola, 2007). According to Feller and Fitzgerald (2000), "Open Source Software is software released under a license conforming to the Open Source Definition (OSD), as articulated by the Open Source Initiative"; this definition will be adopted for the purposes of the paper.

Traditional ways of explaining IT adoption are insufficient to understand the case of OSS diffusion (Miralles, Sieber, and Valor, 2006). Our research efforts lead us to identify key context-specific factors that hamper the adoption of OSS in EDCs. We evaluate OSS adoption trend in industrialized nations and draw comparison to EDCs. We propose further study to our understanding in this area.

## OSS Adoption in Industrialized Nations

To understand the diffusion of OSS into EDCs, it is imperative to first investigate OSS adoption issues in industrialized nations. Miralles, Sieber, and Valor (2006) identified seven factors influencing OSS adoption, which

include: technological risk reduction, cost, technological aspects, supplier's brand name, and end user interest. This paper groups these factors, and others identified in the literature, into five major categories to summarize the main factors contributing to widespread adoption of OSS: (1) voluntarism, (2) software ecosystems, (3) security concerns, (4) technical support, and (5) government policies. Figure 1 depicts these five key environment/contextual factors unique to OSS adoption in industrialized countries.

### ***Voluntarism***

Since its inception in 1995, Apache has controlled 60% of the web server market, (two times larger than Microsoft's IIS share (Langley, 2007)). Apache Software Foundation (ASF) is the major force behind the continuously successful enrollment of new features to fine-tune Apache web server. Programmers participating in ASF and other software developing communities have been driven by the "nobility" of making a substantial impact among peers, and in the software community, void of financial interests (Glass, 2004).

The nearly monopoly nature of some CSS products (e.g. Microsoft's operating system) have limited the number of alternative applications available to software developers and users. The psychological resistance of developers and users to the limited freedom of choice has triggered the growing acceptance of OSS (Kavanagh, 2004). For its part, the OSS community has been promoting resistance to CSS among developers and users (Knowles and Lin, 2004). The "nobility" and resistance among the OSS community is also driven by higher levels of psychological needs, as identified in Maslow's (1943) Hierarchy of Needs Theory, i.e., love/belonging, esteem and/or self-actualization. These elements are voluntary and non-monetary motivators that sustain the continuous growth of OSS communities.

### ***Software Ecosystem***

Microsoft's success lies on its capability of building a dominant platform, the operating system, upon which other compatible applications are built. The OSS alternative is gaining traction into the software market because of its successful attempts in constructing a competing dominant platform (e.g. Linux), as well as intra- (with OSS) and inter-compatible applications (with CSS). OSS-based ecosystems are currently being formed to compete directly with CSS-based ecosystems, e.g., MySQL vs. Oracle and OpenOffice vs. MS Office (Lacy, 2005). Even Microsoft's deeply discounted "Education Versions" can hardly stop price-sensitive users from adopting OSS. Commercial users are attracted towards OSS because of widespread availability of OSS applications (Haddad, 2006). Major e-commerce players like Google have unveiled OSS applications, such as word processor, spreadsheet and operating systems. Meanwhile, Sun Microsystems has joined Oracle and Microsoft to barricade the entrenching efforts of OSS communities (Mullins, 2007), while some companies, e.g. IBM, are utilizing both platforms to minimize risk because the emerging software ecosystem in the OSS community is too great to ignore.

### ***Security Concerns***

The flexibility of modifying OSS source code has enticed active participation from volunteer programmers. However, the convenience of having source code released to the public has posed grave security concerns to many inexperienced and commercial users. Hoepman and Jacobs (2007) argue that although CSS appears to have short-term security advantages, in the long-term OSS will have greater security control.

### ***Technical Support***

Authors agree that lack of reliable technical support is one of the major inhibitors for OSS mass adoption (Brown, 2002; Goode, 2005; Miralles, Sieber and Valor, 2006). Without real-time presence of commercial training and support, most businesses are reluctant to welcome mass adoption of OSS (Morejon, 2007).

