Open source software (OSS) is changing the way organizations develop, acquire, use, and commercialize software. Organizations varying from traditional software houses to service providers from the public and private sectors have realized benefits of OSS. Still, there are conflicting views on what the OSS phenomenon is. Moreover, much has been written about OSS from different perspectives.

The benefits from industrial OSS adoption have been generally stated as: reduced cost through either lack of licenses or reduced hardware requirements, standard compliance, freedom from vendor lock-in, and those related to the existence of an active community (e.g., community contributions in form of bug reports, bug fixes, feature requests, and implementation of functionality). The drawbacks have been generally stated as: OSS products may lack (professional) support; and there might be hidden costs related to adopting and selecting suitable OSS, replacing existing technology, changing current processes, customization needs and participation in the community.

Existing reviews of OSS deal with topics such as community-based analysis [1], processes inside communities [2], weaknesses and needs of empirical research [3], and reflections on the different implications of the phenomenon [4]. But there has been a lack of consolidated evidence about how organizations may exploit OSS benefits. Thus, we conducted the first systematic literature review that focused on OSS adoption in organizations [5]. Our focus was software-intensive organizations, which we define as private or public organizations extensively using or developing software. From 24,289 publications between 1998 and 2008 from relevant SE journals (24), conference and workshop proceedings (7); we found 1540 papers related to OSS. 112 of these contained empirical evidence on practical implications of OSS adoption in organizations. Here we summarize five facts from the 112 papers, highlighting the benefits, challenges and risks faced of such adoption.

Facts of OSS Adoption

1) Ways of adopting OSS

Software-intensive organizations adopt (i.e., benefit from) OSS in at least six different ways (see Table 1). It should be noticed that there are interdependencies between these 6 ways. For instance, an organization may approach OSS in several ways at the same time, and evolve its approach to OSS over time, e.g., from initial use of OSS CASE tools up to providing their own OSS product(s). Hence, the 6 ways of adoption presented in Table 1 are not mutually exclusive.

As the involvement with the OSS community grows, the impact on business strategies and potential benefits and risk of adopting OSS grows as well. Thus, using and deploying OSS tools for example, have a lower effect on the business strategy of the company than the other ways of adoption. The evidence shows that organizations actually work in a variety of domains and employ customized versions of the 6 adoption ways presented here. Small and medium size organizations are pioneering OSS adoption when it comes to lower involvement with the community, while large-size companies are more proactively exploring opportunities to adopt OSS in order to remain competitive and innovative. The last column in Table 1 shows the types of organizations that have been most likely so far to adopt each way.

Keeping in mind that several ways of adoption exist, organizations should carefully evaluate these ways before deciding the most convenient way for their needs.
2) Risks Exist!

The OSS phenomenon has plenty of advantages and benefits, but also risks and challenges. Many organizations are persuaded to adopt OSS only because of the hype of perceived advantages of OSS, without knowing whether they will benefit from it and without having a clear strategy behind the adoption [6]. For dealing with the OSS hype, organizations should be aware of the different risks, benefits and challenges that each way of OSS adoption offers and plan specific strategies to deal with it. Table 2 shows some possible hidden costs, as well as technical and managerial issues related with each way of adoption, that should be considered for any organization aiming to adopt OSS.

In addition, traditional project and risk management strategies should be enforced to deal with common problems. Some general risks mitigation strategies in the OSS scenario are: 1) There should be a feasibility plan for the main organizational needs and goals with respect to OSS, as well as the resources that can be invested and the benefits expected. This should be followed by executing pilot projects and planned stepwise adoption. 2) The organization should carefully choose the products to be adopted, preferring the ones that are of strategic importance to the company, show a clear value-added to the organization and are mature enough to ensure the potential community support. 3) The organization should make sure that the high-level managers and employees foster the OSS adoption, and that they pose the required skills to adopt OSS (hire new or train existing personnel).
<table>
<thead>
<tr>
<th>Ways of Adopting OSS</th>
<th>Using OSS CASE tools</th>
<th>Deploying OSS products</th>
<th>Using OSS Dev. practices</th>
<th>Integrating OSS products</th>
<th>Participating in OSS development</th>
<th>Providing own OSS products</th>
</tr>
</thead>
<tbody>
<tr>
<td>Training and support related to the adopted OSS product</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Dedicating skilled personnel to the community</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Providing necessary resources for enabling community collaboration (e.g., tools, infrastructure)</td>
<td></td>
<td>X</td>
<td></td>
<td>X</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Improved functionality may require further licensing costs</td>
<td>X</td>
<td>X</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Organizations may require supporting services for selection and/or integration issues</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Organizations may require legal staff to envisage a commercial strategy</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Compatibility issues with data formats or specific versions of other software</td>
<td></td>
<td>X</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Problems in following new releases or ensuring backward compatibility and maintenance</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>X</td>
<td></td>
</tr>
<tr>
<td>Need of defining strategies and procedures for community collaboration</td>
<td>X</td>
<td></td>
<td>X</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Hard to select the right product due to the amount of products and information available</td>
<td>X</td>
<td>X</td>
<td></td>
<td>X</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Protection of Intellectual Property Rights (IPR) (i.e., enforcing company strategies)</td>
<td></td>
<td>X</td>
<td></td>
<td>X</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Need of a clearly defined business model in line with OSS related issues</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>X</td>
</tr>
<tr>
<td>There are few opportunities to influence existing communities than when the company establishes its own new community</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>X</td>
</tr>
</tbody>
</table>

