

# OPEN SOURCE SOFTWARE ACQUISITION: BEYOND THE BUSINESS CASE

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## Abstract

*Lately we have seen a growing interest from both public and private organisations to adopt Open Source Software (OSS), not only for a few, specific applications but also on a more general level throughout the organisation. As a consequence, the organisations' decisions on adoption of OSS are becoming increasingly more important and complex. We present three perspectives organisations can employ in their decisions: seeing OSS acquisition as a business case, as COTS acquisition, and as architectural change within a governance framework. We present case studies of decisions on OSS adoption, and categorise the decision criteria we have found. Our results indicate that for large-scale adoption of OSS, focus will be on architectural considerations: enterprise-wide architectures will at first be a barrier, but in the long term OSS's support of open standards can be a major enabler for OSS adoption. In contrast, in smaller organisations and in small-scale adoption of OSS, the cheap price of OSS is a major enabler, as it provides a good opportunity for experiments and short-term economic benefits. For small organisations these experiments can lead to development of a common IT-architecture, and in larger organisations OSS can be adopted in niche-areas, without significantly violating an existing IT-architecture.*

*Keywords: open source, COTS, IT architecture, governance*

## 1 BACKGROUND

Open Source Software (OSS) has been described as everything from a threat to the software industry and software development (Kooths, Langenfurth et al., 2003) to the future of software (Raymond, 2001). With no marketing budget, only relying on web presence, more and more open source software (OSS) products succeed in attracting press and professional interest sufficient to jump from hackers' to businesses' portfolio of software products. Credentials to OSS come from early adopters as well as well-recognised commercial vendors like IBM (Linux) and Sun (OpenOffice.org) with financial strength to make credible commitments to OSS products. Major IT vendors now provide OSS products and offer support and maintenance of OSS applications at customer premises. Governments have taken an interest in OSS at the same time as they increasingly emphasise open standards software.

As a consequence, OSS is now becoming an important alternative to commercial software when organisations decide on software acquisition, and in our research we are interested in the premises for these decisions. How do government institutions and commercial organisations decide on software acquisition in the case of OSS?

## 2 RESEARCH APPROACH

Where most previous research in OSS has looked at the contingencies of OSS development, we turn to customer contingencies to get to both sides of the adoption equation. The research issues that we consider are:

- In longitudinal studies we identify the most important factors for OSS adoption, hoping to identify "best practices" and provide help for organisations' future decisions on OSS.
- We suggest a framework relevant to users' decisions on migrating from a market-dominating commercial platform to an open-source platform.
- From studies of user organisations we learn what "vendors" of OSS need to improve to better target potential OSS users.

Numerous studies of the potential economic advantages of OSS to commercial off-the-shelf software (COTS) have show performance contingencies to be software environment as well as organisational open-source maturity, and the mix and load of functions performed by servers and employees. We are in an early phase of acquiring knowledge on which factors will determine the comparative advantage of OSS.

We base our research on a number of case studies of public and commercial Danish organisations, adopters as well as non-adopters of OSS. In the studies we have been focusing on decision makers' expressed concerns, when asked to explain and argue for their decisions on OSS. We are aware that these expressed concerns may not give a complete picture (decision makers may avoid describing political or personal motives), but see them as indicators of the most important premises for the organisations' decisions. We have collected background information for each organisation and have conducted interviews with decision makers, focusing on their criteria for decisions on OSS adoption, and – if relevant – their plans for and experiences with the adoption process. The interviews were made during 2004 and early 2005. We have previously published results from our work (Holck, Larsen et al., 2004; Larsen, Holck et al., 2004), including a more thorough discussion of OSS in relation to COTS (Holck, Larsen et al., 2005).

The exact meaning of Open Source Software is certainly debatable (Henkel, 2003), but – maybe surprisingly – we have not experienced this as a problem: none of the people we have talked to have asked for or seemed uncertain regarding a definition.

Our studies lead us to believe that decisions on acquisition of OSS are differentiated according to OSS product (maturity), OSS application environment and to the architectural policies of the overall organisation. How we arrive at this tripartite division we will explain in the following sections.

