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HOW PERCEPTIONS OF OPEN SOURCE SOFTWARE INFLUENCE ADOPTION: AN EXPLORATORY STUDY

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Abstract

Much of the assessment of OSS benefits and drawbacks has been based on anecdotal evidence appearing in practitioner publications. Due to its focus on software development, such work neglects whether managerial perceptions of such benefits and drawbacks have any impact on the organisational adoption of OSS. Although some research has been conducted on the topic of OSS adoption, these studies have either focussed on the adoption of specific open source products or have been directed largely at public administrations and companies operating in the primary software sector. Taking the perspective of IS/IT managers, this paper examines the impact of perceived benefits and drawbacks of OSS on its adoption in 13 companies operating in the secondary software sector in Europe. The findings are analysed using the adoption of innovation literature as a lens to reveal how technology, organisational, environmental and individual factors impact OSS adoption.

Keywords: Open Source Software, Adoption of Innovation, Field Study, Secondary Software Sector.

1 INTRODUCTION

Open Source Software (OSS) is one of the most debated phenomena in the software industry, both theoretically and empirically (Comino and Manenti, 2003). OSS has evolved impressively from a generally horizontal infrastructure e.g. operating systems, web and print servers towards more highly visible applications in vertical domains (Fitzgerald, 2006). In the past, the users of OSS have tended to be experts and more or less tantamount to the development pool. Today, OSS has entered the commercial mainstream and it is now common to find OSS products associated with profit-seeking firms (Feller et al., 2006). However, while open source has transitioned into the realm of mainstream business, understanding the underlying dynamics and values of the model and how this translates into business value is less known (CANfloss Report, 2003). Furthermore, the issue of open source adoption from a business perspective has received little attention. Instead, research on OSS has concentrated mainly on the motivations of open source programmers and the organisation of specific products and projects (Lerner and Tirole, 2002; Von Hippel and Von Krogh, 2003). Although some research has been conducted on OSS adoption (e.g. Dedrick and West, 2003; Goode, 2005; Varian and Shapiro, 2003; and Chau and Tam, 1997), these studies have either focussed on the adoption of specific open source products, have been conducted with companies outside of Europe or have concentrated largely on public administrations and companies operating in the primary software sector. Moreover, there is a paucity of research on OSS adoption in Europe. This is rather surprising as 3/5 of OSS developers are in Europe and the region has a strong secondary software sector (FLOSS Report, 2006). This study addresses these issues by investigating how perceptions of the benefits and drawbacks of OSS impact adoption by companies in the European secondary software sector, i.e. in domains where software is used as a component in other products such as embedded software in the automotive sector, consumer electronics, mobile systems, telecommunications and utilities (electricity, gas, oil, etc.). The paper is organised as follows. It begins by discussing the theoretical foundation for the study. Next the research objective and research methods are discussed. The findings are then presented. The paper concludes by presenting a conceptual model of how the various benefits and drawbacks affect the adoption of OSS.

2 THEORETICAL FOUNDATION

OSS plays a critical role in the business models for firms in high technology and other industries (Overby et al., 2006). However, the migration of OSS into commercial settings has led to managerial debate about the business value of OSS in comparison to proprietary software; particularly business and revenue models as well as strategic implications (Agerfalk et al. 2005) Thus, it is necessary to understand managers' perceptions of OSS and to establish whether such perceptions have any impact on OSS adoption. Whilst studies of adoption by Rogers (2003) and Geroski (2000) highlight the importance of how perceptions could influence the adoption of an innovation, there is little in the OSS literature that indicates whether perceptions of OSS have any impact on its adoption. Indeed, the common assumption that the perceived benefits and drawbacks of OSS are a contributing factor to OSS adoption relies heavily on anecdotal evidence found mainly in white papers, web articles, practitioner papers etc. Our review identified that the following benefits may impact OSS adoption: reliability (Forge, 2006; Varian and Shapiro, 2003); security (Forge, 2006); quality (Krishnamurthy, 2003; Forge, 2006), performance (Kenwood, 2001; Forge, 2006), flexibility of use (Varian & Shapiro, 2003, Krishnamurthy, 2003); large developer and tester base (Krishnamurthy, 2003, Kenwood, 2001); low cost (OSI, 2006); flexibility allowed by licenses (IDC, 2005); user support from a community (Krishnamurthy, 2003), escaping vendor lock-in (IDC, 2004); increasing collaboration (Agerfalk et al., 2005) and encouraging innovation (Wheeler, 2005; Forrester, 2000). Our review also identified the following drawbacks: compatibility (Webb, 2001; Guth, 2006); security risks (Herbsleb, 2002; Forrester, 2004); installation problems (Webb, 2001); lack of expertise (Krishnamurthy, 2003); version proliferation (Krishnamurthy, 2003); user-friendliness (Kenwood, 2001); lack of user support (Webb, 2001); lack of ownership (Kenwood, 2001; Guth, 2006); insufficient marketing (Krishnamurthy, 2003); giving away the source code (Hecker, 2000) and higher training investment in OSS (Forrester, 2004).