Table 2: Some issues to consider for each way of adopting OSS

3) There is Diversity

There is a large diversity of initiatives and projects under the OSS “umbrella”. However, the literature has hardly reflected this diversity, but rather has focused on large, high quality and successful products and communities as GNOME and Debian GNU/Linux, portals like SourceForge, large companies as Nokia, Philips Medical, and Hewlett Packard, and well-known OSS companies such as MySQL and JBoss. These are all cases of successful, good quality projects, but not the whole picture.

Few studies report on problems, unforeseen hold-ups, and outright abandonment of OSS-based implementations over time. Some of these few papers report that the majority of OSS projects struggle to attract contributors [7], and that the quality of OSS software is not always as good as expected [8].

In this context, it is vital that practitioners are aware that the OSS phenomenon incorporates a huge diversity, ranging from high quality and successful products to projects that do not reach any of these characteristics. Such awareness would contribute to avoid the rowdy hype of OSS advantages and foster more informed decisions regarding OSS adoption.

4) Radical change?

The history of OSS has been characterized by contrasts like OSS vs. proprietary or closed source software [9], the cathedral vs. the bazaar [10], OSS development vs. software engineering [11], and so on. Although parts of the literature have treated OSS adoption as something new and quite different
from other information technologies and methods for software development, much of the research on OSS in organizations has in fact profound similarities with other research.

The evidence reveals, for instance, that organizations deploying OSS are facing similar and mostly organizational challenges, as with adoption of other technologies. Thus, OSS technology adoption depends more on the actual organization adopting it and on the context in which it is adopted, than on whether the technology is “OSS” or not. Integrating OSS components into other products poses very much the same challenges as when integrating proprietary components (i.e., COTS). Actually, many of the claimed advantages of integrating OSS (like reduced development effort, better quality, and so on) are advantages of software re-use, with some flavor.

Thus, practitioners should realize that OSS adoption can be like adoption of any other technology, and act accordingly.

5 It is all about business

The mythical characterization of OSS as a phenomenon consisting on talented people freely volunteering their services to produce high-quality software is clearly outdated. The OSS phenomenon has evolved into a more commercially viable form, where both volunteers and commercial organizations collaboratively contribute to evolving the phenomenon.

The OSS phenomenon is changing how software is built, used, and commercialized. OSS is therefore of strategic importance for many commercial organizations. Several organizations are strategically considering participating or setting up OSS communities, and radically changing their business models, according to the needs of their customers and communities.

Organizational strategies are becoming an important part of the communities, so OSS and organizations are no longer two separated concepts.

Recommendations

Our review shows that the interest on OSS adoption in organizations has increased in the last years and that many of the related challenges are similar to the challenges in other research areas. Thus, to remain competitive and innovative both economically and technologically, software-intensive organizations need to adopt and foster state-of-the-art solutions mainly for four OSS-related areas:

- **Component technologies:** to envisage component technologies that result in more flexible software architectures (e.g., common component models such as Java beans, Python packages, Web services and their generalizations, plug-ins). It would reduce the cost of building and integrating different OSS components. In addition, it would promote OSS adoption in vertical domains, such as more high-level middleware platforms.

- **Global software engineering:** to let Internet-provided, cooperative facilities enable nomadic and collaborative work processes as in OSS, off-shoring, and outsourcing. It would allow and promote another (better) dialog between end-users and OSS developers.

- **Open and innovative business models:** to support processes and strategies to face the related challenges of being open. In this scenario, open innovation [12] in OSS is a powerful framework to define matching business models between communities and organizations based on mixed internal and external financing.

- **Cooperative ecosystems:** to extend today’s OSS communities to not only share code, but diverse intellectual property such as awareness insights, experiences, and guidelines around OSS adoption, and with legal and economic advice. This is especially relevant for small and medium size companies, but also larger companies can benefit by mobilizing their international networks.

We urge organizations to use the facts presented here to explore the possibilities that OSS adoption offers. More important is to use this evidence to clearly understand and identify the unique benefits,
drawbacks and practical challenges that each way of OSS adoption entails, and to leverage adequate strategies according to the organizations’ own contexts, needs, and resources.

References:


