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# OPEN SOURCE SOFTWARE IN THE TRENCHES: LESSONS FROM A LARGE-SCALE OSS IMPLEMENTATION<sup>1</sup>

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## Abstract

*This paper describes the implementation of an information systems infrastructure using open source software (OSS) in a large Irish public sector organization, Beaumont Hospital. The study identifies the primary organizational drivers in Beaumont's move to OSS, namely principle and pragmatism. It also discusses some of the problems encountered, such as the change in mind-set required when deploying OSS solutions, and resistance from staff who feared being deskilled by moving away from popular proprietary systems. The study reveals a radical shift in open source deployment from invisible horizontal infrastructure systems to highly visible vertical applications. The first phase of OSS implementation is estimated to lead to cost savings of €13 million over five years. These details are useful in that few studies have quantified the savings from OSS deployment. Given that Beaumont was already receiving academic pricing discounts for many of their original proprietary closed source applications, the savings for a typical commercial organization could be even higher. Also, in many cases, the extra functionality available in the OSS systems deployed allowed for a richer feature set overall. Buoyed by the success of this first phase, Beaumont is planning a second phase of OSS implementation for an overall hospital information system, a financial systems suite, and is even considering developing their payroll system in an open source fashion. The study also identifies how a typical company can contribute back to the OSS community in their own unique way, by distributing applications developed from their own particular domain of expertise, rather than having to make code contributions to the code base of GNU/Linux or Apache as might have been assumed to be the case. Indeed, free access to source code played a very limited role in Beaumont's motivation, where given the budgetary constraints, zero cost was of more concern than open source.*

**Keywords:** Open source software, information systems infrastructure, information systems development, information systems implementation

## Introduction

Open source software (OSS) has elicited phenomenal research interest across a range of disciplines since the term was introduced in 1998. Much of this research, however, has focused inward on the phenomenon itself, studying the motivations of individual developers to contribute to OSS projects, or investigating the characteristics of specific OSS products and projects. Far less has been done in looking outward at the deployment of a portfolio of OSS systems in organizations, primarily because this is still a comparatively rare phenomenon. Up to now, most OSS deployments have been in invisible infrastructure applications running on back-office servers: the GNU/Linux operating system, the Apache Web server, etc. These have typically been deployed by

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<sup>1</sup>This research has been supported by the Science Foundation Ireland Investigator Programme, B4-STEP (Building a Bi-Directional Bridge Between Software Theory and Practice).

technology-savvy information technology personnel, who were persuaded of the quality of the products and were not susceptible to any FUD<sup>2</sup> scare tactics. Given that the purchase cost of these products was more or less negligible,<sup>3</sup> IT personnel were able to quietly deploy these products. If management had been made aware that most of their vital infrastructure was based on software that was not supplied by a vendor with a legal responsibility for ensuring its performance and continued support, it is very unlikely that the use of these products would have been sanctioned in the first place.

In more recent times, OSS products have started to be deployed in more visible applications such as desktop applications for word processing, spreadsheet, e-mail, etc. Beaumont Hospital, a large Irish public-sector organization, recently embarked on the implementation of their overall information systems (IS) infrastructure through the deployment of OSS solutions. The objective of this study was to investigate this implementation, with the twin aims of (1) understanding the motivation behind the move, the benefits, and associated problems, and (2) helping to ensure a successful intervention in the overall implementation of an OSS infrastructure. The paper is structured as follows: In the next section, contextual background information is provided in relation to Beaumont Hospital, and the action case research method used in this study is also described. Following this, the overall proposed IS infrastructure in Beaumont and the OSS applications being deployed in the first phase implementation are discussed. The focus then shifts to the drivers in the move to OSS, the implications of the move in terms of a changed support model, and the manner in which Beaumont intends to contribute back to the OSS community.

## Background: The Beaumont Hospital Context

Beaumont Hospital was formed from the amalgamation of three of the oldest hospitals in Ireland and employs 3,000 staff directly. It serves as the training hospital for the Royal College of Surgeons in Ireland (RCSI) and Dublin City University (DCU). Similar to many other organizations worldwide, Beaumont's IT budget has undergone a significant contraction since 2000 in the wake of the increased budget in the lead up to the Y2K, and in 2003 alone they faced a €17 million budgetary shortfall.

