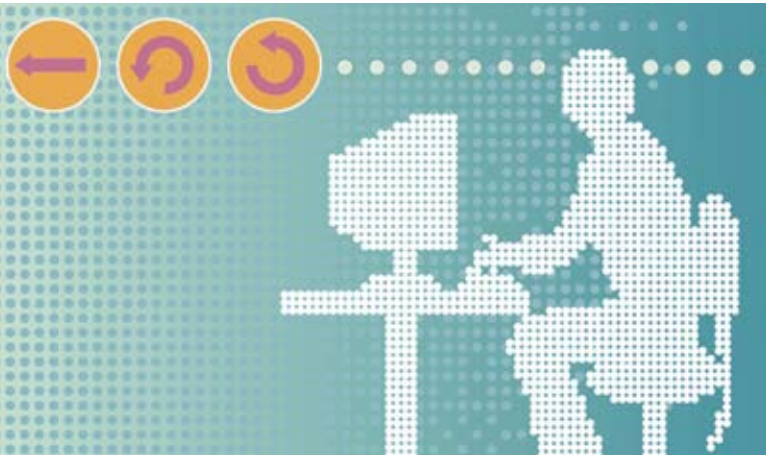


Lessons Learned from the Adoption of Open Source Software

By B. Fitzgerald, J. P. Kesan, B. Russo, M. Shaikh & G. Succi



Adopting and assimilating innovation in the Public Sector is a multi-faceted process that involves a large and heterogeneous population of employees. As traditional vendor support is not ensured, managers need to implement strategies to champion OSS within their public organization. Individual factors and political machinations also play vital roles in this process. In this article, the authors present a comparison of management decisions and actions that have determined the success or failure of the OSS adoption process in five real world cases. The lessons learned would readily transfer to other innovation contexts, such as open innovation, more generally.

Early implementations of open source software were largely in the form of back-office ‘invisible’ infrastructure’ applications – the Linux operating system, Apache web server, Samba file/print services, for example.¹ These applications were adopted by ‘tech savvy’ ICT staff, often deployed ‘under the radar’ as no formal organisational approval was needed since these applications were free of charge. However, that landscape has now changed as OSS has moved to more visible front-office applications. Indeed, it is difficult to find any area of software development where OSS is not in use to some extent.² In this context, the stakes have shifted and adoption is a more risky endeavour that can become problematic in those organizations with limited resources and heterogeneity of end-users such as the public sector. Championing OSS can make the difference in this case. Managers are called upon to define strategies to challenge employees and mitigate the risk of failure. When the adoption is a success, organizations can further benefit from the effects of open source innovation. Namely, one intriguing facet of the open source phenomenon is the effect it has had on fields and methods of

organizing outside of software development, e.g., crowdsourcing of ideas, the move towards open collaboration as a ‘better’ form of innovation, open government, and open standards. The lessons presented here are relevant more generally to these domains in the heterogeneous society of public organizations.

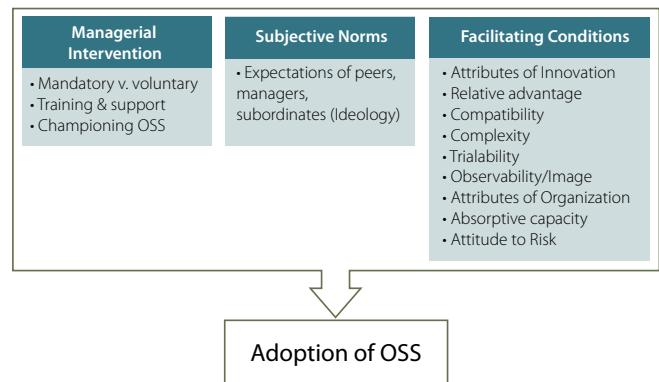
The case studies from which these lessons have been drawn represent a hospital in Ireland, an ICT support consortium in Italy, the Chamber of Deputies in the Italian government, a technology and innovation support unit in Extremadura in Spain and the Commonwealth of Massachusetts in the United States. Thus, they represent a wide geographical spread and a good cross-section of public institutions.

