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OPEN SOURCE SOFTWARE ADOPTION: DIFFERENCES BETWEEN DEVELOPED AND DEVELOPING ECONOMIES

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Abstract

Open Source Software (OSS) holds a great promise to bridge the digital divide. Nevertheless, OSS adoption frameworks for developing economies do not parallel the frameworks from developed economies. This paper reviews the literature to identify determinant factors for OSS adoptions in developed economies. Three case studies from Ethiopia were used to answer the research question whether OSS adoption differences exist between developed and developing economies. The Ethiopian cases are used to identify some OSS adoption differences in developing economies. Further study to understand the differences is recommended.

Keywords: Open Source Software, Open Source, Free Software, Developing Economies, Economically Developing Countries, Closed Source Software, Proprietary Software, IT Adoption

Introduction

Free Open Source Software (OSS) alone does not guarantee successful adoption in developing economies (Negash, et al., 2007); “Free isn’t enough” (Babcock, 2007). Unlike proprietary or Closed Source Software (CSS) like Microsoft Windows operating system or Microsoft Office, OSS such as the Linux operating system, OpenOffice.Org, Apache HTTP web server, and PHP web programming language do not have associated license fees. Many national policy makers recognize these cost-effective features, and tout OSS as a potential solution for bridging the digital divide between developed and developing economies (van Reijswoud & Topi, 2003; Wright, 2006). One may be led to believe that developing economies would adopt OSS in large numbers. In fact, as Wright (2006) noted, while some developing economies such as South Africa and Namibia are employing positive discrimination policies in favor of OSS, adoption across developing economies is not yet widespread; a view supported by our case studies from Ethiopia, in which we observed resistance to OSS adoption. Ethiopia does not have a national policy for promoting OSS.

This paper uses the general term developed and developing economies as opposed to developed and developing countries often cited in the literature, where the western world is depicted as developed country. A country’s development includes culture, morality, and other norms; there are certainly many world cultures that existed before the western world. The application of these terms is focused on economic development; for this reason we chose to use the terms developed and developing economies in this paper. When we refer to the country in general we use the term economically developing country (EDC).

“There are 139,834 open source projects under way on Sourceforge, the popular open source hosting site. Five years from now, only a handful of those project will be remembered for making lasting contributions—most will remain in niches, unnoticed by the rest of the world” (Babcock, 2007, p 38). Should developing economies delay their evaluation of OSS until developed economies sort out the winners and losers?

Recent studies have proposed OSS adoption frameworks (West and Dedrick, 2006; Miralles, Sieber, and Valor, 2006). OSS adoptions are impacted by factors other than the typical incumbent software advantages: network effects and switching costs (West and Dedrick, 2006). Traditional ways of explaining IT adoption are insufficient to understand the case of OSS diffusion (Miralles, Sieber, and Valor, 2006). We evaluate OSS adoption frameworks and trends in developed economies and draw comparison to developing economies using three case studies from Ethiopia. We propose further study to our understanding in this area.

Literature Review

Research on OSS 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 is adopted for the purposes of this paper.

In their framework, West and Dedrick (2006) defined “standard adoption”, the dependent variable, as the likelihood that the new standard will be adopted for a given task. They identified three theoretical constructs (relative advantage, switching costs, and network effects) that influence “standard adoption” directly and a fourth construct (internal standardization) that moderates “standard adoption”. Two additional moderators (timing of deployment and scope of deployment) were included. Their qualitative study of 14 organizations showed that relative advantage has a positive influence on standard adoption while switching costs and network effects induce negative effects. The constructs are summarized in Table 1.

Table 1. OSS adoption constructs from West and Dedrick (2006)

Construct	Definition
Relative advantage	The degree that the new standard has an advantage relative to the incumbent standard(s) in use, as perceived by users: cost, performance, reliability, and fit to task
Switching costs	The costs that would have to be borne to switch to a new standard: new training for users, new training for IT staff, buying new software licenses, porting custom applications, and changing work processes
Internal standardization	The extent to which the organization attempts to use the same platform standard for all uses throughout an organization
Network effects	The relative advantage of the incumbent standard over the new standard, as results from the number of others using each standard, and the availability of external complements for each standard.
Timing of deployment	The degree to which the timing of deploying a new system reduces switching costs: new use or replacing an obsolete hardware/software
Scope of deployment	The extent to which a technology deployment impacts the organization and interacts with complements: technology type (I, II, or III), general vs. special purpose use, new use vs. switching, and degree of internal standardization.
Standard adoption	The likelihood that the new standard will be adopted for a given task.

