Open Source Integration into Business Strategies: A Review

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Abstract

Open source projects have enabled many business establishments to take advantage of robust software at low cost. This is because open source software is one whose license allows for free modification of source code for ease of reusability. This paper discusses the values of Open Source that can be adopted in business development strategies. The concept of open source and open standards were reviewed .The Open source developments have been closely related to our "Open Onions Ontology" approach. This approach has viewed open source development from five layers. Each of these layers is recognized to have strong attachment with the next closest layer in that order. The bond of coexistence between these layers is identified as the unifying factor which forms the basis for open source developers' motivation.

1. Introduction

The Open Source development process is a paradigm that has gained prominence in recent years. The paradigm was recognized and widely accepted with the advent of its high quality and stable products such as Linux operating system, Apache web server and Mozilla Firefox. Other newer successful opens source products are Open office, MySQL database, and Open Solaris. These software applications are considered open source because their source codes are available in a free and ready to use format, they are registered under certain open source licenses and the source codes are allowed to be modified and redistributed either free or for commercial purposes.

Our earlier paper [16] discussed the various software quality assurance activities as specified by various standards organizations; ranging from ISO, SPICE, FURPS and IEEE. These standards are to ensure adherence to software quality standards and models in software development. Comparisons were made to highlight the similarities and differences between proprietary software development and open source software development paradigms. It was discovered that proprietary or open source, they are both software but the licenses and the massive developer/user participation in open source development actually distinguishes the two paradigms

The open-source approach has a lot to offer the business world. With open source paradigm, it is possible for various business organizations to collaborate and find a lasting solution to a common problem of peculiarity to their business nature, which makes it easier to solve through collaboration instead of tackling at individual level.

There is no doubt that industry has accepted and embraced Open Source Software (OSS) [4, 14, 17 and 18] This is because major OSS products have proven to be just as reliable and secure as similar commercial products and even better. Both Linux and Apache have played a big role in gaining industry confidence in OSS [15].

Various open source projects have been successfully accomplished. Some prominent open source projects are Emacs, vim and nano, which are used for code editing. gcc, make and auto conf are used as project builder. X11R7 (from X.org) is used to run x11 applications in parallel with native applications. Ruby and Python are used for scripting. Apache and PhP5 are web servers of great acceptability, Ruby on Rails framework is a web application builder as well. DTrace from Open Solaris is used for measuring application performance. Mac 3.0 and Free BSD5 are operating systems built to fully conform to UNIX operating system.

1.1 Adoption by organizations and government

There is no doubt that both the industry and government have accepted and embraced open source [1, 3, 13, 14, 17 and 18]. Its wide acceptance could be attributed to its ability to provide quality software of high reliability and flexibility at lower cost while providing opportunity users, such as government of various countries, to be liberated from being tied up to a closed source vendor on whose hands is the total control of such a closed source software application.

There is a heavy adoption of open office by Government of various countries, such as Brazil, Japan, Malaysia and the United Nations' encouragement for its member countries. These could be attributed to the 'close to zero' cost associated with open source, and the freedom of not being tied up to a particular vendor..

Malaysia became one of the first Asian countries to propose the use of ODF as a national standard for office documents.

Considering the high volume of usage of the computers and computing technology, the BBC news [17], Brazilian government announced the adoption of Open Source products in place of Microsoft's proprietary patented software, it was stated that the government as at 2005 pays an average of $250 to Microsoft Corporation on every work station.

This has been the trend for most Government policies on cutting down the cost on IT. For example, Malaysian Government, through the Malaysian Administration Modernization and Management Planning Unit (MAMPU), has taken a bold step in ensuring a successful transition of public sector from Microsoft office into Open Standards and Open Document format (ODF) [14]. For effectiveness of migration towards ODF, the Malaysian Open Source Software Alliance(MOSSA) has provided full support to achieve success in the government struggle towards reduction in software licensing cost and the struggle towards the freedom from being tied up to a foreign closed source company.

2. Open source and Business Strategies

The open source software has spanned many phases of business endeavors. The market for Customer Relation Model (CRM) of many years have been dominated by Netsuits, Seibel, Salesforce.com and some others which are predominantly commercial proprietary software applications. The Open Source CRM is now growing in appeal and credibility especially for organizations wanting to cut cost or desiring to integrate existing applications with CRM applications [9 and 10]. The summary of the properties of few of the well rated open source CRM as rated by Google and SourceForge are as described in table 1 below [9].