Outside the OSS domain, Tornatzky and Fleischer (1990) argue that three elements influence the process by which innovations are adopted – the technology, organisation and environment. This framework has only been elaborated on in relation to the OSS adoption process in studies carried out by Dedrick and West (2003); Glynn et al., (2005) and Chau and Tam (1997). The technological context relates to the technologies available to an organisation. Its focus is on how technology factors influence the adoption process (Tornatzky and Fleischer, 1990). According to Rogers (2003), five technology factors influence the likelihood of adoption - relative advantage, compatibility, complexity, trialability and observability. Several of these factors were also mentioned by Dedrick and West (2003) as influencing OSS adoption. The organisational context looks at the structure and processes of an organisation that constrain or facilitate the adoption and implementation of innovations (Tornatzky and Fleischer, 1990). Some organisational factors were found by Glynn et al, (2005) to impact OSS adoption. In addition, factors such as total cost of ownership (Varian & Shapiro, 2003), boundary spanners (Ven & Verelst, 2006), and relevance to the organisation (Goode, 2005) could also fall into this category. Tornatzky and Fleischer (1990) propose that the external environmental context, i.e., the industry, competitors, regulations, and relationships with governments, in which an organisation conducts its business presents constraints and opportunities for technological innovations. Research carried out by Chau and Tam (1997) and Dedrick and West (2003) found that environmental factors such as market conditions and available skills and services influence OSS adoption. Other factors such as lack of real world experience (OGC, 2002) and the need for a well-performing business model (Barnes, 2003) also appear to impact OSS adoption. According to Glynn et al. (2005) classical innovation adoption theory also emphasises the importance of individual factors such as the presence of an OSS champion for innovation adoption. Other factors identified in the literature that could be labelled as individual include fear, uncertainty and doubt (OGC, 2002) and skills obstacles (Barnes, 2003). However, while there is anecdotal evidence of a relationship between certain factors and OSS adoption, the relationship between OSS adoption and the perceived benefits/drawbacks is not well understood.

3 RESEARCH OBJECTIVE AND METHOD

The objective of this study is to examine how the perceived benefits and drawbacks of OSS affect adoption. The study was categorised as exploratory due to the scarcity of empirical work in the area of OSS adoption and an interpretive approach as recommended by Klein and Myers (1999) was followed. Thus, Marshall and Rossman (1989) suggest that either a case study or field study research methodology can be used. The researchers decided that a field study would be appropriate as it would facilitate the collection of data from a larger number of organisations and would form the basis for more focused research at a later stage. A stratified sample of organisations was used to add diversity to the sample (Patton, 1990). Data collection was carried out using semi-structured interviewing in 13 companies (see Table 1). Five interviews were carried in person while eight were conducted over the telephone. Each interview lasted between forty-five minutes and two hours and 115 pages of interview data was transcribed. Content analysis was undertaken using coding techniques proposed by Strauss and Corbin (1990). This approach recognises that social phenomena are complex, and seeks to develop theory systematically in an intimate relationship with the data. This form of analysis facilitates the development of substantive theory without prior hypotheses, and can be utilised in the absence of, or in conjunction with, existing theory (Strauss and Corbin, 1990). In the initial phase, ‘open coding’ was used to determine the main ideas in each transcript. Using existing theory to inform the derivation of constructs is consistent with the work of Strauss and Corbin (1990). These ideas were then grouped by significant headings to reveal categories and sub-categories. The next step involved ‘axial coding’ which is the process of relating categories to their sub-categories. As a list of codes began to emerge, the analysis moved to a higher or more abstract level; looking for a relationship between the codes. Once a relationship had been determined, the focus returned to the data to question the validity of these relationships. The final step, ‘selective coding’, is the process of determining a core category; that category that is connected to most of the other categories.

Name	Business	Extent of OSS Adoption	Informant
BSS Group PLC, United Kingdom	Specialist Distributor of heating, plumbing etc.	Decreasing adoption. Abandoned previous use of OS email system; now limited to servers only	IT Contracts Manager
Combitech Systems, Sweden	Consultancy	Have used it in some projects; Evaluating use in embedded systems.	Lead Engineer
Conecta, Italy	Consultancy	Predominant – service built on OSS	Head of R&D
Eircom Group PLC, Ireland	Telecommunications	Some use of OS products in Technical support, e.g. JBoss app. server, MySQL but quite limited adoption	Technical Architecture Mgr
Eurocontrol Experimental Centre, France	Air Traffic Mgt	Limited to infrastructure; evaluating further use in air traffic mgt.	Senior Researcher
Consult Comp. (pseudo), Switzerland	Consultancy	Specialises only in open source consultancy/training	Consultant
Nokia Research Centre, Finland	Mobile Communications	Moderate use in telecommunications infrastructure and embedded applications	Head of Software Technology
Phillips Medical Systems, Netherlands	Supplier of medical equipment & devices	Limited; involved in some OS projects; hope to increase level of adoption	International Project Leader
Siemens AG, Germany	Large Engineering Multinational	None, working on open source initiative called corporate source	Program Manager
Sony Computer Entertainment Europe, UK	Manufacturers & Distributors of entertainment systems	Moderate use in servers, consumer products etc. – increasing levels of adoption	Linux for Playstation 2 Specialist
St. Galler Tagblatt AG, Switzerland	Media	Extensive – migrated entire SAP software environment to OSS	CIO
Supertramp, UK	Manufacturing	Extensive (100% open source shop)	Tech. Director
Vodafone, Spain	Mobile Communications	None; collaborating with others to create Linux platform for mobiles	R&D Engineer Head of R&D

Table 1: Companies Studied

4 FINDINGS

The benefits and drawbacks found in the study are outlined in Table 2. The ability to access the source code, modify it etc., has resulted in many of the technical benefits found in the study, e.g. security, quality, flexibility of use and performance. The business benefits found were seen as very significant for the interviewees, particularly escaping vendor lock-in, increased collaboration, and innovation. Although many of the benefits are similar to those found in the literature, some new findings also surfaced. These included improved harmonisation, extra functionality and establishment of de facto standards while the drawbacks include: poor documentation, less functionality, proliferation of interfaces and problems with finding the right staff and competencies.

