Open Source Software: Strategic Choices for Developing Country Governments
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Introduction

Software is subject to network economies that make an application rise in value rapidly as the number of users increase. This leads to winner-take-most markets, where a single enterprise achieves overwhelming dominance. Consumers become captive or "locked" into a single technology because everyone uses it and because the costs of shifting and learning to use alternative products are high [Shapiro y Varian 1999].

The role of Government is to promote competition in all markets and increase consumer surplus. The leading software vendor has often bundled features in its software that increase consumer dependence and thwart competitors that directly threaten its dominance. Regulators have sought to level the playing field by imposing fines for anti-competitive behavior and by requiring the sharing of technical information to make it easier for desktop applications made by competitors to connect to the dominant vendor's servers (Economides [2001], Wall Street Journal [2004, 2005], European Commission [2004]).

As often happens it is not the effort of regulators but rather the maturing of technology and innovation in business models and in know-how that are gnawing away the leading software vendor's dominance.[1]

Network effects and technological lock-in are highest where a significant investment in a proprietary technology is already in place. This is hardly the case in most developing countries where e-government and computerization is only beginning. The retraining and other transitional costs of moving from proprietary technology to a low-cost open source technology are much higher in the US, Australia, Sweden, Korea or Singapore, where there are over 60 computers for every 100 people; than in most developing countries. In Asia, very few countries reach even 3 computers per 100 people. In most developing countries the adoption of a national program can prevent technological lock in through selective judicious cost-effective use of open source software.

Analytical work has firmly established the reliability of open source software as practical and robust technological platforms supported by sensible business models have risen (Varian and Shapiro [2003], Lemer and Tirole [2004]). There are many reasons why people and companies contribute to the development of open source software. The participation of large companies who are direct competitors of the leading proprietary vendor in these developments – e.g. Sun Microsystems, IBM, Novell - have provided the coordination and investment resources needed to ensure that some widely used applications developed under an open source are reliable, sustainable and available across several technological platforms. The companies have done well because their support of open source serves as a viable business model: they are regarded as "community friendly" (a powerful form of advertising), and they can make a profit on services (e.g. training, technical support) or by selling enhanced software products.[2]

Some governments are making large scale all-purpose migrations from proprietary to open source software. The small Municipality of Extremadura, Spain was perhaps the first to make the move [Cobo 2004], and cities like Bergen [Znet 2004], Barcelona [InformaticaPublica 2004] and Munich (Libbenga [2004], Delio [2004]) have followed suit. Paris considered migration (Lettice [2004]) but given its strong dependence on proprietary software opted for a gradual shift to open source [IDABC 2004]. After many years of recommending migration to open source systems in government desktops, the Government of Brasil appears to be on the verge of issuing a presidential decree mandating migration of all its 22 federal ministries to computers running open source (Linux and FreeBSD) operating systems. (Business News Americas [2005]).

Table 1. PCs and e-Government indicators: Asia and Selected Countries

	Population 000 000 (2003)	Per capita GDP (US$ 2002)	PCs per 100 people (2003)	2004 Web Measure Ranking
South Asia				
Bangladesh	135.1	352	0.8	147
Bhutan	0.7	734	1.4	165
India	1,056.9	494	0.7	30
Pakistan	149.6	428	0.4	49
Maldives	0.3	2,258	7.1	89
Nepal	23.7	237	0.4	66
Sri Lanka	19.2	863	1.7	81
Other Asia – Pacific				
Australia	19.9	20.230	60.2	8
China	1,256.9	963	2.8	54
Indonesia	215.1	860	1.2	70
Korea (Rep.)	48.4	10,014	55.8	4
Malaysia	25.2	3,870	16.7	46
Singapore	4.2	20,894	62.2	3
Thailand	62.5	2,044	3.4	39
Other				
Brasil	176.0	2,603	7.5	24
Canada	31.7	23,417	48.7	7
Chile	14.7	4,413	11.9	6
Estonia	1.3	4,732	44.0	17
Ireland	4.0	31,041	42.1	21
Germany	82.5	24,122	48.5	10
USA	292.3	36,223	66.0	1
UK	58.1	26,369	40.6	2
Sweden	9.0	26,864	62.1	13

Telecommunications Indicators from ITU (http://www.itu.int/ITU-D/ict/)
Web Measure ranking is from [UN 2004] and covers a total of 170 countries.