The current IT environment features 36 Intel-based servers, 22 running Red Hat or SuSE Linux and 14 running Microsoft Windows NT. In addition to the Intel servers, Beaumont's primary clinical application is based on a HP 3000 mainframe computer. The overall environment is thus characterized by a heterogeneity of application platforms and associated servers. Beaumont has always followed a mixed-market policy, acquiring software solutions where these were readily available, and creating or modifying existing applications as necessary. This mixed-market philosophy extends to the range of application providers who are involved in business relationships with Beaumont. This includes Hewlett-Packard, IBM, Sun, Linux providers (Red Hat and SuSE), and Microsoft.

Beaumont has approximately 1,000 desktop machines to support. Approximately one-third of these are bordering on obsolete, specified at 64 MB RAM or less and with clock speeds of less than 300 MHz. This situation arises because of a relatively low level of funding to sustain its IT infrastructure. As a direct consequence of this, as money became available, Beaumont acquired a variety of software of different vintages and capabilities, including a mixture of application packages. This in itself created problems as staff who changed departments usually insisted on bringing their familiar desktop applications with them.

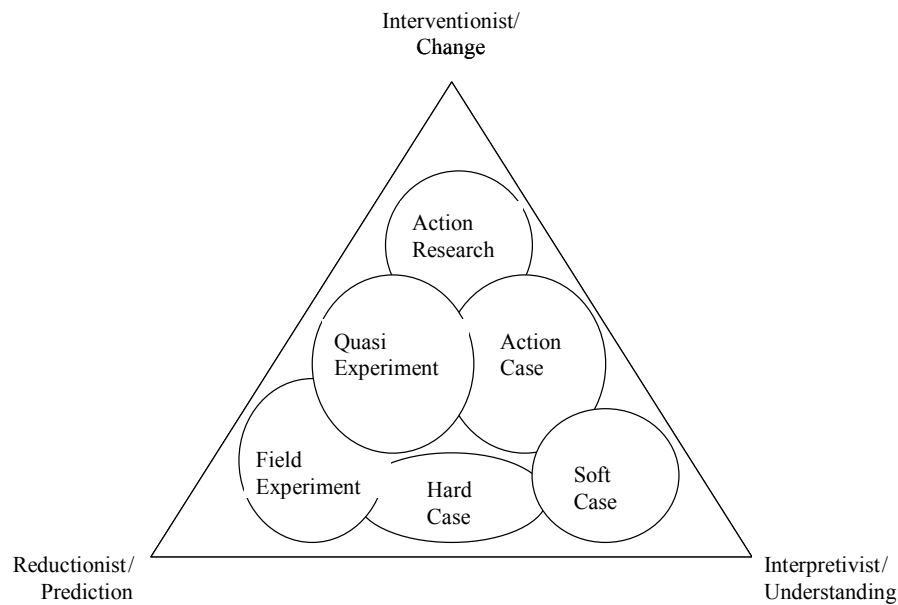
## The Action Case Research Method

Braa and Vidgen (2000) propose a useful framework integrating positivist, interpretivist, and critical approaches to IS research which has been used in a number of studies (e.g., Donnellan and Fitzgerald 2003). In Figure 1, the corners of the triangle represent the different perspectives and outcomes of the research. Thus, from the positivist perspective, a reductionist approach would be followed to produce the desired outcome, which is that of prediction. From the interpretivist perspective, on the other hand, the motivation would be primarily that of understanding, while from the critical interventionist perspective, the primary motivation would be one of change.

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<sup>2</sup>FUD is an acronym for Fear, Uncertainty, Doubt, and it represents a "dirty tricks" strategy which has been used particularly in the computer industry to help undermine competitors (see Irwin 1998).

<sup>3</sup>It is a common misconception that OSS is of no cost. However, OSS and its almost identical counterpart, Free Software, intend the term *free* to connote *freedom* rather than *no cost*. In English the term is ambiguous, but not in many other languages which have different words for freedom and no cost. Thus, Libre Software is the term commonly used in Europe. However, in this paper for the sake of simplicity and widespread usage, the term *open source software* (OSS) is used.



