

How to Overcome the Challenges to Large Scale Adoption of Open Source Software and Systems in Pakistan Business and Industrial Environment

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Abstract

In this paper we present details of challenges we have faced in implementing open source software and systems in the Pakistan business and industrial environment over a period spanning last 12 years. The Pakistan business and industrial environment is characterized by many socio-economic trends and forces which are inhibitors to large scale adoption of open source software and systems. However, we also present arguments that there is a strong business case for open source software and systems adoption in Pakistan. We show that the problem is really that of awareness and education. We propose a methodology or strategy whose adoption can provide a suitable response to the challenges being faced.

1. Introduction

Regions like China, European Union and South America have developed into bastions of open source software and systems [1, 2, 3]. In the case of Pakistan open source software and systems' penetration of the overall information systems infrastructure remains shallow. Has open source failed Pakistan or will it actually prevail against the multinational closed source software giants trying to extinguish its flame in a highly consumption oriented Pakistan environment? In this paper we provide our answers to this question in a systematic way and try to put things in context and a proper perspective. Of course, we are biased strongly in favor of open source software and systems adoption in Pakistan. Nevertheless, we provide some strong logical arguments supporting our position.

Now we provide an outline of our paper. In section 2 we present a brief history of the open source software movement. This historical context would allow us to describe the essential features of the open source software paradigm which are presented by us in section 3. In section 4 we summarize the prevailing industrial and business environment in Pakistan and its essential features with respect to information systems and automation. In section 5 we de-

scribe the technical and scientific environment of Pakistan with regard to information systems professionals, computer specialists and information technology companies engaged in development of indigenous products and services. In section 6 we present our business case for the adoption of open source software and systems by highlighting several readily deployable open source software solutions. In section 7 we describe the many obstacles and challenges we have faced over the last 12 years in promoting and implementing open source software and systems. In section 8 we make concrete recommendations for the key players in Pakistan information technology sector in order to make the large scale adoption of open source software and systems into a reality. Finally, in section 9 we provide conclusions based on our work and possible future work on the subject.

2. History of Open Source Software and Systems

Open source software is not a new phenomenon. A misconception is that open source software started its existence with the advent of the Free Software Foundation in the 1980's at the MIT [4]. Software was originally open source. In the beginning when computers started to be made, their hardware was highly proprietary in design. One vendor's equipment or any part thereof could not interoperate with another vendor's equipment. Software was not well developed and very low-level. There was no business model for software. The hardware vendor gave you some software and its source code along with the hardware simply to make the vendor's hardware usable and useful to you and your organization. You had to modify and tweak the vendor provided software to your particular needs and develop other software based on it. Then came high-level languages whereby software became portable. In the 1970's responding to consumer demands hardware was standardized, and along with development of portable software and operating systems, it became possible to use the same software on multiple vendors' hardware systems. Thus a business model for closed source software developed. The software

vendor which came into existence now just gave you executable program to run for your type of hardware and the vendor was assured of a big market for the software because it could run on any hardware vendor's equipment. The personal computer revolution in the 1980's further contributed to the closed source commercial software model to develop and become the dominant business model for software. Many users of the computer and software saw this as a radical and unfair change. The free software movement was started at the MIT by Professor Richard Stallman [5].

The 1990's saw the development of the Internet based on the open source software model and both of these phenomena fuelled growth in each other. By the beginning of the new millennium even many big commercial and closed source vendors like IBM, Sun Microsystems, Novell, Netscape and Hewlett-Packard realized that open source software and open standards-based hardware were the destiny of the information technology industry. We show the relative growths of open source and closed source software in figure 1. The figure is not based on any actual numerical data because no such data is available. However, the purpose of the figure is to show the trend which has been observed and which we explained in previous paragraphs.

