

Open Technologies and Developing Economies

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Abstract

Open Technologies have already become a global phenomena and a frequently talked about topic in technology circles today. Although considered a part of hobbyist and geek-culture initially, Free/Open source software and technologies have an important part in global economy today. Openness has been a part of everyday computing and has been making impacts in governmental, business, education and every other sectors imaginable. But what is the impact of open technologies in developing economies? In this paper we try to analyze various country cases that have embraced this wave of openness and freedom. While doing so, we focus on what economic benefits have they brought in along with social and other benefits. We also go through some of Nepal's cases in open technologies and the overall scope. We finally analyze the economic impact of open technologies in various sectors of the country, mainly government, business and education.

Keywords

open technologies, open standards, economy, developing countries

1 Introduction

Open source is a model of open, distributed and shared software development. It is one of the mainstream and frequently talked about topics in software industry today. Only a couple of years ago, many software industry pundits rubbished the idea of open source software development model as a few naive programmers' fantasy. But the success

of many open source softwares with self-sustainable model has made everyone to make adjustment to their view about Open source softwares.

Open source development has engaged communities throughout the globe but the major contributions have primarily come from developed countries. Recently, however, the economic benefits associated with Open source software has attracted many developing countries to move towards open source. Moreover, a few noteworthy open source contributions are also coming from developing countries and these are transforming the way the software have been traditionally perceived. Many people are of the view that open source can influence social, political and economic dimensions of a society and the impact of such changes would be more prominent in developing economies and in general such changes are favorable.

2 Economic Advantages of Open Technologies

Proponents and advocates of open technologies, including Free/Open Source Software and Standards (FOSS) are quick to point out that the main advantages of free/open source software are the freedom that they provide, in terms of use, change, distribution and adaptation, rather than the cost benefit they might offer. Despite that, one of the main arguments in favor of such technologies in developing economies continues to remain the low cost associated with them. In the case of developing countries, because of limitation of resources and the need to prioritize development goals other than Information Technology, this argument might be one of most important ones. Once the economic fac-

tors associated with a technology seem viable and attractive for such economies, other associated advantages will be appreciated. The main characteristics of open technologies are the sharing of knowledge, collaborated mode of development and licensing models that allow for the reuse and improvement of existing work. This presents an opportunity for developing countries to customize technology by allowing individuals to adapt the existing technology to their specific needs and conditions, which are not necessarily the same as those in developed countries.

Several attempts have been made to identify the economic impacts resulting from the adoption of open technologies. Some studies have suggested that it is not possible to accurately calculate the total costs and benefits of the choices of technology platforms. This is because total costs of technology adoption go beyond the cost of procurement, maintenance and service. They also include other overheads like the cost of training the users. Calculation of the total benefits has to take into consideration even more parameters. Besides the values of services and products generated, other invisible aspects like productivity and skill-development need to be taken into consideration for such calculations, the process of doing which is not always straight forward and deterministic. Consideration or omission of such direct and indirect costs and benefits can significantly alter the results of any study made to identify the economic impacts of any technology adoption, including open technologies.

2.1 Total Cost of Ownership

As an example, we can consider the highly-debated subject of the total cost of ownership (TCO) of FOSS and proprietary systems. Studies conducted by several parties have produced conflicting results and often this tends to be a source of confusion to anyone trying to study the subject. Though open source software are not necessarily free of cost, a principal character of such software is the zero licensing fee. This has been considered a reason for the lower TCO of FOSS systems. Although most popular FOSS systems don't cost any money to acquire and use, varying amount of money might be required to obtain the support, migration-service