As migrations to open source advance the underlying costs, legal risks[3] and implications for human resources re-training are becoming better understood. Government agencies appear increasingly more judicious and selective in their use of open source solutions, carefully weighting the costs and benefits involved (Becta [2005], Blitz [2005], Blitz and Waters [2005b]).

Challenges by Type of Application

Developing country government choices regarding software may be broadly categorized into three major groups:

      i. e-government portals and service delivery systems;

      ii. desktop office applications; and

      iii. community networking and online collaboration software.

A distinction between user requirements is necessary. The most successful open source systems - Perl, Linux, Apache, PHP – are used primarily by information technology specialists who value the ability to make changes in the code to suit specialized needs (Evans and Reddy [2002], Franke and von Hippel [2002]). Many e-government applications fall in this category: the possibility of modifying code is valuable to public agencies developing their online service applications. It can enable an agency to share code and coordinate developments with other agencies, without having to reinvent the wheel or pay hefty proprietary fees. [4]

In contrast, the much larger market for desktop applications – spreadsheets, word processing, presentation, and publishing - is made up of people interested in ease of use and the standard features of an application. Their desire or technical capability to alter code is for the most part negligible. The costs of shifting from one technological platform to another are generally high for users of desktop applications.

Networking and online collaboration software is in a separate class. This kind of software is important in developing countries because it is through the interaction of people and communities with shared interest that the truly empowering value of computers and the Internet will be realized. Most community group members are not expert users. They use mailing lists and interact with others to achieve social and economic objectives, and rely on administrators or webmasters to manage the software. The costs of shifting technologies is not an overriding concern to members of the community, but the availability of a system that meets the needs of many countries and multiple language requirements and that can be continuously upgraded at low cost should be of concern to governments, donors and development agencies.

e-Government Systems

Public intervention in support of e-Government under an open source platform may be justified on social welfare grounds [Comino and Manenti 2003]. The Internet is a prime example of a "government" sponsored development, a public good, made freely available for use by the public. The Hypertext Markup Language (HTML) exemplifies a successful software application, available in the public domain continuously upgraded by a consortium of corporations, research groups, non-profit organizations and governmental agencies.

The Open Source movement has often promoted "viral" licenses that discourage innovation by preventing subsequent developers from making a profit. Software developed under the GPL license, for example, requires that any future developments built from the original software must be distributed freely with full access to the code.

Governments, however, need not follow a restrictive license regime. Some licenses enable government agencies to make the software developments they sponsor freely available, but also allow private entrepreneurs to use the code and sell improvements under a proprietary license (Schmitz and Castiaux [2002], Hahn [2002]).[5]

R1 Software developed under developing country government sponsorship should consider open source solutions, particularly if these developments are potentially useful to other members of society or to government dependencies. These developments should be subsequently made available for use by third parties (e.g. through an online software code sharing repository[6]), under a license that enables further development and reasonable commercial exploitation.

Use of open source need not be an all or none proposition.[7] When a wholesale shift in software technology is not practicable, significant economies may still be achieved by sharing selected open source applications. In the US, the States of Massachusetts, Rhode Island, Pennsylvania, Utah, Kansas, Missouri, West Virginia, and the cities of Glaucester, MA, and Newport News, VA, have formed a Government Open Code Collaborative Repository to enable open source software code sharing by government agencies ([GOCC 2004], Kriss [2004]). The municipalities of Extremadura and Barcelona, in Spain, and Porto Alegre in Brasil, have established a similar network to exchange experiences and software developments [PortoAlegre 2004]. A similar initiative has been proposed for the EU [Schmitz and Castiaux 2002].

e-Government efforts have often resulted in "data dungeons" that do not interact with each other. These disparate systems reside in different agencies and become outdated rapidly. They tend to rely on proprietary software that does not conform to open standards; interconnection may be achieved but often at a high cost.

Great Britain has adopted a flexible open source policy, developed through a public consultation process [Cabinet Office 2004].[8] The UK has also adopted an e-Government interoperability framework to which all government dependencies must adhere. The proposed architecture mandates the use of on open standards, e.g. XML, by all government agencies [Cabinet Office 2005]. Proprietary software is not excluded, provided that it meets the open standards.[9] Similarly, Brasil's interoperability architecture (*e-ping*), envisages the occasional need to use proprietary software, but will rely mainly on open source solutions and open standards [Governo Brasileiro 2004].