**Figure 1. A Framework for Integrating Research Perspectives and Methods**  
(Adapted from Braa and Vidgen 2000)

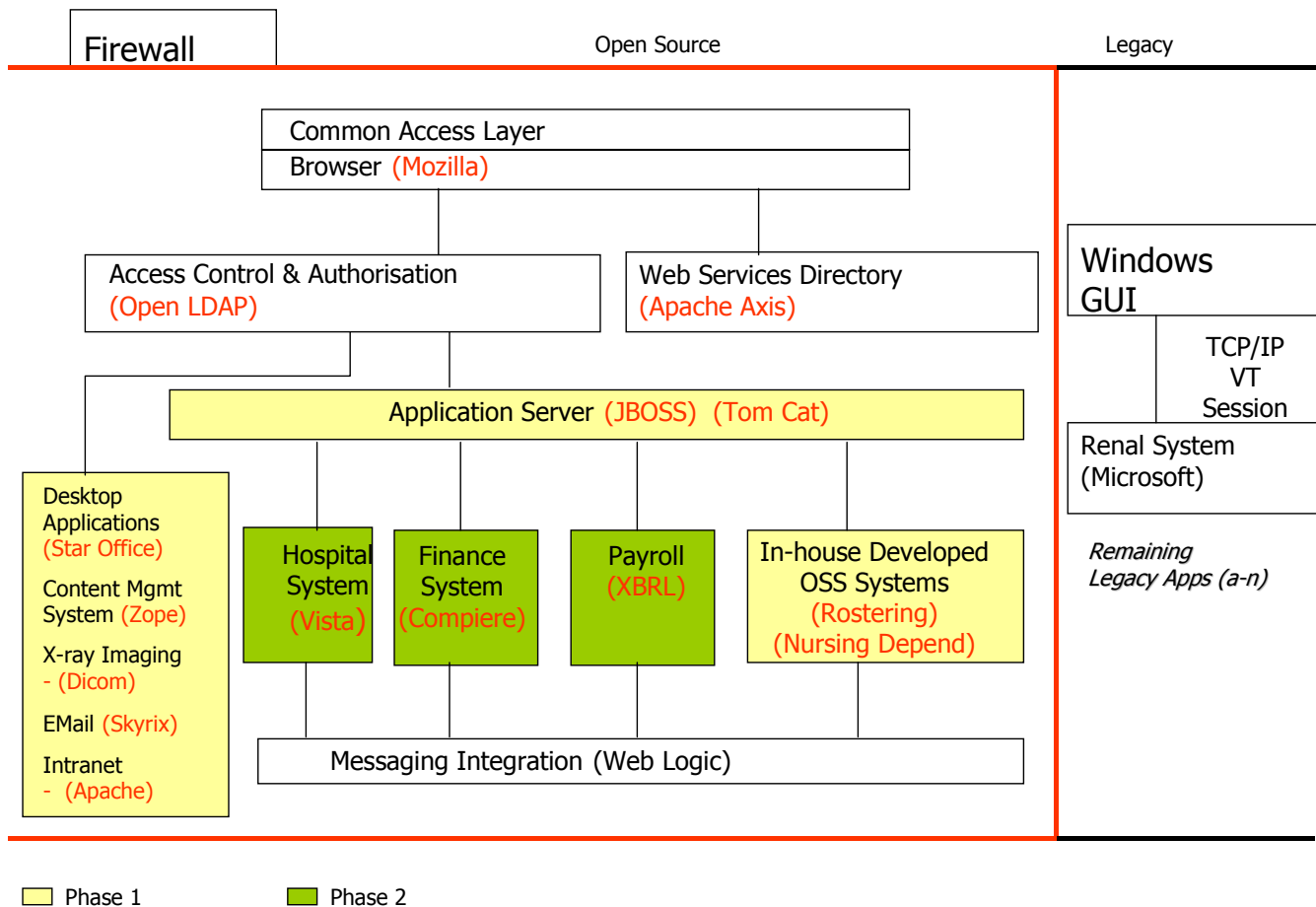
Given that little research has been conducted on the implementation of an overall IS infrastructure using OSS applications, this study was concerned with achieving an increased *understanding* of this process, and the benefits and problems of such a strategy. Also, as it represented uncharted territory to a large extent, the study was also motivated by an interventionist desire to achieve successful *change* in this real organizational problem given the lack of any roadmap documenting how this can be successfully achieved. Thus, a hybrid of the interventionist/change and interpretivist/understanding perspectives was appropriate. Braa and Vidgen locate a number of hybrid research approaches where a mixture of perspectives is motivating the research (Figure 1), and in cases where a mixture of interventionist/change and interpretivist/understanding perspectives is at stake, as in this study, the action case approach is deemed appropriate.

Given the antecedents of the action case in action research, there are two primary outcomes: an *action* outcome, in terms of a hopefully beneficial intervention in the organization, and a *research* outcome, in terms of a contribution to research on the phenomenon in question. Both of these outcomes occurred here and are reported later. Also, the nature of action research lends itself to a cycle of intervention and reflection. In Beaumont, a two-phase implementation process has been adopted, with this paper reporting on the first implementation phase of OSS applications. Following this first-phase intervention, there has been a period of reflection as the lessons have been analyzed, and a second phase of OSS applications is now planned.