and training for such systems. Some surveys¹ show that the total TCO of Windows based systems are lower than of Linux based ones. In the result of one such survey, the TCO for Linux based systems was shown to be higher than for Windows based systems in three of the four major areas covered². On the other hand, surveys conducted by other groups, including those funded by corporations like IBM and Red Hat have showed the TCO of Linux based systems to be significantly lower than of Windows based systems. In this paper, we try not to focus into such ambiguous comparisons, but instead try to focus on the larger picture, including the impacts the choice of technology platforms can have on areas like manpower-skill, society, opportunity, efficiency, and so on. Rishab Aiyar Ghosh [Ghosh⁽⁵⁾] argues that the "TCO studies are rarely taken seriously by IT managers any more, since their results seem to depend on who sponsors them as well as the details of the specific organizations subject to study. The concept of TCO is important, but the actual total cost really differs from organization to organization." In countries where labor costs are high, license fees themselves are less significant in comparison to the countries where labor costs are low. In low labor-cost economies, the share of the license fee in the total cost of ownership is much more significant, even prohibitively so [Ghosh⁽⁴⁾]. "Moreover, no likely discount would significantly reduce this cost, and in any case the simple fact that a single vendor controls any single proprietary software application means that there can never be a guarantee that any discount offered is intended to be sustained for the long term, rather than as a temporary measure used to tempt consumers into a lock-in situation at which point in time the discount can be reduced."

2.2 Division of Labor

An analysis of FOSS based on the classical division of labor perspective [Garzarelli et al.⁽²⁾] suggested that FOSS is more promising because it favors market expansion more than proprietary software does. According to renowned economist Adam Smith, a crucial ingredient of intensive growth is the division of labor and with the subdivision of tasks accom-

¹mostly funded by Microsoft

²IDC Survey, http://news.cnet.com/IDC-Windows-cheaper-than-Linux/2100-1012_3-975938.html

Country	GDP/cap	PCs ('000s)	Piracy	WinXP Cost*	Cost in GDP months
Brazil	2915	10835	56%	6777	2.3
China	911	24222	92%	21678	7.4
European Union	19926	87764	n.a.	991	0.3
Ghana	269	66	0%	73442	25.0
Indonesia	695	2298	88%	28412	9.7
Nigeria	319	889	71%	62014	21.1
Romania	1728	801	75%	11433	3.9
United States	35277	178326	25%	560	0.2

Note: US\$560 price from amazon.com in June 2003. GDP Data from World Bank World Development Indicators Database, 2001; Piracy data from Business Software Alliance. * Windows + Office XP equivalent US\$ cost calculation = \$560 * (U.S. GDP per capita/Country GDP per capita).

Figure 1: Share of licence fee in TCO : A comparison of the fraction of GDP required for the purchase of Mircofost Windows in various countries. [Ghosh⁽⁶⁾]

panied by market expansion, there will be further growth. The FOSS model of development favors sees this kind of division of labor and market expansion more than proprietary software does, tapping into spontaneous work input. Thus, the kind of generation of a circle of knowledge growth, reuse and sharing enabled by FOSS development “leads to increasing returns, which are crucial for economic growth.” According to the study, because of the knowledge reuse made possible in FOSS development, output increases by a factor greater than the corresponding increase in input.

2.3 Skill Development and Employment

In 2002, a comprehensive analysis of developers and users [Ghosh⁽⁶⁾] showed that the most important reason for developers to participate in open source communities was to learn new skills — ‘free-of-cost.’

The community-oriented development model of FOSS involves many professional and volunteer developers, engineers and people from other non-technical field alike. The culture of sharing and improving upon existing works enables a collaborative environment where people can learn from each other and improve their skills. An extensive research [Ghosh⁽⁶⁾] showed that the following are the main ways in which people involve in FOSS development process:

- participate in politics and advocacy works
- providing help
- bug-reporting
- software testing
- bug-fixing
- participate in discussions
- manage projects
- website administration
- preparing documentation
- software translation
- artwork
- programming and developing complex systems

The study found out that participants develop many sets of skills through involvement in such projects. The improvement of such skills in a FOSS development process was found to be higher than in other kinds of development process. Listed below are some of the important ones:

- Technical Skills
 - write modular code
 - create new algorithms
 - documentation

- write re-usable code
- bug fixing
- Managerial Skills
 - co-ordinate with the work of others
 - evaluation of others' work
 - lead a project or a group of people
 - define and achieve targets
 - settle conflicts
 - motivate people
 - plan work
 - stick to a schedule
- Legal Skills
 - understand the differences about patents, copyrights, licenses
 - understand copyright law issues
 - understanding of liability issues
- General Skills
 - understand English and technical discussions
 - understand software development process
 - understand and work with people from different cultures
 - interact with other people

The study also surveyed different employers to understand if such skills learned through participation in FOSS communities were really useful in the job market. A large majority of respondents expressed the opinion that such skills can even compensate for the lack of formal degrees and that almost half of them would make no difference in the payments made to them since this skills development and training process occurs at no additional cost to the employers.