A Framework for Studying OSS Adoption

Our analysis is structured along the lines of the framework proposed by Gallivan³, who draws on Rogers⁴ for studying adoption of ICT such as OSS (see Fig 1). We use such a framework to present our findings related to OSS adoption in the five public institutions studied.

Managerial Intervention refers to actions taken, and resources made available, by management for the purpose of expediting adoption. This includes issues such as whether adoption is mandatory or voluntary, the provision of training and support, hiring new employees or consultants to act as mentors, and the championship of the OSS adoption initiative. Management support is undoubtedly critical for radical, high-risk initiatives such as OSS deployment because it contravenes the traditional model where on-going support is legally guaranteed by a vendor. Indeed, management support is likely to become even more important in the future as OSS adoption moves beyond the domain of invisible infrastructure systems and into more visible, high-profile applications.

Fig. 1 Framework for OSS Adoption (adapted from Gallivan 2001)



Subjective Norms concern how individuals believe their peers and co-workers expect them to behave in relationship to technology. This can lead to enhanced efforts to learn about and adopt an innovation, or even lead to the abandonment of a technology. This issue resonates with attributes of the innovation itself, such as compatibility and image. The importance of ideological values in OSS has been well documented.⁵

Facilitating Conditions include both attributes of the innovation and attributes of the organisation. Attributes of the innovation are largely drawn from Rogers who identified five key perceived attributes of an innovation that influence the outcome of the adoption process:

- Relative advantage - the extent to which an innovation is perceived as being better than its precursor.
- Compatibility - the degree to which an innovation is perceived as being consistent with the existing values, norms, needs and past experiences of potential adopters.
- Complexity - the degree to which an innovation is perceived as being difficult to understand and use.
- Trialability - the degree to which it is possible to experiment with an innovation.
- Observability - the degree to which the results of an innovation are visible to others.

In brief, Rogers suggests that innovations become diffused more quickly and successfully when they are readily *trialable*, have high *relative advantage* in comparison with the incumbent technology, are *compatible* with the preferred work practices and values of people, are not excessively *complex* to use, and where use is readily *observable* by others. These attributes have been confirmed in many studies. Additional relevant specific attributes of innovations, such as *image*, have been identified. Although this might be subsumed into Rogers' category of relative advantage, we believe it is worthy of isolation given that it has been confirmed in several studies.⁶

Attributes of the organization include general attitude to risk, IT governance policies and standards in relation to software, and absorptive capacity.

Risk-averse industry sectors often exhibit a reluctance to engage with inherently risky implementations such as OSS, because they do not offer traditional legal comforts such as vendor-guaranteed hotline telephone support and written maintenance contracts.

In sectors which are highly regulated and where interoperability is paramount, long-standing IT governance policies may exist in relationship to IT infrastructure. These were often drawn up in an era when OSS solutions were not widely available, and may wind up mandating a proprietary software solution by default even when there is no compelling reason to do so.

Absorptive capacity refers to an organization's ability to recognise the value of new information, absorb it and subsequently leverage it productively.⁷ Absorptive capacity is relevant for OSS adoption in general. The ever-increasing number of OSS applications that continue to appear in the marketplace represent a significant knowledge challenge that needs

to be overcome. For example, the knowledge of what applications exist, which applications are most viable, how well applications are supported, what functionality applications offer, and how applications can be integrated with other OSS, or proprietary, applications.

Below we use the framework in Fig 1 to discuss significant issues in OSS adoption as it took place across the five institutions studied.