R2 The formation of national Task Forces on Open Source and Interoperability in e-Government applications bringing together senior IT officers from ministries and agencies planning e-Government systems is recommended. The first order of business should be the drafting of guidelines for the development, use, and sharing of low cost interoperable applications across public agencies.

Desktop Applications

Technological lock-in in desktop applications started in high income countries when the software industry was still in its infancy. Desktop systems have since become quite sophisticated in functionality and interoperability. Businesses are resisting expensive changeovers to new versions that exhibit only minor changes in functionality. This is especially true of the standard office desktop applications – spreadsheet, word processing, presentation and desktop publishing - for which robust free downloads or inexpensive alternatives are available.

The leading open source office suite OpenOffice (www.openoffice.org), may be downloaded for free. It is rich in features and its files are readable by other leading vendor office suites. The new version's (Beta 2.0) interface is practically the same as that of the leading vendor (Naq [2005]). OpenOffice is available in more than 70 languages (http://l10n.openoffice.org/languages.html), a feature made easier by free access to the source code.

Because OpenOffice is available in common operating system platforms, i.e. Windows, Macintosh, Solaris, Linux, and FreeBSD, **the decision to migrate to OpenOffice may be considered apart from the decision to change operating systems.** This is important for Governments considering migrations to open source. The applications on offer are still larger for Windows than for Linux and problems of compatibility are more serious across operating systems. For novice developing country users who only need to type letters, write emails, work on spreadsheets, the basic functionality of low cost open source solutions that can operate in different operating systems is usually adequate.

Since 2001, the city of São Paulo has run a tele-center program under an open source environment – including operating system (Linux) and desktop applications (http://www.telecentros.sp.gov.br/). The city sponsors 110 tele-centers, all located in the most impoverished parts of the municipality, showing that inexperienced users can perform well in an open source environment. After an initial trial with dual operating systems, the city decided to exclusively install the open source Linux operating system on all of its telecenter computers. This was a crucial strategic choice which aimed purposefully to avoid technological lock-in to the dominant technology by new users. Sao Paulo's program served as a model for Brazil's nationwide 3,200 tele-center program, presently under implementation.

Pirate software has been and continues to be commonplace in developing countries (Table 2). The basic desktop applications make a very large portion of pirated software. Policing small shopkeepers, cybercafe operators and low-income users using pirated software is impracticable and politically untenable.[10] Governments are inevitably forced to adopt lenient enforcement policies that lead to public contempt and lax attitudes towards intellectual property rights that run counter to international commercial obligations and end up hurting budding local proprietary software industries.

Table 2. Piracy Rate in Asia-Pacific Countries and World Wide

Piracy Rate in Asia-Pacific Countries 2004			
Country	**Piracy Rate %**	**Country**	**Piracy Rate %**
Vietnam	92	Hong Kong	52
China	90	Korea	46
Indonesia	87	Singapore	42
Pakistan	82	Taiwan	43
Thailand	79	Australia	32
India	74	Japan	28
Philippines	71	New Zealand	23
Malaysia	61	Other AP	76

Piracy Rate by Region		
Region	**Piracy Rate %**	
	2004	**2003**
Asia-Pacific	53	53
European Union	35	37
Rest of Europe	61	61
Latin America	66	63
Middle East/Africa	58	56
US/Canada	22	23
All Regions	**35**	**36**

Piracy rate: Number of pirated software units divided by total number of units put into use.
Source: BSA-IDC [2005]

If Governments were to encourage their citizens – through widespread governmental use in its own offices and projects – to use a low cost desktop office application software alternative, the common excuse of high cost of software could no longer be regarded as compelling. The political and real costs of policing intellectual property rights violations would be lower and could therefore be enforced more strictly and effectively by focusing on fewer violators.

R3 Most people do not need sophisticated office suites, and the freely available and low-cost desktop alternatives (e.g. OpenOffice) are sturdy enough for widespread country-wide adoption at significant savings and **without having to change operating system.** Government sponsored telecenter, school computerization programs or renewing their government office applications software, should consider widespread migration to low-cost open source software.