Miralles, Sieber, and Valor (2006) identified eight factors in their framework: cost, technological capabilities, lock-in, organizational capabilities, network externalities, informational cascading, reputation of IT managers, and user community effects. They used qualitative methods to evaluate 11 case studies of national and multinational companies. They introduced two new factors that are not considered in the literature: user community effects and social responsibility. A brief description of the eight factors they identified is shown in Table 2.

Table 2. OSS Adoption Factors from Miralles, Sieber, and Valor (2006)

Factor	Definition
Cost	Total Cost of Ownership (TCO) that includes initial purchase of hardware and software, licensing, and ongoing technical support.
Technological attributes	Technology characteristics including reliability, performance, scalability, security, and brand name.
Lock-in	The degree the adopter is constrained by existing technologies: long term agreements with the suppliers, refusal of the workforce to learn new software applications, portability, and brand image.
Organizational capabilities	The capability of the organization to adopt the new standard: learning burden on adopters, irreversibility of the investment, and risk avoidance (diversifying the IT portfolio to hedge against a single platform risk)
Network externalities	The presence of organizational factors external to the IT adoption but has impacts on the adoption: availability of complements and skills of existing IT workers
Informational cascading	The behavior of decision makers when they are subject to bounded rationality and observe the decisions made by their peers without full knowledge of the reasons why these observed decisions were made: reputational herding (observation of decision of peer groups), information overload, and existence of conflicting data.
Reputation of IT Managers	The impact of the adopted system on the IT manager: career, incentive incompatibility, and agency theory (decision makers act based on individual objects instead of the overall best interest of the organization).
User community effects	User driven pressures due to the community effect of the developer community.

There is overlap between the frameworks presented by West and Dedrick (2006) and Miralles, Sieber, and Valor (2006). In addition Babcock (2007) identified nine criteria for identifying winner OSS applications, see Table 3.

Table 3. How to spot successful open source project (Babcock, 2007)

Factor	Definition
A thriving community	A handful of lead developers, a large body of contributors, and a substantial—or at least motivated—user group offering ideas.
Disruptive goals	Does something notably better than commercial code. Free isn't enough.
A benevolent dictator	Leader who can inspire and guide developers, asking the right questions and letting only the right code in.
Transparency	Decisions are made openly, with threads of discussion, active mailing list, and negative and positive comments aired.
Civility	Strong forums policy against personal attacks or niggling issues, focus on big goals.
Documentation	Documentation
Employed developers	The key developers need to work on it full time.
A clear license	Some are very business friendly, others clear as mud.
Commercial support	Companies need more than e-mail support from volunteers. Is there a solid company employing people you can call?

Additional OSS factors were also identified in the literature including government policies and adoption approach.

Government policy: 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 developed economies, mandated and subsidized use of OSS is rare; governments predominantly leverage information provision to help promote the use of OSS by uninformed consumers (Comino and Manenti, 2005). 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).

Adoption approaches: three classifications of technology diffusion adoption approaches were identified by Rogers (1995) and Carr (1999): directional, micro vs. macro, and push vs. pull. Directional approach can be either top-down or bottom up. Top-down, a technology that is adopted by the organization as a whole and cascades down to the business units; bottom-up, where the technology garners support from individual adopters or business units and moves up the organization structure. Micro approach is where the adoption begins at the individual level; macro approaches start at the government level. Push approach refers to technology diffusion where a technical focus is driving the diffusion; in a pull approach the focus is on adopters.