Managerial Intervention

A thorny issue in relation to OSS adoption concerns whether adoption is seen as mandatory or voluntary. In the cases where adoption was mandatory, there were a number of unexpected and unhelpful consequences. Firstly, there is always likely to be some natural resistance to mandatory usage of a technology. However, this is exacerbated if particular cohorts of users can opt out of usage, as this creates an elite group who are seen as privileged. This was borne out in a comment from a user: "*You meet people and hear they are using <original proprietary software >, and you immediately ask them how they managed to do that.*"

In terms of training and support, in some cases there was a tendency to underestimate the level of training needed because they saw the OSS products as being similar to proprietary products being replaced. Where training was tailored to meet user needs, this helped promote adoption, and also helped employees to up-skill their competence set. Also a common misperception is that free software should also imply free training. This is not the case and money spent on high quality training consultants can have a big payoff. Such costs need to be considered when estimating the total cost of ownership (TCO) of OSS.⁹

Championing the adoption of OSS was very much a factor associated with success in the cases studied. Such championing is all the more necessary in the case of OSS as there is typically no software vendor who would traditionally perform such a marketing role.

Subjective Norms

For some OSS advocates, there is a strong ideological conviction which underpins their use of OSS. However, this is by no means universal. Ideological fervour was evident in OSS champions in the organizations but the decision to adopt OSS was more a pragmatic one. There was also evidence in the cases studied that some people perceive their work being undervalued if asked to use free software. This is captured in a quote from a user who suggested that their "*<open source package> was a poor man's <proprietary package>.*" Thus there was feeling that users were being de-skilled through adopting OSS. Indeed in some cases the use of OSS was also seen as a loss of independence because it was an imposition on users. This was exacerbated if there were no other local exemplars in the same sector that could be referenced as a successful comparison.

Attributes of the Innovation

Here we discuss a number of specific attributes that are

inherent in the technology itself and their effect on adoption.

Relative advantage/Compatibility

It is important to illustrate the relative advantages of the OSS solutions. The training phase is the natural place to do this. In the Spanish case, a version of Linux was created especially for the project with specially tailored features. Also, it was beneficial if users could use the new OSS products at home as well as at the workplace. It was also found to be less problematic when the OSS solution was not replacing a previous proprietary system, as in such circumstances relative advantage was not an issue. The feeling that the proprietary solution was better was captured in a quote from a user: “*we didn't think <open source package> was given to us as a bonus. We thought <proprietary package> had been taken away*”

The issue of compatibility is also related to relative advantage in that solutions should be compatible with the needs of users. In one case studied, a major problem arose through the failure of the OSS system to maintain a service for disabled users. This was a highly emotive issue which served to tarnish the image of the OSS solution.

Observability/Image

In Rogers' view if people observe others using a new technology, which typically would have a positive image, it would enhance adoption prospects. However, both observability and image are more complex in the case of OSS. Firstly, observing that people are using OSS can be confounded by the fact that many OSS products are designed to be as similar as possible to proprietary counterparts. Also any differences may be downplayed to make it easier for users. And as the Irish case shows, perhaps downplaying the fact that the software is OS may well do less observable harm. Thus, the image of OSS can be negative. In one case, although the OSS code base was newer than the alternative proprietary product, the OSS product was seen as antiquated and from “*Jurassic Park*”. In another case, OSS had a much more positive image as it was seen as a flagship project leading the rest of the country.

The Spanish case reveals that observability is useful at both the internal and external level. Internally, the organization found that being able to compare and perceive the difference between OSS and other software lead to internal discussion among staff, especially between the users and the developers. Better software in terms of matching real user requirements was noticeable which made the work of training less stressful for the trainers and users. Again at an external level more communication was evident but this time it meant better engagement with open source communities and expertise but also formed a part of the strategy of showcasing the OSS adoption occurring in this organization to other local councils.

Trialability

Trialability is a key property of OSS as the software is usually openly available as a free download. Thus it is easy to

experiment. Nevertheless, this was sometimes associated with a perception that training would not be needed. Nearly all the cases however, refute this idea in practice because training is essential, and when done well with plan and thought can ameliorate many complications of adoption.

The Spanish case makes the importance of being able to experiment with OSS products at home quite evident. One of the Italian cases, in particular however, showcases how trialability enhanced adoption. Multiple distributions of the OSS were experimented with and as the conditions of use in the organization were highly complex and demanding this proved a very useful strategy. The trialling of distributions was held in an open manner where external vendors were allowed to be a part of the process of customizing the software. This in turn created vendor support for more than one distribution, and reduced lock-in in general.