R4 The decision to migrate government ICT development programs to open source operating systems is more complex. It may be justifiable in a developing country context provided the following conditions are present:
> i. the proposed migration involves a sufficiently large number of PCs to actually generate network economies[11]; and
> ii. the country has the potential to develop an innovative and sizeable national software industry.

R5 Apparently generous offers to supply software to a few government sponsored telecenters or school initiatives usually ignore the large mass of small cybercafé owners and low-income computer users. These offers should in general be resisted by government decision-makers. They are part of a concerted effort from the dominant vendor to retain market dominance.[12] The risks are high that the temporary free provision of the dominant desktop applications to new computer users will end up locking the country into a high cost proprietary software spiral from which it will be increasingly difficult to extricate itself.

R6 Developing country governments would do well in supporting international cooperating bodies made up of academic and civil society developing country representatives that set standards for open source operating systems, as a means of ensuring their special language and font requirements are met and to encourage development country software development capabilities**.**

Community Networking

Software to establish mailing lists, web pages and enable resource sharing is a most valuable tool for empowering rural communities and encouraging collaboration online (Oksa and Turunen [2000], p. 7).

There are powerful proprietary software options (e.g. First Class, Lyris), some highly specialized (e.g. Blackboard for education content management). There are also open source list servers (PHPList), web page creation programs (Postnuke) and online collaboration tools (e.g. http://wikipedia.sourceforge.net/; http://www.kolabora.com/; Basic Support for Cooperative Work http://bscw.fit.fraunhofer.de/). Existing online services like Yahoo Groups (http://groups.yahoo.com/) and Dgroups (www.dgroups.org) have limited functionality but are presently available for free.

What appears to be missing is an integrated low-cost system available or easily translated into local languages that is suited to facilitate information exchange and user friendly web page creation by small community groups in developing countries. Such a system would have the following features:

The software developed should use open source software, under a non-restrictive license regime.

The software would enable the use of special fonts (e.g. Sinhala, Tamil) as well as the corresponding standard fonts to allow a variety of optional languages of communication between users.

The Community Portal and Networking Software should make it possible for different institutions – community groups, schools, small businesses - using the software to have their own distinct unique Portal *shell* with its own logo and banner.

The software developed should be easy to use and run directly and independently by individual user groups, requiring no intervention of any external institution.

The Community Portal and Networking Software developed should have a separate section for simultaneous chatting by registered group members, through a Web page interface within the system.

R7 Government and donors would do well to contribute and support the design and implementation of an open source **Community Portal and Networking Software.**[13]

Concluding Remarks

A rapid expansion in e-government applications is imminent in many developing countries. The present setting offers unique opportunities to expand systems rapidly and to avoid duplications and locking the country's e-government services into proprietary technologies that could prove costly. It is an opportunity to be purposefully seized and planned for.

Most present users of computers in developing countries are English speakers and use proprietary software, but they represent a very small proportion of developing country populations (Table 1). For the few well off individuals who use computers the costs of shifting to another software technology are high, even if they are insignificant from the standpoint of their own societies considered whole. Yet their views carry weight because most decision-makers and government officials fall in this category.

A dependency on proprietary software in desktop systems should not be forced upon the vast majority of peoples who do not speak English, have no vested interest or training in the dominant technologies, have limited income, and will be the ones to pay the most if an expensive proprietary software platform is adopted – either by design or by default – by their country's leaders.

Ultimately, the decision regarding what type of software a government agency implements should be dictated by a sober analysis of economic and social considerations. Such a choice should be **technology neutral**, as advocated by the leading vendor and the Business Software Alliance [2004], but should not be blind to future costs and benefits and should seek to **avoid costly technological lock-in** on proprietary software technology.

Notes

1. Something similar is happening in telecommunications, another industry subject to strong network economies. The emergence of new wireless technologies and Voice over Internet Protocol telephony have been much more effective in fostering competition than regulators' efforts to force the sharing of elements of the infrastructure. [Hazlett 2005].

2. For example, Star Office is a product sold by Sun Microsystems, as an enhanced version of OpenOffice (www.sun.com/software/star/openoffice/).

3. The city of Munich has put its plans to migrate to open source on hold, pending a review of potential liability due to patent infringement risks mostly related to Linux [Wildstrom 2004]. The patent infringement risks associated with Linux are discussed in OSRM [2004], Moglen [2003].