TECHNICAL BENEFITS	
Reliability	High availability and dependability of applications
Security	High security due to the availability of source code, the reduced threat of viruses and extra awareness of security in design phase of products
Quality	Enhanced quality from peer reviews and the quality of developers / testers
Performance	High performance in terms of capacity and speed
Flexibility of Use	Beneficial because it facilitates changes, customisation, experimentations and allows freedom of choice
Large Developer/Tester Base	Very beneficial as it ensures that OSS is quality software and is up-to-date
Compatibility	Great interest in conserving formats for better interoperability
Harmonisation	Improved harmonisation in interoperability and practices/operations
BUSINESS BENEFITS	
Low Cost	In terms of reduced licensing fees, upgrades, virus protection and the cost of the whole package, i.e. service and software
Flexibility allowed by licenses	Has a significant impact on reducing capital expenditure in company
Escapes vendor lock-in	Highly beneficial as it facilitates freedom of choice, gives sense of control and provides independence from private vendors
Increases collaboration	Greater collaboration from OSS facilitates product development, cooperation and exchange of knowledge, provides new ways of collaboration and permits sharing of expenses with other companies
Encourages innovation	Access to the source code produces ideas and encourages technical innovation while also creating more opportunities for innovation.
Extra business functionality	Beneficial because it results in ability to keep teams small which in turn improves productivity and communication
De facto standards	Not the only company doing something
TECHNICAL DRAWBACKS	
Compatibility Issues	Not significantly disadvantageous, but some compatibility problems with current technology, skills and tasks
Lack of Expertise	Employees lack OSS expertise - may be more about lack of awareness
Poor documentation	Documentation outdated or may have died in development
Proliferation of Interfaces	Results in confusion in deciding which one to choose
Less Functionality	Level of integration not as good as Microsoft
Lack of Roadmaps with OSS Products	Makes it difficult for companies to see any strategic direction
BUSINESS DRAWBACKS	
Lack of support	No safety net as there is no support and no company to back it up
Lack of ownership	Inability to hold someone responsible or accountable for problems
Access to the source code	Some are uncomfortable with releasing source code. Lack of knowledge in relation to this issue
Insufficient marketing	No one organisation owns it all; OSS has no marketing budget which results in it being driven primarily by word of mouth
Finding staff/competencies	Can be difficult to find staff and develop competencies to work with OSS

Table 2: Perceived Benefits and Drawbacks of OSS

While it is recognised that the benefits found in the study can be significant for companies, there are also many drawbacks of OSS. As can be seen from the table 2, the findings only support two of the technical drawbacks outlined in the existing literature: compatibility issues and lack of expertise. Interestingly, those drawbacks associated with the software being less user-friendly, version proliferation and problems with troubleshooting/upgrading were not found. Indeed, OSS was seen to be positive in this regard. New issues in the form of poor documentation, less functionality and lack of roadmaps were considered to be the primary drawbacks. Essentially, the business drawbacks were found to pose a bigger challenge for companies than the technical benefits, with lack of support, lack of ownership and insufficient marketing ranking the biggest drawbacks to adoption. In order to fully understand how the benefits and drawbacks impact OSS adoption, the findings were interpreted in the context of the technology, the organisation, the environment and the individual.

4.1 Technological Context

Consistent with Rogers (2003) and Dedrick and West (2003) four characteristics were mentioned in this study as influencing the adoption decision. These areas include trialability, relative advantage, compatibility, and complexity. The manner in which the technical and business benefits and drawbacks influence these four areas is illustrated in Figure 1.

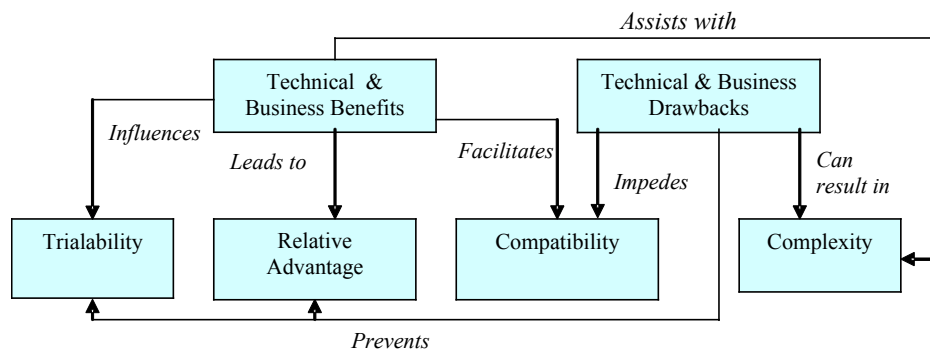


Figure 1: The Impact of the Benefits and Drawbacks on OSS Adoption in the Technological Context

Rogers (2003) argues that technologies are more likely to be adopted if they can be tried and assimilated in small chunks over time. This was quite evident in the study where *trialability* was considered a driving force in the adoption decision. For the majority of the companies, the technical and business benefits associated with open source software have led to trials and experimentations. For example, on the technical side, the reliability of OSS appeared to be a real influence while on the business side, the opportunities that OSS provides for innovation was also significant. In other cases, adoption of open source software has led to further trialability of more open source projects. For instance, the IT Manager at Sony Computer Entertainment explained they have had experiences of staff using something out of interest that turned out to be directly relevant to the company.

Relative advantage is the level to which an advantage is perceived to be better than the idea it supersedes (Rogers, 2003). The relative advantage for the companies was seen in terms of hardware and software costs and the technical benefits outlined in table 2. The CIO at St. Galler Tagblatt explained that adopting open source resulted in 40% cost savings on infrastructure along with lower costs for software licenses and freedom of choice in their new server hardware. In terms of software costs, adopting OSS enabled Supertramp to wipe £15,000 off their licensing budget and re-invest in the development of their systems. Surprisingly, for the Project Leader at Philips Medical Systems, the R&D Engineer and Head of R&D at Vodafone and the Senior Researcher at Eurocontrol, the low cost of software was not a significant factor in whether to adopt OSS. They indicated that high reliability, high performance, flexibility of use and quality are all main advantages of open source software and would be seen as contributing factors to OSS adoption.