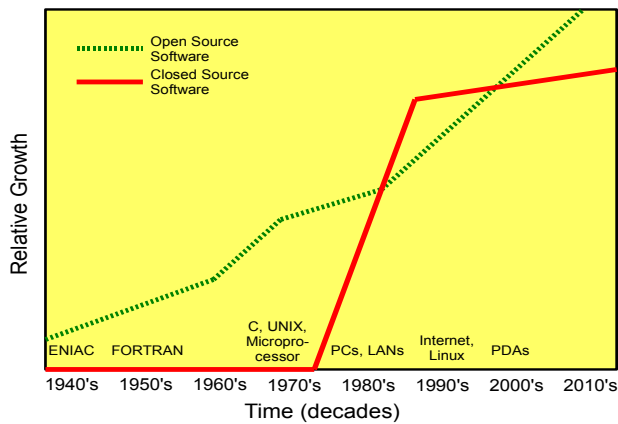


Figure 1. Relative growth of open source and closed source software

3. Essential Characteristics of Open Source Software and Systems

The essential characteristics of open source software depends on the very nature of software itself. Software is unlike any other product which has been developed by the mankind. Software has infinite replicability and software is incrementally improved while relying heavily on reuse. Let us explain this further. For any product to be a financially feasible proposition the inequality given in equation 1 has

to be satisfied:

$$P_{US} > \frac{C_D + (N \times C_{UP})}{N} \quad (1)$$

In equation 1 P_{US} is the unit selling price for the product. C_D is the total development cost of the product. C_D includes all the cost involved in the research, the prototyping and finalization of the product design before mass-production can begin. C_{UP} is the unit production cost for each product unit which includes the cost of the raw material, components, labour, electricity consumed, logistics, etc. and N is the total number of units it would be possible to sell, based on the market demand analysis. For a physical product like a car or a photocopier or a computer, the unit production cost remains fairly constant and significant. The development cost is amortized over N , the expected number of units to be sold.

A software product, like a physical product, requires time and resources to develop. However, unlike physical products the replication cost of software is infinitesimally small. Once the first copy of a software product is ready, it just takes a small amount of electricity and very cheap storage medium (and/or transmission medium if software is delivered via transportation over a network) to produce another copy. All copies are, in fact, identical.

A commercial software vendor keeps charging its users for new versions of its products at the same rate as the original version despite the fact that newer versions of their products are just incremental improvements on previous versions and they have long recovered the bulk of their development costs from the sale of earlier versions. In practicing such a business model the closed source software vendors extract unfair amounts of profits without any justification.

Open source software model on the other hand is based on services. Open source solutions capitalize on software reuse and admit this fact. The customer is only charged for additions, customizations, implementation services, technical support and training costs. These charges too are based on prevailing market rates for such services. This is a more realistic and a fair business model.

Based on the above discussion we would like to highlight the essential features of Open Source Software and Systems:

3.1. Open source is a software engineering paradigm

Open Source is also a software engineering methodology. Software just develops better, quicker and safer when it is done in open source. One of the fundamentals of the open source movement given the name of Linus' Law is that *with enough eyeballs, all bugs are shallow*. [6]. Open source software tends to be well designed. This is so because the design is reviewed on a much wider scale than closed source

software. The future of software development methodology is open source.

3.2. Open source is a fair business practice and a viable business model

Business models developed in the industrial age for physical products are not suitable for the information age software products. Application of those business models has resulted in large accumulation of wealth with few individuals and companies [7]. Furthermore, due to globalization entire countries are coming under the stranglehold of these companies who continue to exploit them as just perpetual consumers who are disempowered and deprived of the benefits of the information age. These neo-colonial practices are also inconsistent with sovereign rights of states and human rights of all people.

3.3. Open source is community driven

Open source software evolution and development is highly user community driven and controlled. Due to this reason open source software is also referred to as community developed and maintained software.

3.4. Open source promotes inter-operability

Open source is the anti-thesis of proprietary and closed systems and interfaces. Open source is vendor neutral. As such open source promotes and practices inter-operability among implementations and free flow of data for the users.