In terms of data collection, a series of formal and informal interviews were conducted over a nine-month period with both the IT manager and key staff responsible for the OSS implementation at Beaumont, and also with key users of the systems. Interviews were generally of a one- to two-hour duration. Informal interviews were used to clarify and refine issues as they emerged. The IT manager in Beaumont Hospital who has had overall responsibility for the implementation is also a coauthor of the paper. Thus, the correctness of the researchers' interpretation was less of an issue than in the traditional model whereby exclusively external authors interpret the research findings.

## Phase 1: Implementation of Beaumont's IS Infrastructure with OSS

Figure 2 outlines the proposed IS infrastructure in Beaumont. It reveals a move away from an architecture of legacy applications toward a Web-based service-oriented architecture. In the first phase (indicated with light [yellow] shading), extensive use has been made of OSS components in supporting this overall architecture. However these will continue to coexist alongside proprietary solutions where the latter have been perceived to offer greater functionality, or are simply easier to operate for the hospital's IT department and can fulfil requirements satisfactorily. The planned OSS systems for Phase 2 are indicated in dark (green) shading in Figure 2, but these are outside the scope of this paper.



**Figure 2. Beaumont's Proposed IS Infrastructure**

In Phase 1, a range of OSS applications have been deployed in Beaumont, ranging from invisible infrastructure systems, such as Red Hat Linux, to more visible desktop applications such as Star Office and Skyrix mail. This move to the deployment of more high-profile OSS products marks a radical shift from the early focus of OSS systems. The implementation of the major Phase 1 systems is discussed in more detail below.

### ***Desktop Applications: Star Office***

In February 2002, Beaumont began a roll-out of the Star Office 5.2 desktop suite. This deployment was very problematic for users and the technical staff. Indeed, the latter became very disenchanted with the implementation. However, this was felt to be largely due to problems in the version of Star Office. In September 2002, Star Office 6.0 was deployed with some support from Sun. However, this implementation was also troublesome. The IT manager wanted to pursue a thin client strategy based around the concept that all applications should be downloaded from the network where practical. The Star Office package was initially loaded onto a single Linux server, but this became overwhelmed, and was then clustered to sustain a dual server strategy. Despite this, users continued to lose network connections in an unpredictable fashion. This inevitably increased frustration and tension among the entire workforce who were dependent on these tools. The IT manager conceded that, “we stuck with the network solution too long. It was only after a series of ferocious encounters with users—and with my own staff—that I recognized that we had to shift.”

So although it would conflict with a purist architectural dogma, Star Office was reinstalled on the desktop instead for those who wanted it. While this move did not immediately ameliorate the users' perception of the problem, it did, over a number of months, have a marked impact on the overall level of satisfaction with the solution.

Interestingly, a number of users, who either already had current alternative products or the money to purchase them, opted not to install Star Office. Approximately 80 users (about 8 percent) of the installed base made this choice. However, the IT manager informed them that this would have consequences in that they would have to assume responsibility themselves for ensuring that the hardware which they use is upgraded and providing resources for future maintenance upgrades.

One of the unexpected benefits of this solution has been the capacity of Star Office to exploit its in-built XML capabilities. This is a very powerful feature of the application which enables documents to be structured in such a way that processing logic is built into different sections of the document, i.e., an on-line human resources form request, for example, which is then automatically routed to the human resources department for processing. This is a significant new feature and provides additional functionality over what was previously offered in Beaumont's proprietary desktop applications.

Beaumont is gearing up to install Star Office 7.0. This contains a number of enhancements which increase the ease of use and attractiveness of the product. Roll-out of this release will commence when Sun releases Star Office 7.0 officially (anticipated in September 2003). Beaumont has had a beta version of the product for training purposes. "This version really breaks down the myth of needing proprietary solutions for presentations and other purposes," according to Beaumont's lead systems trainer, and they are currently planning a widespread training and awareness campaign to ensure that the user community is briefed on the new features in Star Office version 7.

### ***Content Management System: Zope***

Beaumont's content management system (CMS) is based on the Digital Creation's Zope. The product itself may be downloaded for free, but the implementation in Beaumont cost €20,000 in support from a small software company, OpenApp, who specialize in brokering OSS solutions. Interestingly, while the OSS phenomenon is sometimes characterized as a threat that will stifle the local software development industry (cf. Villanueva Nuñez 2002), it is certainly the case that agile SMEs (small-to-medium-sized enterprises) anywhere in the world can leverage the innovative OSS model to create new business opportunities.