* http://sourceforge.net/projects/medrec/

However, only three of the investigated CRM software applications are prominent in Malaysia. It could be noticed that SugarCRM, OpenSourceCRM and Compiere are common.

According to Nic Peeling [19], two specific areas have been identified to be of very high need of open source in future, they are said to be Health and Education. The bases for his argument were further supported with some claim:

- Smaller education projects, e.g. St. Johns School at Northwood, London was said to use Linux server to support a network of 24 PC with web serving and email.
- An Australian school is said to have recycled other wise unusable 386 PC's by using them as diskless display terminals running Linux, the applications running on a server.
- Nic also quoted from sourceforge,* that the project which seems worthy of Government interest is the Medical Record DTD (Document Type Definition).

Josh and Jean [20] have presented some details on the impact of open source software on social and economic welfare. It was highlighted that the open source also has some social costs and benefit. It was argued from the economic perspectives that with no profit attached, open source developers may lack incentives to introduce new useful products.

This could therefore theoretically form a basis for the support of some software giants to the success of open source.

Many Venture capitalists have pumped millions of Dollars into various open-source projects as a way of identifying with the open source effort as well as part of their own strategic business commitment.

The strategy is that they do not need to hire paid salesmen nor is there any need to employ software developer(s) for their highly-valued business needs. They are quite convinced that open-source community does a good deal of the heavy lifting for their businesses.

Sun and IBM and many more are high contributors to open source projects. Microsoft, a closed source software merchant, is also calling for collaboration with open source community.

2.1 Business Value of Open Source

It could be noted that if software is produced for free and with open source, then some advantages are noticed immediately, such as closeness to customers and larger market share. Playing on the 'principle of large number', it could be argued that the larger the market share, the higher the support request which is going to increase the profit margin beyond the expected.

It is interesting to note that the best new concept in the world would not pay off in terms of monetary returns unless people know it is interesting. Getting to know how interesting could be a strategically free of charge. This would only make economic sense when we consider software values as service and the expertise associated with the software. In other words, the business values of open source lies in its support and integration.

Table 1 shows the detail about the various Customer Relationship Management (CRM) applications that are available under open source [9]. However, only three of the listed CRM software applications are prominent in Malaysia. It could be noticed that SugarCRM, OpenSourceCRM and Compiere are common.

3. The concept of Open Source & Open Standards

Open source software is software for which the source code is distributed or accessible via the Internet without charge or limitation on modifications and future distribution by third parties.

All software with GPL and other open source licenses fall within this category. Quality associated with such open source software is intrinsic. This is because the quality assurance (QA) activity would be performed by every player in the development phases. The end users are considered to be very important since they also participate in the development. The software quality in this case, becomes 'everyone's job'. This ranges from the project initiator, to the contributors, the users, programmers and everyone who takes part in the project.

Open standard and open format are quite different. Open format is a published specification for storing

digital data, usually maintained by a non-proprietary standards organization, and free of legal restrictions on use. It is allowed for open format to be implemented by both proprietary and free and open source software. In contrast to open formats, proprietary formats are controlled and defined by private interests. Open formats are a subset of open standards. Some of the available open format are OASIS Open Document Format, PDF (Portable Document Format is the file format created by Adobe Systems in 1993 for document exchange.), LaTeX (a document markup language), DVI (a page description language), TXT (an unformatted text format), HTML/XHTML (a markup language), OpenEXR (an image format), JPEG 2000 (an image format), PNG (a raster image format), SVG (a vector image format), VRML/X3D (real-time 3D data formats), FLAC (an audio format), Ogg - Container for Vorbis, FLAC, Speex (audio formats) & Theora (a video format), XML (a markup language) , ZIP and 7Z (data compression & archive formats).

TABLE1: OPEN SOURCE CRM PROJECTS, G BRUCE et. al. [9]