## 3 PERSPECTIVES ON OSS ACQUISITION

### 3.1 Seeing OSS acquisition as a business case

Although the direct acquisition cost of OSS is small, organisations may not make long-term economic benefits from adopting OSS. Investments should where possible be based on calculations of Total Cost of Ownership, TCO, also considering expenses for support, maintenance, future upgrades etc. Recently the question of whether the TCO of OSS is lower or higher than that of commercial software has been the focus of several industry reports and white papers, often sponsored by companies with obvious economic interests. Probably most focus has been on comparing TCO for Linux, Windows, and proprietary Unix; a few examples are mentioned below:

- A Microsoft-sponsored study from BearingPoint (2004) concluded that “across the representative scenarios examined in medium and enterprise size organisations, the licensing and support costs associated with Windows Server 2003, Novell/SUSE Linux 8 and Red Hat Enterprise Linux 3 were found to be comparable. ... Windows Sever 2003 was found to be less expensive than one or both of the commercial Linux offerings in several cases”.
- A reportedly non-sponsored study from the Yankee Group (DiDio, 2004) concluded that “Linux is a viable alternative to UNIX and Windows ... [providing] businesses with excellent performance, reliability, ease of use and security”, but also that “in large enterprises, a significant Linux deployment or total switch from Windows to Linux would be three to four times more expensive and take three times as long to deploy as an upgrade from one version of Windows to newer Windows releases”. And further, “More than 90 percent of the 300 large enterprises with 10,000 or more end users indicated a significant or total switch from Windows to Linux would be prohibitively expensive, extremely complex and time-consuming, and would not provide any tangible business gains for the organisation.” On the other hand, “Linux shows measurably improved TCO compared with UNIX and Windows in small firms, in organisations with customised vertical applications and in ‘greenfield’ networking situations where there is no existing software infrastructure.”
- A Red Hat-sponsored study from IDC (Gillen, Kusnetzky et al., 2001) compared TCO for Linux on Pentium platform systems with that of proprietary RISC/Unix systems. The conclusion was that for Internet/intranet/extranet and collaborative workloads, Linux showed “significantly lower cost of ownership”. Not only were the associated costs for hardware and software “dramatically lower” for Linux, also the costs for staffing was comparable or lower. A later study (Gillen, Kusnetzky et al., 2003), sponsored by Red Hat and IBM, confirmed these results, showing Linux’ benefits to be reduced costs of hardware, OS, and third-party software; reduced costs for IT staff; and increased revenue opportunity from higher reliability and quicker time to market.
- A study from Forrester Research (Giera, 2004), based on five companies tracking their TCO, indicated that “Linux was between 5% and 20% more expensive than Windows”, but also that for Unix migrations and Linux-only deployments, Linux was the “clear cost winner”.

Even though a thorough discussion of these and similar studies is outside the scope of this paper, three reasonable conclusions seem to be:

- There is no simple answer to the question of whether Linux or Windows shows the lowest TCO; the answer is dependent on the specific circumstances, e.g. application area and company size and price elasticities in markets contested by OSS.
- The cost of making a company-wide switch from one software platform to another may be prohibitive.
- Similar conclusions can be expected for other OSS products where commercial market leaders are contested by OSS leading to de facto price reductions of commercial products though list prices may remain sticky and pricing schemes less and less transparent (Teknologirådet, 2002)

### **3.2 Seeing OSS acquisition as COTS acquisition**

Most research and textbooks in information systems and software engineering silently assume that an organisation's information systems are developed "from scratch". An alternative perspective is offered by the research areas of COTS (Commercial Off-The-Shelf Software) and CBS (Components Based Systems), and these seem relevant when we want to describe organisations' adoption of OSS products. Especially a research group headed by Barry Boehm has been active in both understanding and developing tools for COTS and CBS, see e.g. (Boehm, Port et al., 2003; Reifer, Basili et al., 2003). A number of more or less formal methods for COTS selection have been published, e.g. (Lawlis, Mark et al., 2001; Comella-Dorda, Dean et al., 2002), but empirical studies seem to show that more ad-hoc approaches are used in practice. As an example, a study based on interviews with 16 COTS-based development projects in Norwegian IT companies (Li, Bjørnson et al., 2004) indicates that successful COTS component selection can be done without formal processes, instead relying on practical experience and hands-on experimentation. Also Alves (2003) argues for a "goal-driven requirements engineering perspective", meaning that COTS decisions should not be based on specific requirements, but on more general goals.