Compatibility is the degree to which an innovation is perceived as being consistent with the existing values, past experiences and needs of potential adopters (Roger, 1983). For the majority of the companies in the study the decision to adopt OSS was greatly influenced by the compatibility of the software with their current technology, skills and tasks. This supports the findings from Dedrick and West (2003). Many of the technical benefits and drawbacks (mainly compatibility) are a huge influence in this area, while some business drawbacks (particularly lack of support and skills obstacles) appear to be a barrier to ensuring compatibility. According to the Technical Director in Supertramp, the amount of compatibility for running applications wasn't available when the company adopted OSS and still isn't today. However, this manager was already very experienced in Unix which made the migration to OSS less complicated. The IT Contracts Manager of the BSS Group stated that if the company were to introduce more open source products, they would have to ensure 100% compatibility. For example, he suggested that even if they were told something was 95% compatible, he would not be able to recommend it internally because in relation to the remaining 5%, there was very good chance of staff coming back and saying it didn't work. While many of the companies had, or could foresee, no problems in terms of compatibility with the current technology, important issues in terms of compatibility with current skills and tasks often arise. According to the IT Manager at Sony Computer Entertainment "not all developers in the European market are as comfortable or happy with using OS based operating systems packages. A lot of them are only familiar with proprietary operating systems, and they were not happy that they had to invest extra time and resources in getting people who were familiar with the open source solutions".

Complexity is the level to which an innovation is perceived to be difficult to understand and use (Ahmed, 2005). For the organisations that had adopted OSS, technical drawbacks such as lack of expertise resulted in complexity issues while some of the business drawbacks in relation to finding the right staff and developing the right competencies, training and lack of support also had a compounding affect, thus making OSS adoption difficult. For example, the CIO at St. Galler Tagblatt explained that that the software is more difficult to understand and use and although their system programmers were familiar with Unix, there was quite a significant investment in training them on Linux. Several of the other companies agreed that there may be some complexity issues in adopting OSS due to lack of understanding of OSS. However, some technical and business benefits of OSS have the potential to reduce complexity problems. For example, the low cost of acquisition of OSS often makes it possible for the company to invest in training for staff. This coupled with staff motivation to learn something new and become more innovative also assist in reducing complexity problems.

4.2 Organisational Context

In support of findings from Goode (2005), Varian and Shapiro (2003), Ven and Verelst (2006) and Glynn et al. (2005), the organisational factors discussed below were frequently cited as impacting the adoption decision. Figure 2 outlines how the technical and business benefits and drawbacks influence these areas.

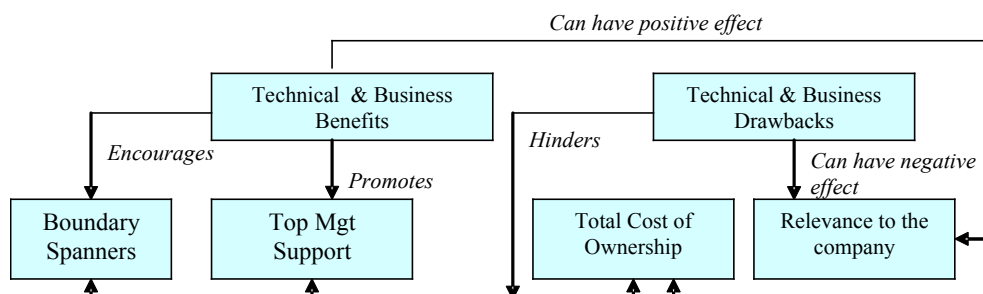


Figure 2: The Impact of the Benefits and Drawbacks on OSS Adoption in the Organisational Context

According to DePietro (1990), *boundary spanners* are individuals who connect their organisation with external knowledge and can bring the organisation in contact with new innovations. The findings revealed that the adoption of OSS is primarily a bottom-up initiative in most of the companies and the presence of boundary spanners is considered very important. In many cases, there are a number of employees in the company who possess knowledge and understanding of OSS, and aid its introduction. It also became apparent in the study that the technical and business benefits of OSS has been influential in encouraging and convincing these boundary spanners to spread the word in the company. For example, the IT Manager at Sony Computer Entertainment explained that she was not a lone voice 'gunning for open source' as there were other others in the company supportive of it. Therefore, she added that she didn't have to be evangelical internally in the company. It was evident that many of the boundary spanners in the companies are investigating open source with other EU companies and universities. The business benefit associated with increased collaboration allowed by OSS appears to be very influential in this case

Varian and Shapiro (2003) suggest that users should consider the *total cost of ownership* (TCO) when making adoption decisions. It was found that the TCO was relative to technical benefits like reliability and performance of OSS and business benefits like low cost and escape from vendor lock-in. However, technical drawbacks like lack of expertise and business drawbacks akin to training investments and finding the right staff etc. have the potential to negatively influence TCO calculations. Some of the companies that had adopted OSS could not make a formal TCO calculation. However, the CIO at St. Galler Tagblatt calculated a saving of €340,000 with cost savings of 40% on infrastructure. According to the Technical Director at Supertramp, the lower costs associated with OSS adoption was "tremendous". For the migration to OSS, the company worked within a budget of £30,000 and felt they had got the assessment pretty right. This Technical Director pointed out that if the company had not migrated to OSS, the budget on hardware and software would have meant that their investment in staff and staff capabilities would have been quite significantly less than it currently is. By adopting OSS, he added that the company could invest more money back into the business process and make that more efficient. While the Technical Architecture Manager at Eircom revealed that that the cost of acquisition of OSS is low, he pointed out that the TCO may be just as high as proprietary software because of the investment the company has to make in support. However for four of the companies, lower cost was not the main driver in adopting OSS. Rather low cost combined with some of technical benefits, i.e. reliability and quality, was seen as more important. For example, the IT Manager at Sony Computer Entertainment revealed that the company had plenty of budget and cost was not a consideration in the adoption decision. She added that the company was more interested in what would get them the most functionality and the most time on the most stable platform.