Nevertheless, OSS application developers are rapidly extending their success to commercial software. OSS applications like customer relationship management (CRM) and collaboration and content management systems are posing threats to many CSS solution providers. OSS users are no longer ignored as some CSS vendors have begun providing technical support (Goldsborough, 2006) for OSS compatible with their products. For example, Oracle is offering Linux patching to its clients (Saran, 2006) and Microsoft is providing Linux support for Microsoft Virtual Server users.

A growing number of training companies and CSS vendors have begun recognizing the importance of OSS. CompTIA, a vendor-neutral certification provider, is currently offering the CompTIA Linux+ certificate. Furthermore, CSS vendors have begun forming online communities, such as Microsoft's Port 25 (<http://port25.technet.com>), to address OSS technical support issues. Eventually, these efforts can increase the number of qualified OSS developers, thereby enhancing technical support for OSS.

## Government Policies

Comino and Manenti (2005) identify three ways government policies may impact the adoption of OSS: (1) mandated adoption, (2) information provision, and (3) subsidies. In industrialized nations, mandated and subsidized use of OSS is rare: governments predominantly leverage information provision to help promote the use of OSS by uninformed consumers. While there is a growing demand and interest in OSS, for many, their needs are unmet due to lack of government support (Valimaki, Oksanen, & Laine, 2005).

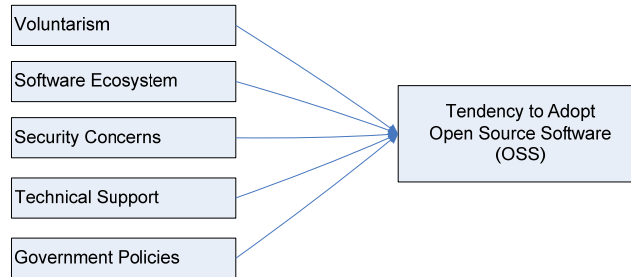


Figure 1. Determinants of OSS Adoption in Industrialized Countries

## Environmental/Contextual Factors Unique to OSS Adoption in EDCs

OSS brings many potential benefits to business communities, such as easier innovation, collaboration and communication. Nevertheless, its adoption has been limited, even in industrialized nations, because it is generally written for use by IT specialists and there is no incentive to make it easier to use (Brown, 2002). EDCs are faced with operational and infrastructure challenges in their attempts to benefit from IT. In contrast the challenges faced by industrialized nations are organizational, i.e. how to use IT to help compete in the international markets (Ives and Jarvenpaa, 1991).

Michael Porter's (1990) National Diamond Model asserts that the competitiveness of a country depends on four contextual factors: factor conditions, demand conditions, related and supporting industry, and firm strategy, structure and rivalry. This model has convincingly explained the success and failure of business activities in a country. All these factors are still primitive in most EDCs. This reality has contributed to the slow adoption of many business activities in EDCs. This study is primarily interested in understanding the factors that are hampering the slow adoption of OSS in EDCs. OSS adoption in EDCs is still in the early phase of the IT adoption curve. We have not seen the use of OSS for intra-industry competition in EDCs.

## Research Methodology

A multiple-case design with embedded units was employed to investigate OSS adoption issues in EDCs. This approach is used to allow examination of OSS adoption in real life context of the relationship between key determinants and OSS adoption decision (Yin 1994); and it provided the ability to answer "how" and "why" questions (Eisenhardt, 1989) for the OSS adoption process. To meet this goal, a protocol to collect qualitative and quantitative data was established and followed. This study primarily used interviews and questionnaires to help describe, understand, and explain the OSS adoption processes of librarians and users in Ethiopia.

## Data Collection

We conducted three case studies over a three year period between January 2004 and January 2007. The case studies were conducted in Ethiopia, an EDC with ambitious goals to utilize Information and Communications Technology (ICT). In his 2005 speech the Prime Minister of Ethiopia, Meles Zenawi, stated that "we are too poor NOT to invest in ICT". Suffice it to say that Ethiopia, one of the EDCs, is aggressively pursuing the implementation of ICT. The three case studies we conducted include: an OSS library system, "Koha", implementation at the J.F. Kennedy Library at Addis Ababa University (AAU); an OSS library system, "Koha", implementation at Addis Ababa Central library (the main public library of Addis Ababa City), and an OSS operating system, Linux, installation for 1200 computers distributed to private schools.