2.4 Innovation and Local Needs

Former Spanish Prime Minister Felipe Gonzalez said, "access [to ICTs] is not enough, it is the ability to create, to add value, that is important."

Open technologies provide an environment for skills development that will be helpful for the economies of developing countries. This can also encourage the creation of SMEs, entrepreneurial skills and local job creation.

Interoperability is one distinct feature offered by Open Technologies for the reason that they are based on open standards and have public releases of their implementation. Interoperability and compatibility were the reasons stated by 90% of the respondents in the FLOSSPOLS survey for selection criteria for new software purchase. The pace of innovation slows down with a lack of competition. Open technologies, and FOSS, on the other hand, provide an environment conducive for increased competition through an emphasis on open standards and interoperability. The EU study of FOSS states that such systems potentially save industry over 36% in software R&D investment that can result in increased profits or be more usefully spent in further innovation.

Open Technologies provide an opportunity to adapt and customize world-class technologies to local needs. This creates a value addition that is retained locally. Because of the access to existing code and the development of skills of local manpower, FOSS provides a low barrier to entry for developing countries in ICT development and innovation.

Outside of the risks which developing countries face with alternative IT policies, the empowerment of the IT industry of a developing country through OSS development is an important opportunity [Weerawarana and Weeratunge⁽¹³⁾]. Steven Weber noted in his famous paper [Weber⁽¹¹⁾], "such economies with a surplus of inexpensive technical manpower could combine the free software tools that the FOSS phenomenon provides, creating an interesting comparative advantage both in local and global markets alike."

Countries around the world have been keen to minimize their reliance on single suppliers, who may not be focused on the country's interest and to avoid opportunism by suppliers the country has locked itself through proprietary software pur-

chases. The use of open source software “means that support and maintenance can be freely contracted out to a range of suppliers competing on quality and low cost for installation, enabling, support, and maintenance. Maintenance is furthermore replicable without incurring large costs, since modifications to the source code are also free”.

Former Indian President A.P.J Abdul Kalam noted that FOSS offers developing nations such as India the best opportunity to modernize. Likewise, the consortium of Japan, China and South Korea for FOSS development, strategies adopted by South Africa and the African region, point to a clear recognition of strategic opportunities that developing countries could exploit utilizing the FOSS phenomenon. Peruvian Congressman Villanueva wrote, “proprietary software creates mainly technical tasks of little aggregate value in countries like Peru; free and open software creates more technically qualified employment, stimulates the market, and increases the shared fund of knowledge, opening up service alternatives to the benefit of producers, service organizations and consumers.” [Weerawarana and Weeratunge⁽¹³⁾]

2.5 High Quality

The GNU/Linux operating system is the most popular FOSS operating system in computing today, representing a \$25 billion ecosystem in 2008 [Gillen et al.⁽⁷⁾].

An extensive study of FOSS by the United Nations University and the European Commission estimated the base of quality of existing FOSS applications “with reasonable quality control and distribution” as worth almost Euro 12 billion for firms to reproduce internally. This existing base of FLOSS represents a lower bound of about 131 000 real person-years of effort that has been devoted exclusively by programmers. “Annualized and adjusted for growth this represents at least Euro 800 million in voluntary contribution from programmers alone each year.” Firms have invested an estimated Euro 1.2 billion in developing FLOSS that is made freely available. “Such firms represent in total at least 565 000 jobs and Euro 263 billion in annual revenue. Contributing firms are from several non-IT (but often ICT intensive) sectors, and tend to have much higher revenues than non-contributing firms.”