Beaumont's CMS provides information such as human resources policies, laboratory standard operating procedures, personnel and nursing on-line forms, minutes of working group meetings, multidisciplinary patient care documents, etc. The Zope application server enables these documents to be managed in an automated manner by using the metatags associated with each document type, which implement rules about how information should be displayed, who is authorised to see it, who can change it, etc. This approach is supplemented by close integration with the Beaumont's LDAP directory server where details of every individual employee is held. Based on their employment category, employees are granted corresponding privileges on the CMS server. Overall, the experience has been very positive, and use of the CMS is growing within Beaumont.

### ***X-Ray Imaging: PACS<sup>4</sup>***

Until relatively recently in most hospitals, x-ray images were actually printed on film for viewing on light-boxes (analog mode). Now the majority of x-ray modalities generate digital images. An international standard, DICOM (Digital Imaging and Communications in Medicine), has defined a standard way for creating and storing such images. In Beaumont, Sun Microsystems donated a Sun Fire V880 with 1 terabyte of disk storage for these images, and Beaumont's IT staff then developed a solution to enable the digital images to be retrieved and viewed online. This involved the writing of Perl scripts to extract a DICOM work list from the existing HP 3000-based radiology information system.

Another hospital in Ireland with an equivalent number of beds incurred expenditure of about €4.3 million in implementing a commercial PACS system. Beaumont will need to incur expenditure to upgrade the quality of its network to sustain rapid retrieval of data. The cost of this is estimated at about €250,000. Additional high-resolution work stations will also need to be purchased

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<sup>4</sup>Picture Archive and Communications System, a term commonly used to describe the subsystems used to display, diagnose, and report on digital images in hospitals.

to sustain radiologists making clinical diagnosis in a manner that is both safe and consistent. Expenditure on these items is likely to be in the region of €400,000. However Beaumont is currently incurring annual costs on x-ray film in the region of about €480,000, so funding for this additional investment should be capable of being generated through internal savings.

Perhaps the most significant development is that Beaumont has acquired experience in utilizing digital X-ray imaging technology for a relatively low cost. Other organizations that have committed to large-scale investments have been obliged to do their learning in this area in the context of expensive commercial contracts, where modifications and changes have consequential impact on both project schedules and budgets. The medical physicist in Beaumont who initiated the whole process is very upbeat, stating that “We believe that this is a better way to learn.”

### ***Application Server: JBOSS and TOMCAT***

Beaumont has committed to the development of JAVA/J2EE as its principal reference architecture for software construction. This is a marketplace dominated by a number of large players such as Oracle and IBM’s Web Sphere suite. The cost of these solutions range in the region of €150,000 to €400,000 for a typical dual-CPU server implementation. Beaumont Hospital selected the open source JBOSS product which is freely downloadable ([www.jboss.org](http://www.jboss.org)). They have incurred expenditure of about €10,000 in set-up consultancy, and expect to incur annual maintenance costs of roughly the same amount for the next five years.

Tomcat, more properly Jakarta Tomcat, is the container for Java Servlets and Java server pages. It is an open source project from the Apache Software Foundation with an active development community, and is based on a collaborative consensus development approach. Tomcat is extensively used within the Java community as a robust and reliable servlet container. Many commercial software vendors actually embed it in their offerings because of its robustness and quality.

### ***E-Mail: Skyrix***

Like many large organizations, Beaumont has been using e-mail for internal and external communications, and held an 800-user licence for Lotus Domino. There was a demand from the organisation to expand the coverage of e-mail to all 3,000 staff, but the cost of achieving this was beyond the tight budget available. A search for an alternative e-mail solution was instigated and the Skyrix mail package was selected ([www.skyrix.com](http://www.skyrix.com)). According to the lead computer operator who managed the implementation, this provides all the basic e-mail functions that users require and, more importantly, it provides e-mail access to all 3,000 staff in the organization, a feature which is greatly appreciated by the various administrative functions in Beaumont.