3.5. Open source promotes diversity

Open source model allows for forking of projects and allows community members to develop software project branches to focus on new, different and even radical paths of development.

3.6. Open source is a mindset reflective of the knowledge revolution

The knowledge revolution implies a rapid sharing of knowledge and ideas cutting across organizational, geographical and political boundaries.

3.7. Open source is a movement and an ideology

In our opinion open source is the most important ideology which is a product of the information age. The age old saying that *man does not live on bread alone* indicates that ideas and ideologies too are required to sustain humanity. Open source aptly fills this requirement for the information age. For more information on the open source ideology one may refer to [8].

4. Pakistan Business and Industrial Environment

Pakistan does have a large and broad-based industrial base. The industry has some sectors which are fairly big. There are export oriented as well as local consumption oriented sectors. There is a large manufacturing as well as a large service sector. Some of the large sectors of Pakistan economy are:

- Textiles
- Leather goods
- Cement
- Sugar
- Banking
- Automotive manufacturing
- Military
- K-12 Education
- Tertiary Education
- Agriculture

Pakistan being a developing country the industrial and business environment is generally very cost sensitive. Budgets for information technology are fairly limited. Heterogeneous and incompatible information systems dominate the landscape. All of that is a reflection of competition amongst various commercial closed source software vendors.

5. Pakistan Technical, Scientific and Engineering Environment

The technical, scientific and engineering landscape of Pakistan remained fairly stagnant during the 1980's and most of the 1990's. The globally occurring changes in information technology, educational methodologies for information age and integration of information technology into business processes were only marginally perceived. May be country's political and geo-political compulsions and priorities forced this state of affairs. Other than country's nuclear program everything else technical remained pretty dormant and uneventful.

The quality of faculty in information technology related disciplines (such as computer science, electrical and electronic engineering) remained and to date remains low. Lack of a research culture meant open source software has been less used.

Another national characteristic effecting the technical base is the unthoughtful group mentality. The students like

everyone else in the society are brand conscious. Brand names like Cisco, Microsoft, SAP and Oracle are household names. On the other hand names like Linux, PostgreSQL, Openldap, Samba, Adempiere and Squid don't ring any bells.

6. Are Open Source Software and Systems Suitable for Pakistan?

Open source software and systems are an excellent match for the business and industrial environment in Pakistan. Below we present ten readily deployable open source software and system solutions and high-light the cost savings and benefits possible through them. This list is by no means exhaustive. Also the open source projects recommended for adoption are not the only ones of their types. These are just the projects, which in authors' opinion, are the best of breed and comparable to any of the commercial solutions in their class.

6.1. User Friendly Desktop Solution

The old complaint against open source software used to be the difficulty to use it. As such for many people open source software systems were ruled out for adoption on end user's desktops in businesses and industry. However, the open source movement has responded well to this challenge over the last five years. Desktop systems based on the Kubuntu KDE provide a highly user-friendly environment and take head-on the likes of Microsoft Vista on technical features and ease of use. Use of Linux Kubuntu systems [9] on the desktop can provide at least US \$100 in savings per computer.

6.2. Thin Client Solution

The thin client solution offered by Linux Terminal Server Project (LTSP) is highly robust, feature rich and can result in savings in hardware, software and support personnel costs [10]. Using LTSP in the organization means that PCs can be used for 7-8 years rather than the current 3-4 years. The cost savings in hardware costs alone would be US \$1,000 per user/computer. Other cost savings would result in technical support staff costs because there is no client-side software installation or configuration required. Some of the technical capabilities of the LTSP project such as *Local Applications*, per user access to local peripherals (such as CD-ROM, Sound, USB) make it a superior choice when compared to commercial offerings.