Anteil	Anteil OpenCRM is a company-backed project, with support provided on an hourly fee basis. Public support for the project appears extremely low, with only 2 developers listed on SourceForge. There is also a lack of any documentation for the project, possibly to encourage revenue-generating support requests
CentraView	CentraView has slightly more developer support than Anteil, 11 developers are registered on SourceForge. Free documentation does exist, in the form of an installation guide, start-up guide, programming guidelines and data model. However, this documentation has limited scope, and additional support is available only to customers paying for a hosted service, or at an additional fee.
Centric	While the Centric CRM looks like a capable system, there are some irregularities in its licencing. The main intent of the license is to allow modification, but forbid any distribution or reselling of any modified code. Because of this, it would be difficult for a third-party to use this package without breaking the terms of the license
Compiere	The largest and most supported of the CRM projects is Compiere. It has a reported 800 000+ downloads. It also includes ERP functionality, covering modules such as marketing and sales, field service, production, inventory control, procurement, distribution, human resources, finance and accounting. Support is thorough, and the application is in a very mature and refined stage of development.
Daffodil	Daffodil CRM is the only CRM project examined that uses an embedded database, Daffodil's own One$DB. Database performance is important in a production environment for CRM systems, so this could be seen as a weakness. Beyond an installation guide, there appeared to be no technical documentation for this project, and developer support is charged for. There does not appear to be any community involvement with the project.
Hipergate	This project appears to have a decent amount of support behind it, although there are only 6 developers registered on SourceForge. There is extensive documentation, including API JavaDoc, available from their Web site. The APIs should allow for Hipergate to be a flexible solution, but the functionality of Hipergate seems limited compared to larger solutions such as Compiere.
Ohioedge	Ohioedge CRM looks like a proficient company-backed package; however, developer documentation as well as support is only available for a fee.
Open For Business	Open For Business (OFBiz) is designed as a base package that provides the foundation to be built on for a custom CRM, ERP and eBusiness package. Documentation is extensive and includes APIs. There is also large community support, as well as evidence of the package being used in production environments and on eCommerce Web sites.
OpenCRX	This is a well maintained project, with regular updates and a well-defined road-map. However, the community support looks small. Installation guides, user guides and customisation documents are available, but there is little in the way of full technical documentation.
OpenSourceCRM	The only information for the OpenSourceCRM project is on SourceForge. There is no documentation and there is little obvious community support.
SourceTap	This project is based on OFBiz, and claims to be sales force automation (SFA) tool. Documentation is extensive; however, the licencing model has been extended from the OFBiz licence, so that there is a free licence for 'open source use', but commercial use is charged for.
SugarCRM	This is another of the larger open source CRM packages. The company offers pre-packaged rack-mount servers for commercial use, as well as fee-based support. The open source branch of the project is well supported with its own
vTiger	This project is based on SugarCRM. There does not appear to be any major points which differentiate the two projects; however, vTiger offers plug-ins for several mail clients. The community base for vTiger is smaller than the community for SugarCRM.

Open Standard: The terms "open" and "standard" have a wide range of meanings associated with their usage. The term "open" is usually restricted to royalty-free technologies while the term "standard" is sometimes restricted to technologies approved by formalized committees that are open to participation by all interested parties and operate on a consensus basis.

Open Document Format (ODF)

ODF was published by OASIS i.e. Organization for the Advancement of Structured Information Standards. Meanwhile, the ODF is an XML based open standard enabling office documents software to format, save and exchange file documents such as text, databases and spreadsheets.

Open source software development could be likened to open onions ontology as it describes the layered representation of its participants. The maintainers,

being at the centre of the affairs, determine and authenticate which contribution(s) conform to the overall project objective and also determine which of the submitted contribution does not retard the overall accumulated efforts.

Open Source Licenses

The first conformance to standardization could be attributed to the Open source License [viii, ix]. Various licenses exist and of widely uses are ten of them. They are: Apache Software License 2.0, new BSD License, GNU General Public License (GPL), GNU Lesser General Public License (LGPL), ISC license, MIT License, Mozilla Public License (MPL) 1.1, Common Development and Distribution License, Common Public License 1.0 and Eclipse Public License.

3.4 Standardization in Open Source Development

Linux Standard Base (LSB): "The Linux Standard Base delivers interoperability between applications and the Linux operating system. Currently all major distributions comply with the LSB and many major application vendors, like MySQL, RealNetworks and SAP, are certifying. The LSB offers a cost-effective way for application vendors to target multiple Linux distributions while building package. For end-users, the LSB and its mark of interoperability preserve choice by allowing them to select the applications and distributions they want while avoiding vendor lock-in"

Freedesktop.org is open source / open discussion software projects working on interoperability and shared technology for X Window System desktops. The most famous X desktops are GNOME and KDE, but developers working on any Linux/UNIX GUI technology are welcome to participate. Freedesktop.org is building a base platform for desktop software on Linux and UNIX. The elements of this platform have become the backend for higher-level application-visible APIs such as Qt, GTK+, XUL, VCL, WINE, GNOME, and KDE. The base platform is both software and standards ii. Others are: Filesystem Hierarchy Standard[iii], Austin Common Standards Revision Group[iv] and Debian Policy Manual[v]

It could be argued that open source conforms to some specified standards. When registered with any of the existing projects, then there are pointers to the documentation and working guidelines in conformance to open standards. David and Alfonso [6] have discussed other application areas of Open standards such as GSM, MPEG.