3 Benefits besides the cost issue

Open Source, in general, helps to reduce the Total Cost of Ownership (TCO) of software. But cost is not the only benefit associated with open source. As soon as Open Source Software (OSS) is adopted, its other benefits become apparent. In most of the scenario, cost is not even the primary consideration.

One of the primary driving factors behind adoption of Open source is the freedom it offers by making source code available. The source code makes it possible for people to modify the software to cater to one’s requirement. In proprietary software, customizing software to local needs has been economy driven and based on global returns. With open source, communities in several instances have taken up the task of localization to translate software in local languages. Localization has, thus, made it possible for non-native English (*lingua franca* for software to a larger extent) speakers to use software.

Developing countries have been realizing that the only way they can speed up their development rate is through better access to Information and Communication Technology (ICT). The access to such technologies is often restricted by language barriers and the context for which such tools are built. While, for proprietary software, changes to adapt such tools to one’s need is restricted by unavailability of source-code, for open source there are several instances where a software has been adapted to desired language and context. For example, a Kenyan crowd-sourcing Open source software Ushahidi has been adapted for several context ranging from geo-mapping of swine-flu outbreak to wildlife mapping in a conservation park³. What is more striking about Ushahidi is the fact that the software originated not in a developed country and most of the adaptations have also come from developing countries.

Open source software not only allow adaptation through localization but can form the basis of a new software. Use of OSS as the basis for new software can lessen the investment and duration required to develop a software. And, this way, one can focus entirely on new features needed for the desired software rather than re-inventing the wheel through

³Ushahidi, <http://www.usahidi.com>

writing software from scratch.

Many people have a misconception that Free and Open Source Software doesn't have an economic model and developing OSS is merely a philanthropic work. A survey carried out by Ministry of Science and Technology in Brazil on OSS developers with 3237 responses found that close to 40% respondents had a paid job to develop OSS [Stefanuto and Salles-Filho⁽¹⁰⁾]. This is close to a profile in an European survey. [Ghosh et al.⁽³⁾].

Open source development generally involve collaborative approach in form of communities. Participation in FOSS communities is helping developers learn valuable skills to get job and run small business. Through involvement in FOSS communities, besides programming one gets to learn about copyright and software licenses which are rarely taught in classroom but very important consideration in software development. FOSS also helps enhance team management skills. FOSS software involve thousands of developers collaborating with each other despite the fact that they have not met each other require learning of skills like team management.

Open source software are not only promoting collaboration among developers, they have also given rise to a lot of competition through freedom of choices for any user. A plethora of choices available to a user with OSS has forced developers to constantly push the layer of innovation giving rise of better quality and a balanced sense of collaboration and competition.

A particular advantage that developing countries have in adoption of open source over developed countries is the low learning barrier. In developed countries, many people have grown up using proprietary software and do show some resistance while unlearning those things but in developing countries, people can directly be introduced to Open source because for most of the people ICT is still a new concept.

A closely associated concept with Open source is Open standard and is mostly implemented by open source developers. Open standards are ensuring interoperability and making it possible for people and governments avoid getting locked in some proprietary standard maintained by a single vendor. The open standards allow anyone to study them and implement hence allowing more competition. When it comes to making choice at government or national

level, open standards become more important since government has to be able to maintain data for perpetual period and should not depend on standards by a particular vendor.

Open source is not merely about software process today. It has become more of a social movement. FOSS has inspired the concept of Open hardware⁴ making it possible for once quite expensive hardware to be within reach of arger mass at low cost. The concept of genetic data pool^{5 6} to facilitate collaboration in genetic research can be traced to Open source. Genetic data pool will mostly benefit medical costs in developing countries.