6.3. File and Print Server Solution

File services using either NFS or Samba [11] allow centralization of data for all of the enterprise. Coupled with system of quotas this makes Linux a perfect choice for central storage solution. The Common Unix Printing System

(CUPS) [12] is a multiprotocol printer sharing software. It is highly manageable and supports accounting and quota management. Thus Linux makes for a powerful platform for the bread and butter of a LAN environment, the file and print serving.

6.4. Directory Services, Identity Management and PKI Solution

An enterprise class identity management solution can be created by the integration of OpenLDAP, GOSa and EJBCA. OpenLDAP implements the standards based LDAP directory service [13]. GOSa provides a very nice and intuitive web-based front-end to define and manage all the enterprise resources such as users, workstations, email accounts, servers, etc. using LDAP [14]. EJBCA is the Enterprise JavaBeans Certification Authority software which allows you create large (and small) PKIs and integrate them with the overall organizational IT infrastructure [15].

6.5. ERP/SCM/CRM Solution

The Adempiere ERP/SCM/CRM is a marvelous development that has matured in the last 12 months [16]. Adempiere is a community fork of Compiere ERP [17] which has been developing for almost a decade now. Adempiere has made open source ERP not only possible but preferable. This J2EE based application is scalable and future-proof business software. The cost savings with Adempiere ERP run into thousands of dollars per user/computer. The increase in productivity further provides dividends to the business and the overall economy.

6.6. Messaging and Collaboration Solution

The Kolab project [18] provides an integrated groupware solution which combines multiple proven open source building blocks such as Postfix MTA [19], Cyrus IMAPd Mailbox Server [20], OpenLDAP user and configuration storage [13], Horde Web-based Groupware front-end [21], Kontact rich groupware client, SpamAssassin spam filter [22], and ClamAV antivirus [23]. All of this is integrated and managed by a user-friendly web-based front end developed by the Kolab team. The installation is made trivial by using OpenPKG technology to result in Linux distribution independent installation and operation [24]. The Kolab-based solution easily provides at least US \$100 per user saving in software licensing costs when compared with commercial solutions in its class such as Microsoft Exchange, Lotus Domino and Novell Groupwise.

6.7. Network Perimeter Security Solution

It is very easy to put together a versatile firewall using Linux on an aging PC with multiple network interface cards and using software like iptables, shorewall [25], Squid [26],

MailScanner [27], OpenVPN [28] and webmin [29] to manage all of it through a nice web-based front end. The cost savings are a straight couple of thousand dollars over commercial firewall appliances.

6.8. Software Development Platform Solution

A plethora of choices and tools exist in open source for software development. The Eclipse IDE allows itself to be used for several programming languages such as Java, C/C++, PHP [30]. All of these open standards based programming languages have mature open source compilers and toolchains. Eclipse is suitable for Enterprise application development as well as embedded device software development. Its plug-in based architecture makes it a very versatile tool. On the one hand it integrates well with compilers and debugging tools. On the other hand it provides seamless connectivity to software version control systems such as CVS and Subversion [31].

6.9. Business Environment High Availability Solution

The Linux-HA project [32] has a ready to use business environment high-availability toolkit consisting of Heartbeat [33], Linux Virtual Server [34] and DRBD [35]. The Linux-HA project basically solves the high-availability problem faced in mission-critical business environments. It also provides load-balancing for most clustered services so as to make optimum use of available resources. With Heartbeat version 2 the clusters can consist of any number of nodes.

6.10. Scientific Environment High Performance Computing Solution

Several open source high performance computing projects are available to choose from. PrallelKnoppix has reduced the task of setting up a parallel computing cluster to booting from a CDROM and just running your scientific application on the cluster [36]. OpenSSI and Kerrighed are trying to give single server image cluster which makes the whole cluster look like a big SMP box with a single process and memory space and fine-grained load levelling [37, 38].

7. Obstacles and Challenges to Adoption of Open Source in Pakistan

Despite the attractive business case which open source makes as show in previous section there are obstacles to its adoption in Pakistan. We briefly discuss the main obstacles.