3.5 Interdisciplinary Applicability of Open Source

Open Source is said to also be social phenomenon as its usage transcends only the issue of source code releases. George von and Sebastian [11] have made comprehensive inter-disciplinary studies of various views of other disciplines on Open Source. The fields under studies were *Economics, Psychology, Cultural Anthropology, Management & Organizational Studies, Sociology and Legal Studies*. They argue that the phenomenon provides and excellent context to promote greater dialog between disciplines and fields. The recent diffusion of Open Source software model of innovation to other areas shows that the field of Information Technology systems has an important role to play in the future research of various fields of endeavours.

However, Feirong and Jin [8] have described the open source arrangement as having a ring-like shape, focusing more on a pre-defined knowledge in a repository to be shared in a ring-like onions manner.

4. The proposed Open Onions Ontology Approach

The hierarchy involved in the onions ontology is as described below. It was captured with onion diagram showing the extent of closeness and bond of coexistence of each layer in the open source development. It was labeled 'a' to 'f' in bottom-up approach.

TABLE II: OPEN ONIONS ONTOLOGY FRAMEWORK

labels	Relevance
a	Project Initiation Layer
b	The Maintenance Layer
c	Developers Layer
d	Users Layers
e	Observers/Non-Interest Group Layer
f	External Layer

Layer **a** is the root of the project. This is the initiation phase. The open source project initiator is the person who started the project and eventually, does not necessarily have to be the core maintainer(s).

Layer **b** is the maintainers' layer. .The maintainers are those people who are responsible for the acceptance and rejection of submissions. They match the submissions to the overall objective of the project and determine the suitability of adding such contribution to the existing overall efforts.

Layer **c** is the developer's layer. These are the people that are very much interested in the particular open source project and are actually working according the available policy documentations and guidelines to maintain top-level quality of such projects. However, their contributions are subject to ratification by layer **b**.

Layer **d** is for the users. These set of people are not necessarily programmers, but they want to have a hands-on experience in order to understand the utilities of the resulting end-product. They are therefore considered very important in the development as their contributions also help in the successful implementation of the project.

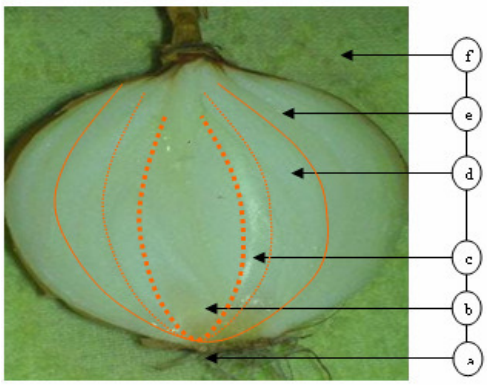

Figure 1: Open Onions Ontology

Layer **e** is considered the set of people wanting to have fun around the codes. They are programmers not interested in that particular project but are willing to have a feel of it. Their coding is not necessarily submitted or is rejected in an attempt to submit.

Layer **f** is the external environment such as the observers. Everybody knows that onions do not grow without an outermost shell. The shell will eventually be pilled off but it has to be present to serve a purpose. David Schlesinger in his own approach, has identifies the different layers of Open Source development as *Mailing List with Archives of Participants.* The Maintainers are said to be the ones to critique and approve suggested changes proposed for the projects [5].

5. Quality Issues in Open Source Development

Building high quality software is the goal of every software organization. Especially in the case of open-source software, quality is a big concern. But quality of software is not easy to define precisely, and there are many different aspects to it. Quality is certainly more than the absence of bugs.

A new release of a software product generally contains bug fixes for the bugs found after the previous release, and enhancements to the functionality. This is made a lot easier when the source codes are readily available at no cost. However, in order to manage and improve software processes more thoroughly, several standardization techniques have been developed across various phases of software developments during the last decades. Some of these are as specified by various quality standardization organizations.