A commission on Intellectual Property Rights setup by UK government recommends that "developing countries and their donor partners should review policies for procurement of computer software, to ensure that options for using low-cost and/or open- source software products are properly considered and their costs and benefits carefully evaluated." [Barton et al.⁽¹⁾]

Linus Torvalds in an interview stated the following view on the importance of Open source in developing countries: "I'm convinced that without open source, developing nations will be totally shut out of IT altogether, always at the mercy of companies that have proprietary technology and without any means to close the gap (technological divide)." He further adds that "I think that if the developing country is serious about not just seeing IT as a cost center, but as a requirement for national development, the real advantage of open source ends up being able to build up your own knowledge base. And that is not cheap in itself – you'll likely pay as much for that as you'd pay for a proprietary software solution. The difference being that with the proprietary solution, you'll never catch up, and you'll have to pay forever, without ever learning anything yourself." [Weerawarana and Werratunga⁽¹²⁾]

Several studies around the world and in the light of several advantages Open source it offers, it would not be an exaggeration to state that Open source or open technology, in general, is not merely a choice for developing countries, it is the only way to go.

⁴SIMPUTER, <http://www.simputer.org>

⁵ENSEMBL, <http://www.ensembl.org/>

⁶SNPS, <http://snp.cshl.org/>

4 Nepal's cases and scope

Nepal has only a handful of examples when it comes to open source projects. A lot of efforts on awareness has been on going through FOSS Nepal Community and various other college level bodies, but there has been very less work when it comes to Open Source Software development from individual level.

4.1 Notable Open Source Projects / Efforts in Nepal

Help Nepal Network eLibrary Help Nepal Network (HeNN)⁷ is a global charity run on a fully voluntary basis bringing together individuals who love Nepal together, to contribute towards health and education in the remote parts of the country. The volunteers include people from all walks of life. The aim of the Network is to encourage Nepalis and those with an interest in Nepal, around the world to contribute and provide assistance in the fields of health, education and emergency relief.

LTSP⁸ eLibrary is a low-cost and low-maintenance computer lab suitable for rural parts of Nepal being deployed by Help Nepal Network - Nepal (HeNN). In this system one powerful computer (usually a normal desktop computer, with slightly more memory) is used as server. Connected to this are computers having low configuration – even Pentium 2 or Pentium 3 computers will work and no hard-disk is required. The whole system runs on Linux along with lots of educational software. Every software used is Free and Open Source.

Open Learning Exchange Open Learning Exchange (OLE)⁹ Nepal is a Nepali not-for-profit organization working on improving quality and access in Nepal's public education system. It seeks to fulfill this mission by developing and disseminating high quality open-source Information and Communication Technology (ICT)-based educational teaching-learning materials that are accessible and available free of cost to all.

OLE has been pioneering in the field of disseminating ICT enabled teaching-learning material with the help of One Laptop Per Child (OLPC). The whole OLPC runs on open source and the material OLE is distributing through OLPC is also open source.

Nepalinux NepaLinux¹⁰ is a localized Debian and Morphix based GNU/Linux Distribution in Nepali. It is a Free Open Source Software released under the GNU General Public License(GPL). It has been developed and released by Madan Puraskar Pustakalaya, Nepal under the PAN Localization Project supported by International Development Research Center (IDRC), Canada. So far four different versions of NepaLinux 1.0, 1.1, 2.0 and 3.0 have been released respectively in December 2005, October 2006, June 2007 and May 2008.

FOSS Nepal Community FOSS Nepal Community¹¹ is a team of volunteers who believe in the usage of Free/Open Source Software (FOSS). The primary objective of the community is to promote and diversify the usage of Free/Open Source Software in Nepal.

The main objectives of FOSS Nepal Community is to raise awareness among general public, government bodies, private sector, civil society, educational institutions and media for expanding the scope of Information and Communication Technology (ICT) via Free and Open Source Software, to sensitize general public, government bodies, civil society and media for the implementation of e-governance by means of FOSS; the optimal solution for e-governance, advocacy for alternatives in Intellectual Property Rights (IPR) specific to ICT and to enhance the capacity of IT professionals by promoting inclusion of Free and Open Source Software in educational system and providing platform for IT professionals to make them globally salable.