As mentioned in (Torchiano and Morisio, 2004), much literature on COTS is not very precise regarding the definition of COTS products. Even though products like Microsoft Office and Windows are surely both commercial and off-the-shelf software, the COTS literature seems to focus more on integrated software components (e.g. program libraries) than on applications. Also, the focus is typically on operational issues (assessing product quality, need for "glue code", acquisition price) and not on tactical or strategic issues (vendor dependency, support contracts, enterprise architecture etc.). These limitations make it questionable if an organisation, considering a shift from Microsoft Office to OpenOffice.org on its desktop computers, will find much help in COTS literature.

### **3.3 Seeing OSS acquisition as change of architecture within a governance framework**

Business-case based decisions on software procurement have been criticised for neglecting or incompletely addressing investments in infrastructure or shared resources, causing the overall performance of IT resources to suffer (Ross and Beath, 2002); a series of case studies showed that investments in IT infrastructure account for as much as 58 % of the overall IT investments (Broadbent and Weill, 1997). Since most if not all business applications rely upon an infrastructure for accessing and processing data from other applications, a business case needs to include infrastructural capacity investments. Companies are therefore required to develop a decision framework coping with multiple business cases and shared resources in an expanding portfolio of IT applications (Weill and Ross, 2004). Further, business models of outsourcing services, as well as hardware, software and staff, using a wide range of different contracts compel corporations to build corporate IT governance capability (Weill and Ross, 2004).

An IT architectural approach, with focus on understanding interface requirements and integration opportunities, can be appropriate as a vehicle for decision-making on IT procurement and maintenance for structuring and supporting IT governance decision making.

Where the business case on OSS becomes inconclusive, adding an architectural view on e.g. interoperability, standards and security will change the setting for OSS decisions from one of a single application to one of an alternative platform (comparing commercial and OSS platforms).

In our case studies we have been looking for if and how the change from a business case to a governance and architectural case takes place. In most cases the commercial alternative is a Microsoft (more or less ubiquitous) platform.

## 4 EMPIRICAL STUDIES OF OSS ACQUISITION

Based on interviews with MIS managers, Dedrick and West (2004) found that the most important driver for OSS adoption was cost, both direct savings (cheap software) and indirect savings (no upgrade fees, lower hardware requirements); barriers included compatibility with current technologies and skills, organisational resources and tasks, and the availability of external technological resources.

A case story from the German monopoly commission (Terhoeven, 2004) presents improved security and reduced costs as the key motivators for changing from a Microsoft Windows to a Linux based desktop environment, and these goals were indeed obtained; however a number of disadvantages with the new solution is also mentioned: compatibility problems when exchanging documents with Microsoft Windows users, some examples of poorer user friendliness, the need for self-developed macros, and an increased need for external consultants.

For another German public organisation (100 employees), the initiative to adopt OSS was provoked by changes in Microsoft support and license policies, and a growing need for organisation-wide standards for document formats and software (Müller, 2004). The organisation had an outdated, Microsoft-based IT environment, and calculations showed that migrating to OSS would save more than 93,000 € compared to the cost of upgrading to newer Microsoft products. The decision to migrate to OSS was taken by the organisation chairman, and led at first to widespread scepticism among the users; this, however, was partly overcome by helping the users install and use the OSS products (Linux, OpenOffice.org etc.) on their home computers. Apart from user resistance, other difficulties in the migration to OSS proved to be lack of both end-user and system administrator qualifications, importing and exporting Microsoft Office documents, and choosing the right Linux distribution and application programs. According to Müller (2004), enablers of the adoption of OSS were the autarchic working style, a limited number of software applications, and strict separation between the internal network and external communication. Also an EU-financed OSS migration study (netproject Ltd., 2003) and a consultancy company with experience in OSS migration proved helpful.