Attributes of the Organisation

Absorptive Capacity

As OSS evolves, the absorptive capacity is growing in organisations. For example, students typically have a good deal of OSS experience by the time they finish their studies due to the high prevalence of OSS in education now. Also, the OSS ecosystem now comprises networks of small local software companies who have become key partners supporting OSS products. The cases studied suggest that this is a very important factor for successful adoption of OSS in the public sector. In the Irish case the choice of OSS application was partly based on the relative familiarity of the users to the package. This may pose issues for comparison but it needs to be weighed in relation to faster learning by the users and assimilation in the organization. Good training was a strategy that the Italian cases make obvious. The Spanish case offers, what was at that time, an innovative strategy in a more IT infrastructural platform model that formed the basis for learning and change. This, coupled with a deeper understanding of planning methods and templates provided a translatable capacity to other areas.

Attitude to Risk

Given that OSS is not a process where those embarking have the safety net that comes with proprietary implementations involving a choice of product vendors for marketing, tailoring and user support, it can represent a rather risky undertaking. The cases studied reveal that there was a positive attitude to innovation, and a healthy tolerance of risk. In one case, it was the first government in the world to mandate open standards, and in the past had been the first to create a public library, a public school, and a public subway.

Lessons learned

In adopting OSS, managers need to reflect on three different levels: strategic, social, and organisational. Neglecting to properly consider any one of these three aspects could result

in failure and significant financial loss.

The five different case studies provided a few key lessons, which we summarise here.

1. Managers need to sustain the process of adoption with specific actions focused on training in the OSS products being deployed, and championing the OSS adoption process in their organisations. The provision of training and championing a technology are related actions. They are often neglected in traditional technology adoption, but in fact are powerful in combination, especially in the case of OSS where traditional vendor support is lacking. There is a need for a clear training plan which does not end with a limited amount of short-term training during the early stages. What is required is phased, highly contextualized (with respect to the organization's needs), and made-to-measure training plan for different job roles. Long-term enthusiasm and sustained adoption is possible with systematic, planned training. The aim of the training is to improve the relationship between the user and the software by creating awareness and positive rapport. Furthermore, seeking to identify and empower lead-users that can then act as mentors for the wider adoption is a very successful strategy.

2. Managers need to understand that the use, and indeed non-use, of OSS is often driven by ideological conviction. As such, campaigning for or against OSS will not lead to uniform success. How this conviction is exploited for adoption is crucial. Individuals can react to OSS adoption initiatives in diametrically opposed ways, i.e., with an adverse attitude, or with a positive attitude extending all the way to co-creation and crowdsourcing. Mandating usage for only some categories of users can create problems. Usage should not be a function of one's position in the organization hierarchy, and permission to opt out of usage should not be seen as a privilege for more important employees. Organizations should instead consider practicing blanket implementation and adoption of any form of OSS. In short, a thorough understanding of people issues and underlying informal social structures is of foremost importance.

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3. OSS adoption is not successful in all environments. There are conditions in relation to both the technology and the organization that ensure that the environment is more conducive to success. For example, the greater accessibility and observability of the OSS technology can in fact be detrimental, as in some organizations users might perceive no advantage, or even perceive disadvantages, to use OSS in comparison to existing software. Such organizations often have little tolerance to risk and experience with OSS.

Conclusion

Adoption of open source software by public institutions is a strategic challenge that is worthy of our best efforts. We realize that many of our recommendations take away from the initial projected cost reductions associated with OSS deployment. Our studies demonstrate that not engaging in this effort in a sustained manner leads to disillusionment and abandonment.

This paper is an abbreviated synopsis drawn from material in Fitzgerald, B, Kesan, J, Russo, B, Shaikh, M and Succi, G (2011) Adopting Open Source Software: A Practical Guide, MIT Press, Cambridge, MA.

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