4. For a comprehensive review of open source software use and system attributes, see Wheeler [2004].

5. The BDS is one example of many. A useful source on licenses is the State of Massachusetts Legal tool kit and Quick Reference Chart: www.mass.gov/itd/legal/index.htm.

6. Open source code sharing online is common. See, for example, UNESCO's Free Software Portal (http://www.unesco.org/cgi-bin/webworld/portal_freesoftware/cgi/page.cgi?g=software/index.shtml&d=1), and the Open Source Content Management Systems website (http://opensourcecms.com/). Additional resources are also cited at: www.itrainonline.org/itrainonline/english/opensource.shtml

7. Dravis [2003] and [2004], documents successful uses of open source by large private and public organizations. See also Dedrick and West [2004].

8. "The key decisions of this policy are as follows:
   · UK Government will consider OSS solutions alongside proprietary ones in IT procurements. Contracts will be awarded on a value for money basis.
   · UK Government will only use products for interoperability that support open standards and specifications in all future IT developments.
   · UK Government will seek to avoid lock-in to proprietary IT products and services.
   · UK Government will consider obtaining full rights to bespoke software code or customisations of COTS (Commercial Off The Shelf) software it procures wherever this achieves best value for money.
   · Publicly funded projects which aim to produce software outputs shall specify a proposed software exploitation route at the start of the project. At the completion of the project, the software shall be exploited either commercially or within an academic community or as OSS."
   Cabinet Office [2004], page 4.

9. "Many proprietary products are intentionally opposed to interoperability. Interoperability promotes customer independence and choice among vendors" (Rosenberg [2002]).

10. In many developing countries there are places well known by its citizens where the sale of pirated software is common. Perú's "Silicon Valley" runs between "blocks 11 and 8 of Garcilazo de la Vega (formerly Wilson) Avenue, and contains dozens of computer and software shops employing thousands of persons..."[Nagaro 1999, p. 13]. "Wilson is the place where all kinds of hardware and software is on offer, in addition to information

services of every kind. All of it within the parameters of the informal, submerged economy. There we find the latest models of computer components and accessories (hardware) and applications (software), as well as related and complementary services (from courses in the different applications to the leasing of computers and equipment for a variety of purposes)..." {Nagaro 1999, p. 3].

11. Because of network effects, if only a few computers are involved in the change over, the end effect will be to punish new users who will sooner or later have to migrate to the widely used de facto proprietary standard operating system.

An exception is the case of schools and universities where there is training value in having open source operating systems even if they are only installed in a few computers and differ from the standard.

12. The following quotations from a 15 May 2003 New York Times article "Microsoft Sticks with Tough Tactics" illustrate strategic thinking by the leading vendor regarding Government software purchases.

> "Orlando Ayala, then in charge of worldwide sales at Microsoft, sent an e-mail message titled Microsoft Confidential to senior managers laying out a company strategy to dissuade governments across the globe from choosing cheaper alternatives to the ubiquitous Windows computer software systems.
>
> The memo on protecting sales of Windows and other desktop software mentioned Linux, a still small but emerging software competitor that is not owned by any specific company. 'Under NO circumstances lose against Linux,' Mr. Ayala wrote…Mr. Ayala's message told executives that if a deal involving governments or large institutions looked doomed, they were authorized to draw from a special fund to offer the software at a steep discount or even free if necessary.
>
> Mr. Ayala's memo said that the discounts could be offered to 'developed and developing countries,' and that an 'initial focus' was being put on Latin America, Africa, the Middle East, India and China. In his In his e-mail message, he focused on governments and large institutions buying mostly desktop software. ..
>
> …In today's 'difficult economic environment' some institutions and companies were focusing on cheaper software'.…'It is important,' he continued, 'that we have a way to address large PC purchases that involve low-cost/no-cost competitors in the education (and government) sectors, especially in emerging markets.' The solution, he wrote, was to 'tip the scales' toward Microsoft in these deals by using the special fund, which he called the Education and Government Incentive Program. The fund was to be used 'only in deals we would lose otherwise,' Mr. Ayala said."

> (New York Times [2003])

13. The possibility of joining forces to develop the Community Portal and Networking Software with other institutions engaged in similar open source software developments (e.g. Bellanet, Jamaica Information and Communications Technology Project, Universidad de la Frontera in Chile) should be explored.

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