Research Design

Methodology

To investigate the impact of technology diffusion in developing economies a long-term assessment is necessary (Ruth, 2000). Action research purports significant job involvement by researchers and proposes that anyone who seeks to understand learning within an organization must become rooted in the organization and must come to know it as its members know it (Sacks, 1994). Unlike other research methods, action research rests in an interpretive philosophical framework (Susman and Evered 1978), and embodies a process that closes the gap between researchers and practitioners.

Greenwood and Levin (2000) argued that action research creates valid knowledge, theoretical development, and social improvements that the conventional sciences have promised to achieve in the research community. Action research, through collaboration, aims to contribute to research and to the practical concerns of people in problematic situations (Rapoport, 1970) and develops self-help competencies for people facing problems (Susman and Evered, 1978).

A case study is an empirical inquiry that investigates a phenomenon within its real-life context, especially when the boundaries between the phenomenon and context are not clearly evident (Yin, 1994). While case studies are mostly interested in what has happened in the organization, action research aims to resolve problems (Lambright, 2001). Action research is a research methodology that aims at producing new knowledge that contributes practical solutions to immediate problems and to general knowledge (Elden and Chisholm, 1993). One of the authors served as a facilitator for the first case study and as a coordinator for the second and third case studies and had responsibility to meet the desired goals. Therefore action research as a case study methodology is considered appropriate for the current study.

Case studies

We conducted three case studies over a three year period between January 2004 and January 2007. The case studies were conducted in Ethiopia, a nation 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, an economically developing country, is aggressively pursuing the implementation of ICT. The three case studies we conducted include: an OSS library system, “Koha”, implementation at a large public university; an OSS library system, “Koha”, implementation at a city library; and an OSS operating system, Linux, and office suite, OpenOffice, installation for 1200 computers distributed to private schools.

Case 1: Koha-- OSS library system at a large public university in Ethiopia

A joint library system implementation between the Addis Ababa University, a consulting group, and Kennesaw State University, was initiated in January 2004. Five students from each university participated in the project. Student enrollment at Addis Ababa University and Kennesaw State University are 30,000 (approximate) and 20,000, respectively. The library at Addis Ababa University has been in operation since 1963. The project was overseen by an advisory group consisting of three library science professionals one from Ethiopia and two from the U.S. After a six month evaluation of different library systems, an open source library system called Koha, <http://koha.org/>, was selected. The team selected Linux, an OSS platform, for its operating system. The student team from the U.S. and Ethiopia 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, departure of the IT director, and budget allocations for the project shifted from the IT department to the library.

Case 2: Koha—OSS library system for a city library in Ethiopia

The city library under consideration serves over 500 patrons per day. The library administration in collaboration with the consulting group took an initiative to modernize the library services with a computerized library system in March 2004. The City library currently uses a card catalog, and conforms to the Dewey cataloging system. With the

intent to create a national standard the public library selected to adopt the same library system and operating system, Koha and Linux, respectively, as the public university identified in Case 1. After 18 months of failed attempts to implement on a Linux platform, the implementation team switched the operating system platform to MS Windows 2003. 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: OSS operating system and office suite for 1200 PCs at Private Schools in Ethiopia

An organization 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 include a mix of brand name computers: Dell, Compaq, HP, and IBM. The contractual agreement between the importing organization and the purchasing schools 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 the importing organization, all recipient schools participated on the training; at least three technicians from each school were trained in using and maintaining Linux and OpenOffice. Immediately after taking possession of the PCs, however, the schools replaced the OSS implementation by 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 the need to follow existing curriculum offered at the schools.

Discussion

West and Dedrick (2006) identified two system level moderators: scope of deployment and timing of deployment. The first moderator, scope of deployment, is described using Swanson’s (1994) three types of information technology innovations: Type I, Type II, and Type III. Type I innovations are restricted to Information Systems (IS) tasks and mainly affect the IS unit; Type II innovations support administration of the business and affect the broader organization; and Type III innovations involve the core technology of the business and affect both the organization and its customers and other external partners. All three cases considered in this paper are Type III technologies; implementation of the selected technology affected both the organization and its customers and other external partners.