An example of OSS adoption in a larger, public organisation (an Irish hospital) has been described by Fitzgerald and Kenny (2003; 2004). This organisation had 3,000 employees, 36 servers and approximately 1,000 desktop machines. Also here, cost savings were the primary motivator for the adoption of OSS: calculations showed initial cost savings of around 4.75 million € (or 96%) when comparing OSS and proprietary solutions, even though the hospital received academic discounts for most proprietary products. Access to the source code was not an important issue; only five lines in Linux were changed in order to support the hospital's Oracle database. According to the IT manager, cited in (Fitzgerald and Kenny, 2003), other important enablers for the adoption were adaptable key staff, already with strong Unix application experience, scalability and stability of OSS applications, and almost identical look-and-feel and functionality in OSS and proprietary applications. The question of technical support was considered to be important, but not a barrier, and even though support procedures had to change (relying more on the Internet, bulletin boards, and mailing lists), the quality and promptness proved satisfactory. The strongest barrier to the migration seemed to be the resistance from staff who feared deskilling.

Several authors have recommended use of OSS in the public sector, including Seiferth (1999) (US Department of Defence), Schmitz and Castiaux (2002) (public sector administrations across EU), and the Danish Board of Technology (Teknologirådet, 2002) (Danish public sector).

Interviews with 16 Australian IT decision-makers (McCabe, 2004) showed most of these to be "agnostic" in relation to OSS, not having a general OSS policy, but rather assessing each OSS product on its own merits. The primary motives for adopting OSS were economic, and a strong element in this calculation was "the issue of vendor dependency and lock-in"; Microsoft's dominant market position was an important issue, and OSS products "seen as specific mechanisms for reducing dependency", also "being used as tactical lever to negotiate a sharper deal today, and as a strategic force to pressure Microsoft into adjusting pricing and licensing policies in future."

## 5 OUR CASE STUDIES

### 5.1 CBA

Copenhagen Business Academy (CBA) provides teaching from 13 outlets in Copenhagen. In 2003 the turnover exceeded 500 million DKK (approx. 83 million USD) with 700 employees and 17,000 students enrolled. Six persons are employed in the IT-group, administrating and supporting the information systems; additionally, some teachers have support of the educational systems as part of their job. The prime goal of the IT-group is to provide efficient and effective administration and support of CBA's IT infrastructure, and the group has as an objective to reduce the complexity and variety of employed systems and software.

Large parts of the information systems at CBA were developed by the Danish Ministry of Education and has been mandatory for the institution: most importantly the student and teacher administration system (EASY-A), and the financial system (EASY-Ø). CBA also employs two Microsoft Exchange servers, running as post offices for students and employees, an executive information system, and various educational systems.

Except for courses in OpenOffice.org (OOo), CBA does not at present employ OSS. According to IT director Torben Johannesson, the primary advantage of OSS should be the low acquisition cost, but because of substantial educational discounts from vendors (primarily Microsoft), this advantage is very limited and the perceived lack of support of OSS is a decisive barrier.

Another barrier comes from the importance of compatibility with the Oracle database management system (DBMS). According to CBA, support of the Linux platform seems to have a low priority for Oracle, causing upgrades for Linux to be almost one version number behind upgrades for prioritised platforms like Microsoft Windows. Therefore, according to CBA, a switch to Linux would seriously increase the need for local system "patches" while waiting for new releases of the Oracle DBMS. Furthermore, CBA is worried about compatibility problems between different Oracle versions, Linux flavours and versions, and hardware.

Summing up, except for a very limited use of OOo for teaching purposes, CBA does not at present employ OSS and does not have any motivation or plan for future adoption of OSS. For CBA, the only potential advantage of OSS appears to be cost savings, but these seem negligible because of substantial Microsoft educational discounts, and do not outweigh what CBA believes are major drawbacks: lack of vendor support, compatibility problems, and poorer support from 3<sup>rd</sup> party vendors.

### 5.2 CFI

Centre for Informatics (CFI) is the central IT department for the Danish Ministry of the Environment, providing basic IT services for the ministry: IT infrastructure, office automation, document management, consultancy and training, etc. In 2001 CFI replaced a number of former, individual IT departments in institutions under the Ministry of the Environment; the objective was to cut down expenses with 17% and staff with 25% in two years, and these objectives have been satisfied. In 2004, CFI employed approx. 30 employees and serviced 2,400 office workers; the yearly budget was approx. 75 million DKK or 12 million USD.