### *Case 1: Koha--Linux OSS library system at J.F. Kennedy Library at AAU*

A joint library system implementation between J.F.K Library, Bethany Memorial Foundation<sup>1</sup> (Bethany), AAU

<sup>1</sup> <http://BethanyMemorial.org>

students, and Kennesaw State University (KSU) students was initiated in January 2004. The project was overseen by an advisory group consisting of three library science professionals one each from Kennesaw State University, Pacific Union College in California, and Addis Ababa University. After a six month evaluation of different library systems, an open source library system called Koha, <http://koha.org/>, was selected. The student team from KSU and AAU worked jointly to develop the system. The pilot test was completed in October 2004 and implementation, with a timeline to complete in six months, commenced in November 2004. The implementation project is still ongoing: while much progress has been made in the project, two years later the project is still far from completion. The OSS project faced repeated delays due to shortage of OSS skill sets.

### ***Case 2: Koha--Linux OSS library system at Addis Ababa City Central Library***

The Addis Ababa City Central Library serves over 500 patrons per day. The library administration, in collaboration with Bethany, took an initiative to modernize the library services with a computerized library system in March 2004. To form synergy with Addis Ababa University the same open source library system adopted at AAU, Koha, was selected for the city library. After 18 months of failed attempts to implement the Linux version of Koha, the implementation team switched the operating system platform to a Windows. Within two months of changing the operating system from Linux to Windows, the pilot phase of the city library was successfully completed. Lack of ease-of-use was the primary reason for the OSS resistance by the public library technicians.

### ***Case 3: Linux OSS operating system for 1200 Personal Computers at Private Schools***

Bethany imported 1200 Personal Computers (PCs), in three shipments of 400 computers each, between April 2004 and January 2007. The computers were purchased in the United States and consist of brand name computers: Dell, Compaq, HP, and IBM. The contractual agreement between Bethany and the Ethiopian schools purchasing the computers clearly stated that the PCs will be loaded with an OSS operating system, Linux, and an OSS office application suite, OpenOffice. A full day introductory training on the Linux operating system and OpenOffice suite was conducted by Bethany technicians for all recipient schools; at least three technicians from each school were trained in using and maintaining the OSS system. Immediately after taking possession of the PCs, however, the schools installed a proprietary operating system, Windows, and a proprietary office suite, Microsoft Office Suite. The OSS project faced resistance by the schools due to enterprise standard platform and curriculum offered at the schools.

The lessons learned and recommendations from the three case studies on OSS adoption are discussed in the next section.

## **Discussion and Propositions**

OSS is seen as a solution for the economically strapped user and, even more so, for the economically strapped country, i.e. EDC (van Reijswoud & Topi, 2003; Wright, 2006). Combined with low cost, its tendency to lag behind hardware innovation (van Reijswoud & Topi, 2003) makes it a logical choice in EDCs where, in recent years, low-end computers have proliferated (Witten, et al., 2002). Based on our case studies we observed four factors for tendency to adopt OSS in EDCs: reward/compensation, local competency, piracy, and intellectual property laws.

*Reward/Compensation:* Financial reward is not the primary motivator for many of the developers engaged in OSS development (Berlecon Research GmbH, 2002). As discussed in the previous section voluntarism rides high in industrialized nations. Many OSS developers are from industrial nations and contribute to the OSS community for non-financial reasons including intellectual stimulation. Our case study analysis of this factor indicates that developers in EDCs are not financially independent and seek financial compensation for their work; hence they gravitate to proprietary software development where more employment exists.