It has been argued that management must perceive some *relevance* of OSS to their business if they are to adopt it (Goode, 2005). All of the interviewees believed that senior managers must see OSS as being relevant to the company if they are to consider its adoption. On the other hand, if they see only drawbacks, they will undoubtedly reject it. Business benefits like the low cost of OSS and the flexibility allowed by licences were contributing business benefits in this case. For the companies with a big budget, the technical benefits of OSS adoption were seen as more relevant by management.

The study revealed the necessity of *top management support* for OSS adoption. This issue is covered in very little detail in the literature with the exception of Glynn et al. (2005). It was evident that the benefits and drawbacks of OSS have a critical influence on whether top management support its adoption. According to the Program Manager in Siemens "unless companies have the support of top management, OSS would not work because inherently companies like Siemens have a tendency to cling on to what they have". At present some of the drawbacks that impede top management support for OSS adoption are the difficulty involved with finding the right staff and developing the competencies necessary to work with open source. Other drawbacks include the lack of ownership and lack of support issue. The companies that had adopted OSS revealed that top management were supportive of its adoption because of the lower cost associated with it.

4.3 Environmental Factors

The environmental factors found in the study that impact OSS adoption are also in line with those of Chau and Tam (1997), Dedrick and West (2003), Barnes (2003), and OCG (2002). The manner in which the benefits and drawbacks influence these factors are illustrated in Figure 3.

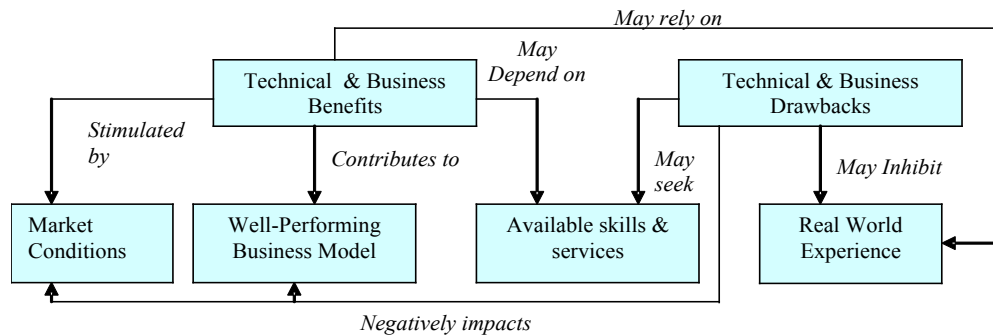


Figure 3: The Impact of the Benefits and Drawbacks on OSS Adoption in the Environmental Context

Consistent with findings from Chau and Tam (1997), most of the companies agreed that when adopting open source software, *market conditions* have to be considered. Again the technical and business benefits and drawbacks have a significant influence on market conditions because they can positively or negatively impact the way the business is conducted. According to the IT Manager at Sony Computer Entertainment the reason behind adopting Linux for Playstation arose out of consumer demand for the product. In her words “they wanted this product, they wanted to be able to have Linux running on their machine and to be able to run OSS”. For the customers, the quality and flexibility of use of OSS was beneficial here. The Lead Engineer at Combitech reflected that if there is widespread adoption of open source, then this would become of high strategic importance to the company. Interestingly, the IT Contracts Manager at BSS Group suggested that “it’s a bit of a ‘me too’ environment”. In other words, if one corporation has a very successful product, other corporations will want to avail of it. He suggested that because there is not a lot of companies doing a ‘me too’ in relation to OSS products, this obviously has a negative impact on adoption.

DePietro et al (1990) suggests that the *availability of external skills and services* may influence the organisation to start new innovations. The availability of external support and services in adopting OSS was mentioned by most of the organisations as being extremely important, the reason being that certain business drawbacks like the lack of user support and lack of ownership were of particular concern to them. This in turn encouraged some of the companies to seek out available skills and services. For example, both the CIO, St. Galler Tagblatt and the IT Contracts Manager, BSS Group considered vendor support contracts to be very important, especially at the start of the adoption phase. The availability of support services appeared to be more important to the larger organisations such as St. Galler Tagblatt, Eircom and the BSS Group that have the budget to buy support etc. However, according to the Head of R&D at Conecta, for many companies it is difficult to find expertise - companies providing support like they do for commercial software. He pointed out that “it’s very easy, if you need to buy support for Microsoft Exchange, you simply go through the website and search. For OSS there is no easy way to find other companies providing support. There are too few, usually very small”. The IT Contracts Manager of the BSS Group pointed out that the marketplace is not bombarded with companies who specialise in installing open source software only because “it’s not commercially sensible. Most people want to promote the Microsoft world because it benefits their pocket ...you need lots of add-ons ...to keep it all in good order. So anybody that has got commercial add-ons wouldn’t go anywhere near the open source market because there is no money in it, because there is a low cost of acquisition and it doesn’t cost a lot to run so you can’t make any money in it”. Taking the above view into consideration, it can therefore be said that while some the technical and

business benefits of OSS, e.g. reliability and low cost are attractive to many companies, these could be considered potential drawbacks for consultants if they were to deal only in OSS.