Any organization considering implementing Internet or e-mail solutions needs to ensure that they have appropriate protection and content filtering services in place. Proprietary solutions are essentially licensed on a per-user basis. While the unit cost is modest in some cases, the overall costs rapidly mount up as the numbers increase. Beaumont identified a number of open source system management tools which fulfil this purpose. These include IP Chains, a firewall system based on the Linux operating system, that essentially provides the same degree of functionality that is offered through more expensive commercial offerings. Beaumont utilize content filtering rules based on the Black Hole product, a rules-based Web content filtering tool. It provides the usual facilities of black lists, white lists and other organization-specific rules which Beaumont’s own staff set up and maintain. Spam Assassin screens all incoming mail and rates the contents on preset rules. Beaumont sets its own trigger level to identify likely spam deliveries. Any messages that exceed this content quota are quarantined for further inspection by the e-mail administrator.

## **Discussion**

### ***Drivers in the Move to OSS: Principle and Pragmatism***

While quite a lot of research has been conducted on the motivation of individual developers to contribute to OSS projects (e.g., Ghosh 2002; Lakhani and Wolf 2003), there has been much less focus on the motivations of organizations deploying OSS. In the case of Beaumont, the IT manager characterized the decision to move to OSS as based on principle and pragmatism, each of which are discussed in turn here.

## Principle

The IT manager in Beaumont stated their fundamental underlying principle was the desire to get the best possible return for the taxpayers' money as the hospital was largely funded from government funds each year. Table 1 identifies the information systems components already implemented in Phase 1 as discussed above. As can be seen from Table 1, the actual cost savings in the move to OSS were extremely significant. The dearth of research which has quantified the benefits and weaknesses of open source software has been identified as a problem (Russo et al. 2003), as few studies have addressed the cost savings issue. One notable exception is the study by Shankland (2002) of Verizon who achieved once-off savings of \$6 million in moving to an OSS desktop. However, one criticism of such studies is that the one-off cost of acquiring software does not reflect the total cost of ownership of software acquisition (Villanueva Nuñez 2002). Calculating the total cost of ownership of information systems is a very complex issue (e.g., Francis-Johnson 2003). It requires consideration of a number of areas, including software purchase, maintenance, and upgrade costs, hardware purchase and maintenance costs, and administrative costs. In this study, we chose to focus in depth on software purchase, maintenance, and upgrade costs, and calculated these total costs over a five-year period.

As Table 1 illustrates, the once-off savings of OSS over closed source alternatives are in the order of €4.75 million. Furthermore, given that annual maintenance costs are typically about 20 percent of purchase price, when viewed over a five-year period, the savings are even more dramatic, in the order of €8.166 million, leading to an overall saving of €13 million from the first phase of OSS implementation in Beaumont.

In these calculations, every effort has been made to compare like with like, in that the estimate of the comparable costs is based on prior experience in Beaumont or on two alternative estimates. However, it is also worth noting that Beaumont receives academic pricing discounts for many of these applications, thus the costs for a typical commercial organization implementing such proprietary packages would be even higher, and the deployment of OSS alternatives would thus result in even greater savings.

**Table 1. Cost Comparison of OSS versus Comparable Closed Solutions for Phase 1**

Application	Initial Cost		Total Cost Over 5 Years	
	OSS	Proprietary <sup>a</sup>	OSS	Proprietary
Desktop Applications	€27,500 (StarOffice)	€120,000 (e.g. MS Office)	€34,700	€288,500
Content Management	€20,000 (Zope)	€126,000 (e.g. Lotus Notes)	€32,100	€140,200
Digital Imaging—X-Ray	€150,000	€4.3 million	€237,000	€7.34 million
Application Server	€10,000 (JBoss)	€302,000 (e.g. Websphere)	€60,500	€595,300
E-mail	€10,000 (SuSE Email)	€110,000 (e.g. Lotus Domino)	€8,700	€175,000
<b>TOTAL</b>	<b>€208,500</b>	<b>€4.958 million</b>	<b>€373,000</b>	<b>€8.539 million</b>

<sup>a</sup> Beaumont Hospital receives academic discounts for most of these applications

For Beaumont, the drive to OSS was primarily due to the necessity of reducing cost. The IT manager was very frank that it was not driven by any doctrine or anti-Microsoft ideology, pointing out that Microsoft was the first to ease Beaumont's budget problems by granting them academic pricing status in 1995. Also, one of the most recent systems implemented—a system to support a comprehensive clinical record for renal patients—was entirely based on Microsoft components.

Free access to source code was not really a factor in Beaumont's decision to deploy OSS solutions. The IT manager admits that open source software in the Beaumont case amounts to "zero cost or as cheap as possible." Thus, even though they have been seeking OSS solutions, they are more guided by the zero or low cost availability rather than open source code. Indeed, this is evident in their choice of Star Office rather than the pure-play open source equivalent Open Office. This decision was taken due to the availability of support directly from Sun. Access to some form of external support provides a degree of reassurance at all levels in the organization, especially when contemplating a major shift in operating paradigms.