A major goal for CFI has been to standardise the systems used across the various institutions. For servers, the operating system is primarily Windows 2003; common governmental systems for accounting (Navision) and document handling (Scan-Jour) require use of Microsoft SQL and Oracle DBMS, respectively. E-mail services and content management are provided by Microsoft Exchange and CMS for most institutions, but one research institute uses Lotus Notes instead; it is the ambition to soon decide on a common platform for these. On the desktop, the standard configuration is Windows XP, Microsoft Office 97 and Outlook 98, except for the one institute's use of Lotus Notes for e-mail.

As expressed by CFI's deputy chief director, most institutions have a long tradition for choosing Microsoft products, but CFI has deliberately wanted to challenge this. As a consequence, CFI has declined Microsoft's Software Assurance programs, where a yearly fee guarantees automatic updates of Microsoft products to new versions and platforms. CFI found these programs too costly and decided to retain the old versions of Microsoft products on the desktop. This has led to the present situation, where old products need to be replaced and all options are open, including choosing OOo as a replacement for Microsoft Office.

Recently, the Danish Ministry of Science, Technology and Innovation has initiated "Project e-government" promoting e-government initiatives across the sector. An important element is development of a common enterprise architecture framework for the entire sector, and as a result, CFI has begun a difficult and long-term process of defining and developing an IT enterprise architecture for all institutions under the Ministry of the Environment. Evidently, this work is closely related to the decision regarding desktop applications.

Thorough, preparatory studies have been made for this decision, including closely following experiences from a number of pilot desktop projects across the public sector. CFI has found the cost of comprehensive TCO studies prohibitive; instead a number of future scenarios have been analyzed. The analyses have shown that most switching costs will be the same, irrespective of whether the choice falls on new versions of OOo or Microsoft Office. This holds for user training as well as updating of interfaces and document templates. As experience has shown a negligible need for external support of desktop applications, the two alternatives are also considered equal in this respect.

The remaining important issues of CFI in relation to the decision on future desktop applications are:

- Differences in acquisition costs, licensing
- Vendor independence
- Interfaces to the new mail system, existing documents, and outside partners
- Conformance with an upcoming enterprise architecture

For CFI, the availability of the source code for OOo was at first not considered an advantage, but because of a poor Danish localization of OOo, CFI has discussed contributing to the OSS project with improvements in this area.

Summing up, the case of CFI has taken the decision on an OSS product from the business case approach to the context of architecture and IT policy. In this regard, the Ministry considered breaking a new ground moving towards platform and architectural reorientation confronting the Microsoft platform of Windows, MS Office, Exchange Server, IIS, MS SQL server, etc. But in February 2005, CFI decided that the adoption of OpenOffice across the organisation was too risky, compared with a budget showing annual savings of only approximately 2 million DKK.

### **5.3 POG**

POG is an anonymous name for a private company in the Petrol, Oil and Gas (POG) industry with 1,200 employees worldwide and a net revenue in 2003 of 19 billion DKK or more than 3 billion USD. There is an IT department for each country; the one in Copenhagen has 14 employees and services approximately 300 users. Traditional "office work" like administration of personnel, economy, and contracts constitutes only a minor part of the application area; IT is mainly used in relation to oil extraction and reservoir simulation, where users typically are geologists and engineers.

For POG, OSS is primarily used for back-office applications like Samba, DHCP and DNS services. An important advantage of OSS has been the conformance to open standards, which makes integration of a quite heterogeneous computer environment possible. According to POG, this is in contrast to commercial products, particularly the ones from Microsoft, which often use proprietary standards and in this way restrict POG's software options. Recently, a switch from Microsoft's Active Directory to OpenLDAP in combination with Samba version 3 has achieved a long-time goal: providing a common login for both Windows and Unix users.

POG deprecates changes in the source code for the OSS products. Access to the source code has, however, made it possible for POG to make custom builds of the software for their specific environment (hardware, operating system, system libraries), and in this way obtain a better “fit” between software and environment than would be possible with closed source standard applications.

From the start it has been a requirement for OSS acquisition at POG that support should be as good as support for commercial applications. After unsatisfactory experiences with a British company, POG made a support contract for Samba with a Danish company, including thorough tests of new Samba versions as well as consultancy in relation to installation and configuration, trouble-shooting, and error recovery and reporting. These consultants act as an “interface” between POG and the Samba developer community, but occasionally POG is in direct contact with the community, reporting problems and errors, and receiving updated software versions. Often the turnaround time for these corrections has been much faster (2 weeks) than what POG has experienced with commercial vendors.