According to Barnes (2003), one of the factors affecting the adoption process is the need for individual open source projects to have a *well-performing business model*. He suggests that the basic intuition behind this barrier is simply that if there is no financial incentive to use open source, then it will not be undertaken by large companies. According to the Technical Architecture Manager in Eircom, “the key thing is why should I be interested in doing it, what makes it better for me and it’s nothing to do with open source per se. I mean proprietary can offer just the same thing but they’re just better at getting their message out, not necessarily having a better quality product” Again, the fact that OSS is insufficiently marketed can form a barrier. For instance, the Technical Director at Supertramp suggested that proprietary vendors do not want to see open source come to market because they feel it encroaches on their business model, so they ramp up their marketing efforts to try and stop this occurring. However, he believed that in the next two to three years companies who are building businesses based around OS products utilising the service model will start to push things forward in the market more.

OCG (2002) found that the lack of *real world experience* and support for migration from closed proprietary software installations to OSS is one inhibiting factor affecting decisions to adopt OSS. Most of the companies suggested that management would like to see more evidence of real world experiences in terms of the benefits and drawbacks of OSS and case studies on successful and unsuccessful migration from proprietary software to OSS. It is evident that real world experience from other companies that have adopted OSS can be perceived by senior management as a safety-net comfort factor.

4.4 Individual Factors

In support of finding from OGC (2002), Barnes (2003) and Glynn et al. (2005), it was found that individual factors such as presence of an OSS champion, skills obstacles and fear, uncertainty and doubt impact adoption. Figure 4 outlines how the benefits and drawbacks influence these factors.

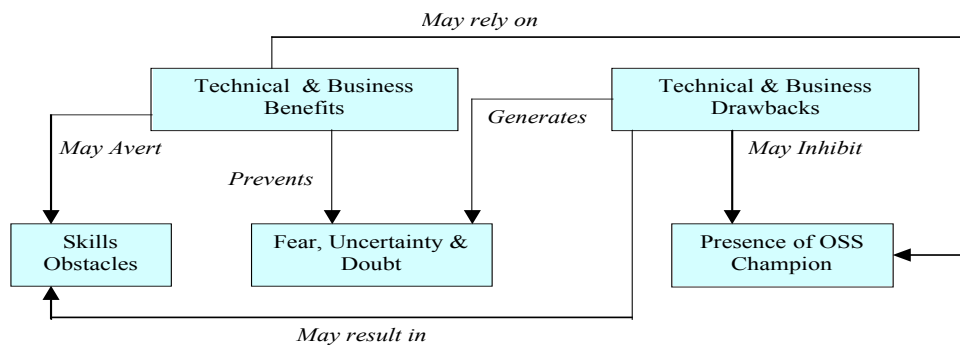


Figure 4: The Impact of the Benefits & Drawbacks on OSS Adoption in the Individual Context

Consistent with findings from Barnes (2003), who found that *skills obstacles* are an important factor to take into consideration when adopting OSS, several of the companies felt that this issue may pose a problem for OSS adoption. For example, the Lead Engineer at Combitech remarked that there might be some resistance in the company if they were to replace Windows with Linux for instance. However, he added that this would be a learning curve and the benefits of open source might kick in. Similar views were evident in Philips Medical Systems and Vodafone. However, for the companies that had adopted open source software, e.g. St. Galler Tagblatt and Supertramp, skills obstacles did not present much of a barrier. Many of the employees had experience in working with Unix so the switch over to Linux and open source didn’t pose much of a problem. However, according to the IT Contracts Manager at the BSS Group, the end users were not aware that they were using an open source system

because it was only used on servers and behind the scenes, so to them, they were working in a Microsoft environment. In the case of St Galler Tagblatt, the CIO explained that employees were happy to move over to OSS because they got new systems, in terms of disc space, storage, hardware and servers. He also added that the employees in this company had worked on several operating systems so the change didn't bother them. For Supertramp, the Technical Director revealed that no resistance was encountered from staff because at that stage, they were fed up with the reliability problems and issues that were happening in the company. According to him "there was this sense of if somebody could just fix this for us, we will embrace it and we don't really care what it looks like".

It has been suggested from previous findings that some of the inhibiting factors affecting decisions to adopt OSS include *uncertainty, misunderstanding and fear* (OCG, 2002). This was certainly the case for half of the companies in the study. For example, the R&D manager at Vodafone expressed some uncertainty about the whole issue of giving away the source code. Again, it can be suggested that the technical drawbacks associated with giving away the source code can negatively impact managers' perception of OSS. Both Philips Medical Systems and Eurocontrol also mentioned that employees in the company had doubts about OSS adoption. The Senior Researcher in Eurocontrol explained that because OSS is unknown, it is very likely staff will have the wrong idea about it and so there is fear. The Technical Director at Supertramp explained that proper leadership and motivation is important in preventing these feelings of fear, uncertainty and doubt, otherwise one could have a 'mutiny on their hands'. Similarly, the Consultant at Consult Comp. explained that there needs to be an awareness of what is actually being introduced and people need to know what the benefits are.

The findings here are in support of those found by Glynn et al (2005) in that the charisma and drive of an *OSS champion* may be a significant factor influencing open source adoption. Again the benefits of open source were influential reasons for driving the OSS champion in the company. This was evident in interviews with Supertramp and Conecta. For example, the Technical Director at Supertramp had the knowledge and awareness of OSS benefits and brought that to the table in an initial conversation with top management of the business benefits of open source. In relation to the other interviews carried out, it was difficult to make a distinction between boundary spanners and project champions. Most of the companies considered themselves in the minority in relation to championing OSS as there were others in the company pushing for it and supporting it also.