Adoption of the OSS system in Case—1, the university library, impacted all levels of the library functions including: patron access, management, inventory, procurement, and cataloging. Customers (library patrons), partners (other libraries and book suppliers), and the organization (staff and management) were impacted by the proposed OSS adoption. The impact of the OSS adoption for Case—2, city library, is similar to Case—1. OSS adoption for school personal computers, Case—3, impacted everyone involved: students, teachers, and partners. Therefore all three adoptions were Type III innovations; the OSS adoption is for general use as opposed to a specific use where the adoption impact is limited.

The second moderator, timing of deployment, focuses on whether the adoption is for a new use, switching from an existing system, or whether it is prompted by a retirement or obsolescence of an existing system. All three cases in this study are for new use, there were no prior applications that needed to be replaced. To the contrary, in Case—3, the OSS for personal computers, the schools had to uninstall the OSS application to install a CSS.

Level	H	High users	Specialized
	M	Case—2	Willing
	L	Case—1	Non-adopters
		H	L
		Openness	

Figure 1: Level of usage and perceived openness towards OSS

Miralles, Sieber, and Valor (2006) classified their case studies in a 2x2 “Openness—Level” framework. The openness dimension depicts the organization’s perceived openness towards OSS; the level dimension depicts the organization’s OSS level of usage. Figure 1 depicts the three cases using the “Openness—Level” framework (Miralles, Sieber, and Valor, 2006).

The decision makers at the university library, Case—1, are open minded to OSS. They had evaluated several CSS systems before selecting the OSS system. The project manager and implementation team are enthusiastic about their OSS choice; as early adopters, many of them viewed their OSS adoption as setting standard for other university and public libraries. Level of OSS usage is minimal at the university library. There are no other OSS implementations and after two years of implementation work the OSS adoption is still in a pilot phase. A year into the implementation, the IT director, who championed the project, left the university; this has caused a serious disruption to the OSS adoption time line, but the effort is still active. This places Case—1 in the bottom left corner of the “Willing” quadrant.

The decision makers at the city library, Case—2, are open minded to OSS. There was significant IT staff resistance with Linux, the OSS operating system. The team eventually changed the operating system to Windows 2003 and completed the OSS application installation. The level of usage is limited. As depicted in Fig. 1, Case—2 is placed between “Willing” and “High users” dimensions.

Decision makers at the schools, Case—3, declined to try out the OSS platform for the personal computers. Their biggest resistance was student/staff training and support. They opted for the familiar MS Windows application suit and operating system; hence classified as “non-adopters”.

Revisiting our research question factors that did not apply to developing economies include switching costs, internal standardization, lock-in, and user community influence. Factors that were shared by developing economies include cost, technology capabilities, network externalities, information cascading, government policies, and adoption approaches. Due to space constraints only a few of these differences are discussed in the following section. We draw from our case studies to highlight some differences in adopting OSS in developing economies:

Switching costs: Complementary software applications benefit both developed and developing economies. Should they decide to adopt OSS, developed economies have to replace their large CSS installed base. The lack of large installed base reduces the switching costs for developing economies, hence an advantage for developing economies if they choose to adopt OSS.

Information cascading: ICT adoption is fairly new in developing economies, not to mention OSS adoption. In Ethiopia, for example, successful OSS implementations are rare. As decision makers search for local exemplars, decision of peer groups plays a significant role. The city library’s decision to defer application selection to the university library follows what Kauffman and Li (2003) called “reputational herding”.

User community effects: User communities were found to have a positive effect on the adoption of OSS at a university (Miralles, Sieber, and Valor, 2006). In the university library we evaluated a user community for OSS did not exist; hence it did not affect the OSS adoption decision.

Government policies: Comino and Manenti (2005) argue that governments can stimulate OSS adoption through providing information, mandates, and subsidies. Mandates and subsidies have little impact in developed economies, not so in developing economies. Through mandated adoption, South Africa and Namibia are employing positive discrimination policies in favor of OSS (Wright, 2006). In Ethiopia, like many developing economies, the overwhelming majority of technology projects are government owned; vibrant private industries are hard to find. Government effort to push development projects to the private sector may generate interest among IT professionals to experiment with OSS innovations.