POG has, however, found the consultants’ services to be both too expensive and too limited, offering only support for Samba and a few other OSS products, so at the time of the interviews POG were exploring the possibilities of receiving OSS support from larger companies like HP and IBM.

On a more general level, it is important for POG to maintain a high degree of IT vendor independence. The arguments for this are of course economical, being able to have a wide range of products to choose from, when finding the most cost effective solution, but also emotional arguments like wanting to stand against Microsoft’s near monopoly play a role.

Decisions regarding software acquisition are in general not based on conformance to a company-wide IT strategy or detailed analysis of TCO or ROI. Company management has refrained from implementing a formal, general IT strategy; the informal strategy is to keep the company vibrant and prepared for changes, avoiding the restrictions being the consequence of a formal IT strategy. Also, TCO or ROI analyses are believed to be too expensive and leading to uncertain results. When choosing between different products, the only financial analyses are simple and based on acquisition and yearly support contract prices. This shall be seen in the light of a relatively small number of employees, producing high returns (approx. 1.8 million USD per employee, before taxes), which is why it is considered more important to “nurse” these operations than to obtain minor savings by finding the exact, most cost-effective software and hardware products.

Summing up, the CBA case showed a negative posture to OSS products from a platform point of view rather than from an application-by-application point of view. CFI, while in the process of developing a ministry-wide IT policy and architecture, took an interest in OSS due to a coming decision on which desktop to move forward. Conformance to an evolving government architecture policy postponed decisions on desktop applications for more than a year. Finally, the procurement policy of POG was flexible, with the important goal of not restricting future options in hardware and software acquisition. Rather than bet on any particular platform or architecture, POG opted for open standards, and this led to the interest in OSS. At the same time, the POG case showed the least economic constraints of all cases.

## **6 CATEGORIZING THE CONCERNS**

In an evaluation of OSS, the distinction between product indicators and application indicators suggest looking at product maturity before assessing the business case for an OSS product. In our case studies we have met the following indicators of OSS product maturity: Community of developers, community of users, distribution, and commercial consultants. The distinction between developer and user community reflects a need to assess the extent of “commercial use” as the real test case of a product’s maturity. Professional distributions, with well-selected and thoroughly tested components that fit business requirements, signal product maturity. Finally, availability of professional and highly competent consultants has been stressed in most of our cases and in others, too (Müller, 2004).

In COTS analysis there is increasingly attention to the fact that not only do several applications share the same data and networks for internal and external communication, applications are also services to other companies. A business case for an application becomes harder to make without considering shared resources and communication requirements and services. Ross and Beath (2002) argue that returns on individual investments must now be weighed against demands for organisation-wide capabilities. Therefore, they introduce a framework for IT procurement that considers both strategic objective and technology scope leaving a “pure product” assessment approach in favour of an “application approach”.

The scope required for an application evaluation is the same for OSS and COTS. To structure the considerations found in the organisations, we have used the framework of Ross and Beath (2002) that distinguishes between application or product related considerations, and architectural considerations; the latter having a broader focus than shared infrastructure which may be only part of the architecture.

		Strategic Objective	
		Short-Term Profitability	Long-Term Growth
Technology Scope	Business Solutions	<i>Process Improvement</i>	<i>Experiment</i>
	Shared Infrastructure	<i>Renewal</i>	<i>Transformation</i>

Table 1. Framework from Ross and Beath (2002)

Arguments driving a business case and arguments driving architecture may not be opposed in the case of OSS if open standards are important to architecture. It depends upon who is driving the IT acquisition. Governance concerns allocation of decision-rights and accountability requiring transparency, performance metrics and ex post evaluation, narrowing any scope for ad hoc decisions. OSS has hit the IT agenda in recent years, reflecting rising public and political awareness and with political overtones that have coloured the positions we have met in all cases. Looking through the OSS concerns mentioned by the organisations, it seems clear that many of these concerns are not related to OSS in particular; they are related to applications as part of the IT architecture, and the issue of change from a vertically integrated Microsoft platform.

We addressed the issue of OSS acquisition interviewing at a managerial level of the IT organisation in all case studies; for these people, not being OSS developers, OSS was a promise from others in the organisation (POG) or in the public (CBA and CFI).