*Local ICT Competency:* The OSS community has made efforts to create more user-friendly software and more people in EDCs are said to hold good or deep knowledge of computers than ever before (Wright, 2006). Nevertheless, OSS still lacks sophisticated administrative tools and it is widely acknowledged that its installation and ongoing maintenance requires more technical knowledge than commonly used proprietary systems (Cervone, 2003; Ghosh, 2003; Wright, 2006). The OSS movement is a community based movement with developers around the globe providing support and reciprocal skills development (Cervone, 2003; Ghosh, 2003). This model assumes, and relies upon, the existence of a robust infrastructure to maintain global collaboration. EDCs, however, are short in robust infrastructure (Cervone, 2003; Witten et al, 2002). In Ethiopia for example, home Internet access is far from reality even in the capital city, not to mention the large rural community.

*Piracy:* In many EDCs piracy is rampant. Our case study analysis indicates that developers gravitate towards proprietary systems when piracy is prevalent. Moreover, as Heeks (1999) points out, as a short-term strategy, software piracy can aid distribution of ICT in EDCs, providing a platform for learning and making ICT accessible

because cost is no longer an issue. Case 2: Koha--Linux OSS library system at Addis Ababa City Central Library supports this proposition. By installing Koha on a Windows operating system, implementation has been achieved and users now have a platform for learning the library system without being burdened with learning and maintaining an unfamiliar operating system, i.e. Linux.

*Intellectual property laws:* Once users at Addis Ababa City Central Library are familiar with the library system software, it can be re-implemented using Linux; a necessary step, as piracy is seen as a barrier to foreign investment (Heeks, 1999). Microsoft opened its development office in Egypt after the company reached agreement with its government to sign tighter intellectual property rules into law (Ghosh, 2003; Heeks, 1999). In a country where intellectual property laws are not enforced the Total Cost of Ownership (TCO) of CSS is not appreciated. EDCs in many cases do not have strong intellectual property laws.

## Future Direction

Not all the OSS adoption factors shown in Figure 1 apply to EDCs. Based on our case studies the issues in EDCs are different. Some of the differences include:

*Voluntarism:* voluntarism is a big factor in facilitating OSS development in industrialized nations. However, issues of reward/compensation observed in our case study pose a different challenge for EDCs.

*Software ecosystem:* complementary software applications that create software ecosystems benefit both industrial nations and EDCs. Industrialized nations have a large CSS installed base to consider. In contrast, EDCs may benefit from the absence of legacy systems.

*Security concerns:* security concerns apply to both industrialized nations and EDCs. Industrialized nations may be more sensitive on this issue because of larger data set already dependent on computer systems.

*Technical support:* technical support is a challenge for both groups. The specific concerns, however, differ between the two. Lack of infrastructure in EDCs exacerbates their case.

*Government policies:* the role of government between the two groups differs significantly. Mandated adoption and subsidies are applied differently in EDCs than in industrialized nations.

Our evaluation of these factors reveals sufficient differences in OSS adoption between industrialized nations and EDCs.

## Conclusions

The OSS movement has a lot of potential for EDCs, and may present an opportunity to bridge the digital divide but it certainly is not “A Free IT Solution for Success”. In Ethiopia like several other EDCs many of the ICT projects are paid for by the government; therefore policy makers need to consider the future potential of OSS and layout strategies to include OSS in their ICT arsenals. As discussed in Case 2, it is often onerous to implement a new enterprise application using unfamiliar OSS platform. Nevertheless, once users are familiar with the application the organization needs to acquire licenses for the proprietary systems or switch to an OSS. Non-adopters were more likely to be influenced by information cascading, while “high-users” and the “willing” were more likely to be influenced by end-user interest in OSS (Miralles, Sieber, and Valor, 2006).

O’Reilly (1999) posits that OSS adoption represents a “global trend towards networked collaboration” (p.35); this assumes that globally people have access to “network” of collaborators. What we find in the literature is that OSS is a community and user adoption is influenced by access to this community. As evidenced by the digital divide EDCs have limited access to the global network, hence we argue determinant factors for adoption of OSS in industrialized nations are different from EDCs. This paper has identified several factors that distinguish OSS adoption in EDCs from industrialized nations. If the potential of OSS is to be realized for EDCs, further study is needed to understand the full extent of these differences.

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