5 CONCLUSIONS

This is the first piece of research that we are aware of in relation to how the perceived benefits and drawbacks of OSS impact adoption in the European secondary software sector. This paper has contributed to our understanding of OSS by systematically investigating the impact of the benefits and drawbacks on OSS adoption. The findings were analysed in the context of the technology, the organisation, the environment and the individual, all of which are important factors in the adoption of an innovation. The study revealed that the technical and business benefits of OSS positively influence the various technological, organisational, environmental and individual factors, resulting in trialability, relative advantage, top management support, TCO etc., thus driving adoption. However, it was also found that the technical and business drawbacks of OSS negatively influence these factors and prevent trialability, relative advantage etc. transpiring; thus forming a barrier to adoption. The conceptual model presented in Figure 5 depicts a further elaboration of the impact of the benefits and drawbacks on OSS adoption. However, the findings reported here are the result of an exploratory research design and further research is necessary in order to go deeper into each factor and level of analysis, as well as focussing on consistent theoretical lenses that can help to explore these levels.

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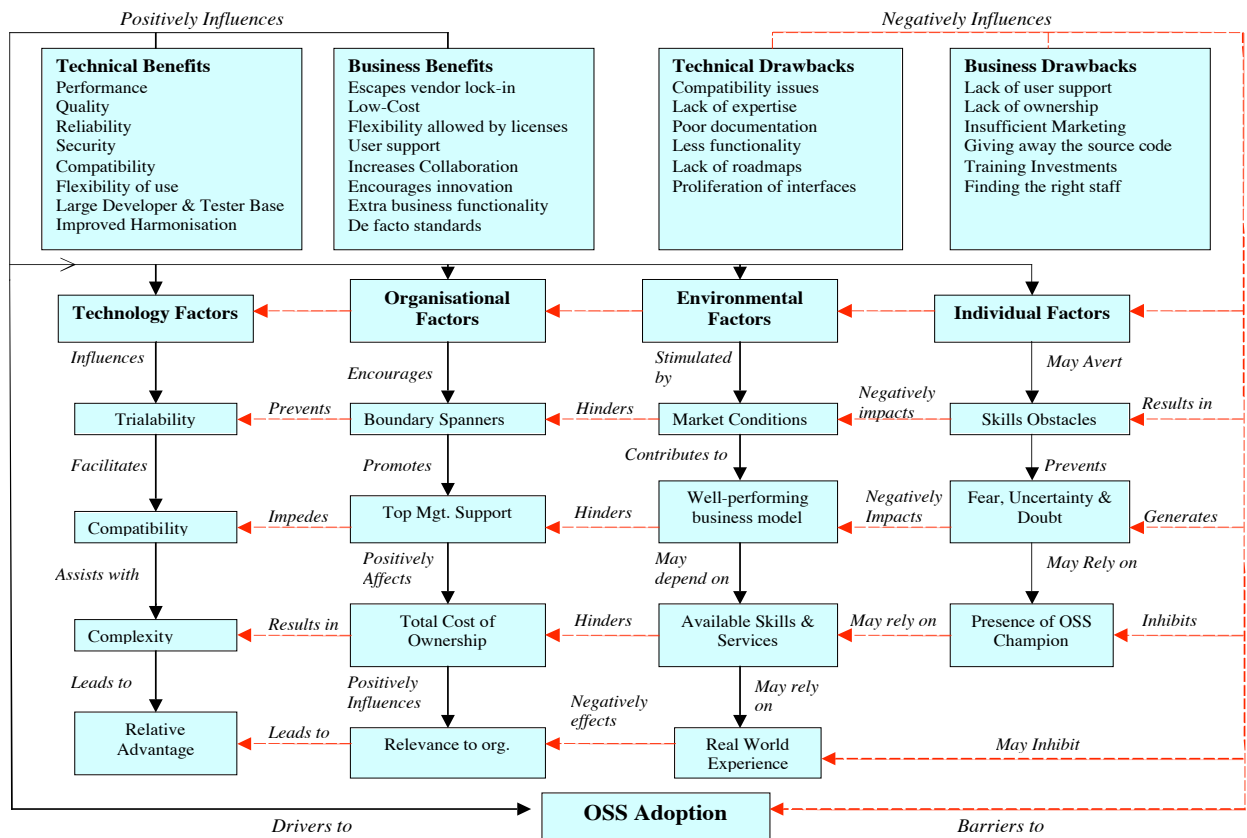