⁷Help Nepal Network, www.helpnepal.net

⁸Linux Terminal Server Project, <http://ltsp.org>

⁹Open Learning Exchange, www.olenepal.org

¹⁰Nepalinux, www.nepalinux.org

¹¹FOSS Nepal Community, www.fossnepal.org

4.2 Scope

Developing countries like Nepal can benefit a lot from Open Source Software. Open source software's provide alternative to the Microsoft's and other commercial organization's product in cheaper or even in free. In Nepal also the software commonly used are the pirated versions with many defects or reduced capability. The Open source software provides easy and customizable solution to many demands of the user. Since the software are made by the users they are more user friendly and can be modified as user demands.

Localization is another area countries like Nepal can benefit most from Open Source Software. Language is one of the prominent barrier while introducing IT to the rural areas. This can be largely solved by localizing the software in local language and context, which is extremely easy and well supported in Open Source Software.

Another reason is price.

5 A sustainable economic model

Free software is not necessarily free of charge. You can sell free software, but since you can't stop your buyers from reselling or giving it away at no charge, simple economics shows that any free software package is likely to be available, somewhere, for a price of zero. [Ghosh⁽⁵⁾] This concept of zero priced software is of huge impact for developing countries where the money plays a bigger role while adopting new technology. However there are other advantages too.

5.1 Government

All countries want to be able to control the terms of their connection to the knowledge economy. Nothing can fulfill this desire than open source software.

Basically the reasons for government to adopt Open Source software comes down to four major points.

- Independence
- Cost Savings
- Speed to Deployment

- Greater Security

5.2 Business

While many companies use open source for the cost advantages, it offers a number of other benefits, including early access to new technology, faster time to market, ease of deployment, freedom from vendor lock-in and greater security. [Microsystem⁽⁸⁾]

However, enterprises need to be aware of some potential pitfalls. Open-source licensing fees can make the software expensive. While community support and bulletin boards are free, that level of support may not be enough for mission-critical applications or deployment. When exploring open-source software alternatives, enterprises can work with aggregators and support firms like Redhat and Sun Microsystems.

5.3 Education

Education is one field where the institutions can use Open Source software to directly save money, which can be further spent on fields like research. Moreover, Open Source software encourage students of any age and situation to read the source code and learn as much as they want to know. Schools that use free software will enable gifted programming students to advance.

Economics aside, the use of proprietary software is even considered illegal and is even compared to distributing free cigarettes to minors by tobacco companies. [Stallman⁽⁹⁾]

6 Conclusion

Open Technologies have benefits outside of IT too. Several cultures and communities outside of the IT industry have successfully demonstrated the benefits and successes of using open technologies. A notable example is the online encyclopedia Wikipedia. The collaborative attempts between biotechnology firms in the ENSEMBL25 or the SNPS consortium have reaped good results.

Clearly, there are measurable cost benefits from Open Technologies as discussed in this paper. Other than that, the culture and environment of innovation they nurture are valuable for every country. Among various reasons cited by countries ex-

perimenting migration to such technologies, reducing the dependence on particular firms or countries for the very important information economy, reducing the imports, ability to cater to local needs by making suitable modifications and adaptations, have been the principle ones. The principle motivation for people to get involved in the development of Open Technologies remain to be the factors other than money. Such an involvement helps in skills-development, acquiring knowledge from other domains and learning about collaborative work environment. Such skills in turn benefit the overall economy of developing countries; the proliferation of local manpower and industries, technologies in/for local languages and needs and so forth. Besides that, open technologies help maintain the security and integrity of a nation's sensitive information networks like defence and intelligence. It has already been discussed that Open Technologies make up the best technologies that are available in the world. For developing countries that lack sufficient skills and resources to reproduce them, the opportunity to study, modify and distribute them as required by the context of the country provides a convenient and cost-effective way of bridging the digital gap.

In Nepal, Open Technology user groups have been actively promoting them. Many organizations and businesses have been making their use for different purposes. Despite the committment, little has been done by the government to harness the power and opportunities provided by Open Technologies. However, the bright prospect of Open Technologies and the economic advantages that come along are undeniable. Open Technologies have come a long way and for developing economies it seems to be the only way to go.

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