ISO 9000 describes the quality elements that must be present for a quality assured system to be compliant with the standard, but it does not describe how an organization should implement these elements. ISO 9001 is the quality standard that contains the requirements that must be present in an effective software quality assurance system. In addition, quality can be defined in terms of a broad array of quality factors and measured using a variety of indices and metrics. SEI's Capability Maturity Model (CMM), Humphrey's latest Personal Software Process (PSP), BOOTSTRAP - the European approach, SPICE - the new International standard being developed, The international guideline ISO 9000-3, The British standard related to ISO 9000-3 : TickIT, European project result: AMI i.e. Application of Metrics in Industry.

With a very high growth rate of acceptance [3], Apache web server was said to occupy about 70% of the market share as at February 2005. This goes a long way to show the level of industry confidence in open source products. The Open Source development process has defied traditional software development practices by generating widely accepted products (e.g. Linux, Apache, Perl) while following unconventional principles such as the distribution of free source code and massive user participation [4]

The economics of software componentry leave system developers with no choice but to incorporate large commercial-off-the-shelf components into their systems. Unfortunately, developers have no way of knowing what is inside those COTS components, and they have no control over the direction of their evolution. Software architectures and COTS decisions are made hastily, and the time pressures leave no opportunity for code adjustment and optimization even at leisure.
In the past years, software engineers have addressed quality by a way of applying solid technical methods and measures, conducting formal technical reviews, and performing well-planned software testing.

Despite all these attempts according to Boehm and Basili [2] software still remain surprisingly fragile, prone to unpredictable performance, dangerously open to malicious attack, and vulnerable to failure at implementation despite most rigorous development processes. In many cases, they said, software has been assigned tasks beyond its maturity and reliability.

DeMarco [7] explained that the quality of a product is a function of how much it changes the world for the better. This could suggest that the overall quality of a software product has a direct relationship to the user satisfaction.
Open source projects have enabled many institutions to take advantage of robust software at low cost.
With open source development, software quality is everyone's job. Better quality can however be achieved through competent analysis, coding, multi-layered testing strategy, better control of software work products and the changes made to them along with application of acceptable open standards.

6. Role of SourceForge, Open Source CMS, Open Office.org to enhance Business Values

Quite a number of activities are going on in the opens source development set-up. SourceForge.net is a site where major open source projects are published. This is a site that facilitates interoperability by making it allowing effective communication between the various layers of the open source development as described in the open onions ontology arrangement above.

Major open source projects are made known under the SourceForge.net and Open Source CMS portals. As at 31st March 2008, there are about 173,292 registered projects and registered users of about 1,819,869 that could be tracked under sourceForge.net projects.

*SourceForge.ne*t is the world's largest Open Source software development web site. SourceForge.net provides free hosting to Open Source software development projects with a centralized resource for managing projects, issues, communications, and code.

The existing open source codes are made available for new projects to reuse, each projects policy standards are published under each group to facilitate understanding and uniformity of purpose amongst

members working together in the group. The programming standards, the document standards, the accessibility standards are clearly spelt out under each group working document standards. Where necessary, web portals Open standards are specified such that WebPages regarding the project portal could be of open format so that any browser should be able to load it without error.

Openoffice.org is another site well known for publishing and enhancing the interoperability of various documents. This is made possible by ensuring the open document format standard to be able to ease out interoperability problems.

The Open Desktop is another group working towards standardizing the desktops so as to facilitate ease of plug in to enhance easier interoperability among components. The aspect of desktop interoperability which is supported range from office applications to multimedia, business and educational among others [12].

7. Discussions and Future Work

Team work is a strong underlying factor behind the success of open source. Therefore, every business stakeholder should consider himself as an active team player. Success is further enhanced by personal motivation. This implies that every member of the strategic business goal should be personally motivated even though with an initial zero-monetary value. The end should justify the means.

The strong bond of co-existence between various layers of Open Source development as described in the open onions ontology is a unique way of unifying like-minds in order to achieve a common goal of developing quality software to enhance or improve business strategies. An on-going research on complete specifications of the interactive relationship between the five layers would completely highlight the relationship between these layers.

This strong bond has facilitated developer's readiness to support the course of open source products. This is evident in their way of collaboration and understanding to utilize common framework, architecture, programming styles and adhere to quality software standards while dancing to the business tunes appropriately in order to achieve success in the project group of concern.

Identifying the appropriate quality factors such as adherence to framework, standards and open architecture for high interoperability are also key factors in the open onions ontology approach.

However, further research is being conducted on complete specification of the interactive bond of coexistence among all the layers in the open onions approach.

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