Figure 5: Benefits, and, Drawbacks of OSS Adoption

References

- Agerfalk, P.J., Deverell, A. Fitzgerald, B. and Morgan, L. (2005) Assessing the Role of Open Source Software in the European Secondary Software Sector: A Voice from Industry, *Proceedings of the First International Conference on Open Source Systems*, Genova, 11-15 July 2005, 82-87.
- Barnes, J. (2003) *Open Source Software as a Computer-Specific Organisational Technology*, opensource.mit.edu/papers/barnes.pdf
- CANfloss Report (2003) *Open Source Software in Canada*, www.e-cology.ca/canfloss/report
- Chau, P.Y.K. and Tam, K.Y. (1997) Factors affecting the adoption of open systems: An exploratory study, *MIS Quarterly* 21(1):1-24.
- Comino, S. and Manenti, F. (2003) *Open source vs. closed source software: Public policies in the software market*. <http://opensource.mit.edu/papers/cominomanenti.pdf>
- Dedrick, J. and West, J. (2003) Why Firms Adopt Open Source Platforms: A Grounded Theory of Innovation and Standards Adoption. *Proceedings on the Workshop on Standard Making: A Critical Research Frontier for Information Systems*, Seattle, Washington, 236-257.
- DePietro, R., Wiarda, E., Fleischer, M. (1990) The context for change: Organisation, technology and environment. In Tornatzky, L.G., Fleischer, M. (eds) *The Processes of Technological Innovation*. Lexington Books, Lenxington, Massachussets, 151:175.
- Feller, J., Finnegan, P., Kelly, D. and MacNamara, M. (2006) Developing Open Source Software: A Community-based Analysis of Research, *Proceedings of IFIP 8.2 W.G. Conference on Social Inclusion: Societal and Organisational Implications for Information Systems*, 12-15 July, Limerick.
- Fitzgerald, B. (2006) The Transformation of Open Source Software, *MIS Quarterly*, Vol. 30, No. 3.
- Forge, S. (2006) *The rain forest and the rock garden: the economic impacts of open source software*, www.emeraldinsight.com/10.1108/14636690610664633
- Forrester (2004) *The Costs and Risks of Open Source*, www.forrester.com/Research/Document/0,7211,34146,00.html
- Forrester Report (2000) *Open Source Cracks the Code*, www.forrester.com/ER/Research/Report/0,1338,9851,00.html

- Geroski, P.A. (2000) Models of Technology Diffusion, *Research Policy*, vol. 29, 603-625
- Glynn, E., Fitzgerald, B. and Exton, C. (2005) Commercial Adoption of Open Source Software: An Empirical Study, *Proceedings of International Conference on Empirical Software Engineering*, Noosa Heads, Australia, Nov 2005.
- Goode, S. (2005) Something for nothing: Management rejection of open source software in Australia's top firms. *Information & Management* 42(5):669-681.
- Guth, S. (2006) Limiting factors for the adoption of open source software, http://claweb.cla.unipd.it/home/sguth/pdfs/OSS_gov_cons.pdf
- Hecker, F. (2000) *Setting Up Shop: The Business of Open Source Software*, <http://www.hecker.org/writings/setting-up-shop.html>
- Herbsleb, J. (2002) *Research Priorities in Open Source Software Development*, www.infonomics.nl/FLOSS/workshop/papers/herbsleb.htm
- IDC Research (2004) *End-User Perspectives on Cost, Substitutability, Trustworthiness, Support and Adoption: Industry Report* <http://www.idc.com/getdoc.jsp?containerId=33131>
- IDC Research (2005) *Quality drives European open-source adoption* <http://www.itworldcanada.com/Pages/Docbase/ViewArticle.aspx?id=idgml-8f87ddb3-bfe0-4b69&s=90323>
- Kenwood, C.A. (2001) *A Business Case Study of Open Source Software*, (http://www.mitre.org/support/papers/tech_papers_01/kenwood_software/kenwood_software.pdf)
- Klein, H.K. and Myers, M.D. (1999) A Set of Principles for Conducting and Evaluating Field Studies in Information Systems, *MIS Quarterly*, 23(1), 67-94.
- Krishnamurthy, S. (2003) A Managerial Overview of Open Source Software, *Business Horizons*, 46(5), September-October, 47-56.
- Lerner, J. and Tirole, J. (2002) Some Simple Economics of Open Source, *Journal of Industrial Economics*, 52, 2: 197-234, June.
- Marshall, C. and Rossman, G. (1989) *Designing Qualitative Research*, Sage Publications, California.
- Northwest Educational Technology Consortium (NETC) (2003) *Open Source Means More Choices*, www.netc.org/circuit/2003/special/opensource.pdf
- Office of Government Commerce (OGC) (2002) *Open Source Software: Guidance on Implementing UK Government Policy* community.asiaosc.org/~iwsmith/policy/UK%20-%20Guidance%20on%20Implementing%20Policy.pdf
- Open Source Initiative (OSI) (2006) *The Open Source Definition*, <http://www.opensource.org/docs/definition.php>
- Overby, E.M., Bharadwaj, A.S., Bharadwaj, S.G. (2006) An Investigation of Firm-Level Open Source Adoption: Theoretical and Practical Implications. In R.K. Jain (ed.), *Open Source Software in Business - Issues and Perspectives*, Hyderabad, India: ICFAI University Press, 2006.
- Patton, M. Q. (1990) *Qualitative Evaluation and Research Methods*, Newbury Park, CA., Sage Publications.
- Rogers, E. (2003) *Diffusion of Innovations*, 5th Edition, Free Press, New York.
- Strauss, A. and Corbin, J. (1990) *Basics of Qualitative Research: Grounded Theory Procedures and Techniques*. Sage Publications, Newbury Park, CA.
- Tortnakzy, L.G. and Fleischer, M. (1990) *The Process of Technological Innovation*, Lexington Books, Massachusetts, USA.
- Varian, H.R. and Shapiro, C. (2003) *Linux Adoption in the Public Sector: An Economic Analysis. Working Paper*, University of California, Berkeley.
- Ven, K. and Verelst, J. (2006) The Organisational Adoption of Open Source Server Software by Belgian Organisations, *Proceedings of IFIP 8.2 Foundation on Open Source Software Conference*, 08-10 June 2006, Como, Italy, 111-122, Springer.
- Von Hippel, E. and Von Krogh, G. (2003) Open source software and the 'private collective' innovation model: Issues for organisation science, *Organisation Science*, 14, 2:209.
- Webb, M. (2001) *Going with Open Source Software: Is it the Right Choice for your Organisation?* <http://www.techsoup.org/howto/articles/software/page1124.cfm>.
- Wheeler, D. (2005) *Why Open Source Software/Free Software (OSS/FL, FLOSS, or FOSS)? Look at the Numbers!* http://www.dwheeler.com/oss_fs_why.html.