7.1. Open Source Has the Awareness Problem

Open source software suffers from one fundamental business flaw. There is no company which markets the

open source brand. Instead what we have is many small companies which sell services around one or at most a few open source software and systems. On the other hand commercial and closed source software always has some company which markets and campaigns for the products and its brands. In the highly brand conscious socio-economic culture of Pakistan open source is treated like an unwanted orphan.

7.2. Brain Drain

Brain drain ensures that individuals of sufficient technical and analytical maturity are not available in various organizations to give open source the serious thought and evaluation that it requires. Open source depends heavily on accumulation of expertise and knowledge-base over a period of time. Brain drain does not allow critical mass of these to accumulate and as a result open source alternatives simply appear to be bad choices due to lack of human resource trained in them.

7.3. Too Few Open Source Companies

Even when a business or an industry takes the strategic decision to adopt open source software it finds that the number of companies providing open source solutions can be counted on the finger tips. Lack of open source software expertise increases the risks associated with the adoption of open source software solution. As a result of this the closed source software companies get a walk over.

7.4. Open Source Has Lacked Government Support

The government policies have been very erratic and inconsistent in respect of open source software and systems. Around 2002 the Government of Pakistan did take an initiative on the open source front under the umbrella of the Technology Resource Mobilization Unit (TRMU) [39]. The initiative however did not result in the development of any national policy. More recent efforts by the government under the auspices of the Pakistan Software Export Board (PSEB) [40] include the Open Source Resource Center [41]. However, no strategic policy recommendations have ever come out of this effort either. The role of the government should be to formulate the policy framework for the whole nation. Unfortunately, even when the government has tried to promote open source it has gotten involved in nitty gritty of mundane things rather than concentrate on its core role of policy development and policy enforcement. As such the government initiatives have ended up being playgrounds for vendors, be they open source or commercial, rather than policy generation mechanisms which they ought to have been.

8. How to Bridge the Reality and Expectation Gap - Responsibilities of Key Players

8.1. Industry

The most important responsibility of the industry is to develop an awareness and educate itself in the open source software and systems. The rest will follow as a corollary. Industry must understand that the open source business model is based on services and companies that provide open source services must be compensated adequately to be able to survive and be there to provide services around the open source software. The industry must truly understand that open source software is free in the sense of freedom and not in the narrow sense of financial cost alone.

8.2. Universities

The universities must use open source software as a rule and commercial software use must be made an exception. The computer science, engineering and information technology programs must incorporate use of open source tools in all the courses. The faculty and the students must adopt the open source philosophy and consequently become parts of the global community for various open source projects. In this effort the Higher Education Commission must formulate an open source policy framework for the universities.

8.3. Government

The government should make open source adoption into an official national policy and strategic objective. The government must mandate the use of open source software and systems in all of its ministries and departments and the local and provincial governments. On the external front the government must resist all pressures from other governments and large multinational closed source companies who take Pakistan as a market for granted.

8.4. Technology Companies

Technology companies have a responsibility to become active members of various global open source communities. Technology companies in Pakistan have to fully embrace the open source philosophy. Half-hearted or partial adoption and application of open source does not yield the benefits promised by it. Technology companies need to reorient themselves with the open source business model and open source practices.

Several good efforts can be seen in this direction during the last two years. These include the Linux Professional Institute Pakistan [42] and the International Free and Open Source Software Foundation (iFOSSF) [43]. These non-profit organizations are filling the void because pure technology companies working in open source arena are too

few.

9. Conclusion

In this paper we have summarized our experiences and analysis of the open source adoption in Pakistan. We have tried to clarify the open source picture to the un-initiated. We shall continue to undertake the recommendations we have ourselves proposed and we look forward to others to propose and advise with other perspectives. We hope to see adoption of, at least some of, our recommendations on the part of the industry, the academia, the government and the technology companies.

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