The paradoxical issue as to whether many OSS users are actually interested in access to the source code is discussed in some detail in Feller and Fitzgerald (2002), where it is labeled the Berkeley Conundrum. The latter poses the question as to how important



open access to the source code actually is if the vast majority of consumers never look at it or modify it. This was largely the case in Beaumont where, apart from a five-line change to Linux to allow their Oracle database applications to run on it, they have not made changes to the source code of their OSS applications, and do not have any desire to do so. However, one of the strengths of OSS is that access to the source code allows the creation of killer applications in that mass market packages can be tailored precisely to the needs of each customer, but many organizations are not comfortable in making changes to the source code. This suggests that the Free Software Foundation definition of free software which stresses four fundamental freedoms, of which access to source code is a precondition for only two (see <http://www.fsf.org/philosophy/free-sw.html>), is more relevant to describing the phenomenon.

## **Pragmatism**

The choice of OSS solutions in Beaumont was also largely driven by pragmatic considerations (interestingly, pragmatism also featured in the motivations of OSS developers in the study by Lakhani and Wolf 2003). Beaumont's IT budget had undergone a significant contraction since 2000 in the wake of an increased budget in the lead up to the Y2K, and the IT manager did not foresee much prospect of an improved budget allocation in the near future. So, faced with the choice of either reducing their overall level of service to cope with these restrictions or looking for less costly alternatives, the focus was on what could be found in the open source market-place. Beaumont's IT staff undertook an extensive phase of desk research over a six-month period. The quality of the exchanges on SourceForge and slashdot.org were sufficient to convince the IT manager that OSS was worth investigating further. Some direct experimentation with downloaded OSS programs was then sufficient to convince him that the risk involved was relatively low.

The IT manager considers it fortunate that a number of key staff, particularly in the computer operations department, rapidly adapted to the new OSS environment, and he describes the operations team as the "leaders in the overall adoption of OSS." Indeed, Beaumont is now a little worried that their operations staff with experience in OSS deployment may be poached by other organizations. It also helped that Beaumont already had strong experience with UNIX applications to draw on, so the transition was not as radical as it would have been if staff experience was simply based on GUI-enabled systems administration. In the words of the Linux systems administrator, "We are not afraid of the command line interface." This may be significant as developers in the past have referred to the "exhilarating succession of problem-solving challenges" in installing OSS products (Sanders 1998), and it is unlikely that nontechnical users will be entirely comfortable in installing under such conditions, although the user-friendliness of the install process is improving daily. Beaumont's IT staff have also been very impressed with the scalability/stability of the OSS solutions, and have actually moved a number of DOS-based applications onto Linux in such a smooth transition that the user community never even noticed the change. Indeed, the IT manager expressed the concern that staff who had gained experience in deploying OSS solutions would now become targets for poaching by other organizations, rather than being deskilled by not having continued experience in commercial software packages.

The IT manager also cited the fact that the functionality and the look and feel of the OSS applications was practically identical to the conventional proprietary ones. Interestingly, it seems to be the case that even though the functionality provided by OSS products is pretty much identical, users prefer the comfort of an identical interface. Thus, Ximian are currently working on a release of Open Office that will clone the MS Office interface, even to the extent that the default format for saving files is the MS one! The comfort factor of a familiar interface should not be underestimated. One of the key complaints from the administrative staff and users in Beaumont who moved to an OSS platform was that they feared being deskilled if they didn't have skills in popular proprietary applications.

## ***A Changed Model for Support and Maintenance for OSS Solutions***

The IT manager accepted that OSS-based solutions did not offer the same degree of assurance as would a commercially acquired solution. There is an element of risk in proceeding on the OSS path:

We absolutely have to satisfy ourselves that the solutions that we adopt command a significant following in the OSS community. This is fairly easy to do—just look at the level of postings and on Source Forge [sourceforge.com] to determine what is active and what is a moribund project.

There is a need for a complete rethink of the support strategy. In the past, Beaumont have always purchased support from a competent third party provider. While with OSS this option still exists (i.e., they can get Linux support from Hewlett-Packard

or IBM), there is a significant difference in expectation associated with the deployment of OSS solutions. Simply because one can download a product off the Web, does not mean it can be used effectively. As the IT manager put it:

I downloaded Zope early last summer and gave it—together with a book I had bought—to a university student who was doing an internship with us. At the end of the summer he had made very little progress in actually configuring the solution. If we had not involved a specialist consultancy firm—OpenApp—we would not have achieved the results that we have to date.