Accounting for the response we adopt Ross and Beath’s framework that poises short to long term impact and infrastructure technology to business solutions, thus focusing on a decisive shift in acquisition: from an internal IT department to a business wide IT governance issue. The challenges from this shift are made explicit in all three cases, but with different outcomes.

In CBA, OSS was considered in terms of a company-wide integration requirement that the IT organisation would like the vendor to guarantee. A piecemeal component approach was out of the question, seen as jeopardizing vendor guaranteed integration.

In CFI, a major barrier was the lack of experiences from other organisations that could serve as exemplars for CFI, and OSS acquisition became a corporate matter of risking to position the Ministry ahead of the mainstream without having expected supplementary resources for that purpose. At the same time, specific technological interoperability concerns were brought forward, while stressing adherence in principle to an open standard architecture.

In POG, the IT department implemented a renewal of technology in particular part of the IT infrastructure adopting OSS. After a learning process, satisfaction with the OSS alternative pushed OSS higher on the agenda in architecture and thus in acquisition, though still not leading to a company-wide IT strategy and architecture.

Thus, we learn that only if not reaching a corporate IT agenda does OSS succeed. We therefore suggest that issues of IT governance and of architecture raise doubts of the advantages of OSS in spite of open source, open standards and component-based architecture of applications.

## 7 DISCUSSION

Based on our limited – in both breadth and depth – case studies, we are not able to provide a general answer to the question of what organisations need to consider when they make decisions on adoption of OSS. Our studies drive our search for explanation in two directions: one following the economics of OSS and another following the technical characteristics of open source and open standards. We transformed the distinction into one between a product or business case approach, and an application and architectural approach, leading to a more systematic understanding of the differences between COTS and OSS.

Our cases lead us to summarise our understanding in terms of not the scale of the company adopting the software, but rather the scale of the organisational unit responsible for the adoption.

For *small-scale* adoption of OSS in single departments in a large organisation, or for OSS adoption in small organisations, the cheap price of OSS is of major importance on a short-term basis. They will find it hard to negotiate rebates on commercial software, but OSS makes it possible to experiment on a very limited budget, and adopt further OSS modules when they are seen fit for the purpose. Since OSS does not tie an entrepreneur to a particular vertical platform IT is less likely to turn into an impediment to collaboration opportunities. For small organisations, enterprise-wide IT architectures – if they exist at all – will only be a minor consideration. In larger organisations, OSS will be considered an attractive alternative in special “niches” (e.g. dedicated servers), where OSS can be adopted for experiments or for narrow business case reasons, without interfering (too much) with the enterprise-wide IT architecture.

For *large-scale* adoption of OSS in medium-sized or large organisations, often receiving substantial discounts on commercial software, the cheap price of OSS is of minor importance on a short-term basis. As these organisations will often have enterprise-wide IT architectures, decided by top management, large-scale adoption of OSS will imply changes to these architectures; changes that can be both costly and risk prone and will be perceived as important barriers for adoption of OSS. On a long-term basis, however, large organisations will be likely to benefit from adoption of OSS, because OSS makes it possible for the organisation to obtain enterprise-wide IT architectures that both guarantee a high level of interoperability (because of OSS’s open standards and interfaces) and easy maintainability (because of the communities and open source code). In this way OSS better than COTS preserves technological options that are hard to calculate for products coming out of an innovative IT industry.

An important barrier facing large-scale adoption of OSS may also be the question of user adaptability. Most initiatives of OSS adoption have not been in conformance to, but rather against users’ wants. For CFI with a large group of clerical users, the large-scale switch from Microsoft Office to OOo was faced with substantial opposition from sceptical users; a barrier also mentioned in other case studies, e.g. (Müller, 2004). POG, adopting OSS on a smaller scale, did not face the same kind of opposition, due to the more limited consequences for users’ work and a probably more adaptive user group with a majority of academic and scientific staff.

Our case studies also reveal more interest for OSS in the infrastructure than for OSS in business applications. As OSS is coming to maturity in the Internet era, it has a stronghold on the network and network related technologies. We will continue our research by exploring which components are used for OSS platforms for which domains and functions of corporations and entrepreneurs.

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