Adoption approaches: Some of the delay in the OSS success was attributed to adoption approaches as classified by Rogers (1995) and Carr (1999). The challenges we found in the three classifications are, first, the directional approach used in the case studies was bottom-up. Typical decision making in the organization, on the other hand, is top-down, reflective of most organizations in Ethiopia. Promising progress was observed when directives were issued from the top. Second, all case studies used a micro approach; in the absence of a national policy the micro approach triggered resistance. A macro approach with a proactive national policy may provide a nurturing environment for OSS innovation/adoption. Third, the case studies used a “push” approach. Resistance from staff members, whose job will be affected by the OSS adoption was observed. Some organizational members who were used to a point-and-click interface voiced their disapproval of the menu driven interface of the OSS application. In the case of the City library, staff members raised concern about switching from the familiar Dewey cataloging system to the Library of Congress cataloging system used by the OSS application. To overcome user resistance a “pull” approach with user driven implementation may produce better results. The combined bottom up, micro level, and push adoption approaches used in the case studies have contributed to some of the delay.

Network externalities: Complementary OSS applications are closing ranks with CSS. While this is good news other network externalities, namely skills of existing IT workers is still a major challenge for developing economies. There is a

critical shortage of skilled IT personnel in OSS in Ethiopia. A study surveying 500 Australian companies shows that lack of reliable technical support is one of the major inhibitors for OSS mass adoption (Goode, 2005). Lack of technical support may deter potential users of OSS (Comino and Manenti, 2005); governments can provide necessary funds in the form of subsidies to create a user community that provide technical support.

Technological capabilities: In case 3, implementing OSS operating system and office suite for the private schools, we observed brand name as a major factor.

Cost: The cost advantage, absence of licensing fees, of OSS is often cited as a major incentive for developing economies to embrace OSS. We observed, however, the cost advantage of OSS to be less of a driving factor; this is diffused by the availability of unlicensed CSS. Instead cost is viewed as a negative factor for OSS adoption; cost of ownership due to the lack of skilled IT professionals is the main culprit for this view.

Conclusions and Recommendations

Gaining organizational capabilities emanates from experimentation with the innovation; developed economies take advantage of the many OSS innovations to improve their processes even though the OSS innovations do not reach commercial level (Babcock, 2007). Developing economies are often cited as mere consumers of OSS but not active participants. To benefit from OSS, we recommend that developing economies must become active participants. Simply waiting for endorsement from developed economies overlooks the many OSS innovations that may improve business processes; not to mention the localization benefit of OSS innovations.

In conclusion we summarize the OSS adoption factors in Table 4 delineating between differences and similarities among developed and developing economies. Compared to OSS adoption factors in developed economies (West and Dedrick, 2006; Miralles, Sieber, and Valor, 2006) we found four factors that did not apply in our case studies, shown as differences. The primary reason for these differences is the lack of installed OSS applications in the country. We also found six factors that are shared by developing economies, shown as similarities. These similarities apply to both developed and developing economies, albeit in a different context.

Table 4. Differences and similarities in OSS adoption between developed and developing economies

Differences (mainly due to lack of installed base)	Similarities (albeit in a different context)
Switching costs	Cost (total cost of ownership)
Internal standardization	Technology capabilities (brand name)
Lock-in	Network externalities (skilled IT workforce in OSS)
User community influence	Information cascading
	Government policies
	Adoption approaches

A broader collaboration with other countries will benefit Ethiopia. In this regard, e-Learning Africa conference (<http://www.elearning-africa.com/>), in its second annual debut in Nairobi, Kenya, has dedicated a track for OSS. While we are not aware of any African collaborative initiatives on OSS, the focus at the e-Learning Africa conferences is a commendable beginning.

This study finds some differences and similarities in how OSS adoption factors apply to developed and developing economies. While this paper highlights some OSS adoption differences among developed and developing economies, we recognized the case studies are limited in scope and can not be generalized. Each OSS adoption factor should be evaluated in a wider study to further understand OSS adoption factors that apply to developing economies. Therefore we recommend further study with multiple countries.

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