Thus, organizations need to be aware that there are support and implementation costs associated with OSS solutions. Also, many organizations may face internal resistance to the fact that their support essentially derives from a series of bulletin boards. They may be equally reluctant to purchase consultancy support to effectively deploy a solution, since, as the IT manager aptly summarized,

If you have a product which costs €1 million—it may seem appropriate to spend €500,000 on consulting. However if the product costs nothing, then spending €500,000 somehow seems to be a more difficult decision to take, yet the saving is still €1 million.

The biggest learning for Beaumont Hospital has been to orientate its support staff to effectively utilize the Internet and other resources to deliver support. There is still a hankering to call a support number and have someone else take care of the problem. While the comfort zone this offers is readily understandable, the IT manager believes that this is a transitional issue and that as users and developers get more confident in the success of the systems, this will no longer be a factor. Thus far, the support from online bulletin boards and mailing lists has been very prompt and successful for all of the issues they have faced.

### ***Top Management Support***

Top management support is also critical for OSS deployment, especially as it moves out of the invisible infrastructure systems to visible, high-profile desktop systems. In the case of Beaumont, the decision to move to OSS was given full support by the CEO, largely on the basis that there was no other choice given the cuts in the IT capital budget. However, given the high risk involved in venturing into the unknown without the comfort of the traditional hotline telephone support and written maintenance contracts, top management support is undoubtedly critical.

### ***Giving Back to the OSS Community***

Von Hippel and Von Krogh (2003) discuss the problem of *free riders* for a collective action movement such as OSS. Previous research suggests that the non-excludability of open source software should lead to resentment from contributors who eventually cease to contribute on the basis that free riders who do not actively contribute to OSS are still able to benefit more or less equally. This is an important issue as a delicate equilibrium may prevail and OSS developers may come to resent consumers of their products who make no contributions to the code-base and provide little feedback by way of bug reports. However, notwithstanding their pragmatism overall, Beaumont has subscribed fully to the open source philosophy of openness and sharing, “practicing what we preach” as the IT manager terms it. In terms of contributing to code development on the installed OSS solutions, the IT manager acknowledged that the hospital was unlikely to be in a position to contribute to the Linux kernel or to other infrastructural OSS systems any time soon. Rather, he stated,

We believe that there is space for the sharing of applications, which takes the infrastructural components for granted. In truth, we probably know very little about the internal workings of the Linux kernel, but we do understand rostering and dependency and drug prescribing, etc. So this is the area where we would contribute our expertise to the community. In turn, we hope that others will make matching contributions, thereby enriching the pool of resources available to this pressurized and cash strapped health sector.

Beaumont has created a number of applications which it now offers on an open source basis to other healthcare agencies. Examples of these include a staff rostering system, a tissue matching system, and a casualty system. Other organizations have been quite slow in taking up these offers, probably because they are uncertain how to respond, in the opinion of the IT manager. However a number of hospitals have indicated their interest. One hospital has already installed one of these systems, and two more

are waiting until internal resources within Beaumont are available to support their implementations. Thus, the free rider claim is not ultimately sustained against Beaumont.

## Summary and Conclusions

While a great deal of research has now been conducted on the OSS phenomenon across a range of disciplines, the vast bulk of this research has focused inward on the OSS phenomenon itself, for example, identifying the characteristics of OSS projects, the motivations of developers, etc. However, there has been little focus outward on the consumers of OSS, and the manner in which OSS and proprietary software can be co-deployed in an overall IS infrastructure. This was the focus of this study, and a number of significant findings have emerged.

First, the study reveals a shift in OSS applications from predominantly invisible infrastructure back-office applications in horizontal domains to more visible front-office applications in vertical domains, X-ray imaging in the case of Beaumont, for example. Also, Beaumont has chosen to deploy OSS and conventional proprietary systems in parallel in achieving there is infrastructure. The study also reveals very significant cost savings of €13 million over five years in relation to software purchase and maintenance costs through the first phase of OSS deployment. As Beaumont received academic discounts on many of their proprietary applications, the savings would be even greater for the typical commercial organization. In addition to this, in many cases, the flexibility and ready availability of additional features in their OSS applications allowed Beaumont to offer extra functionality they could not offer in proprietary alternatives. The issue of access to source code comes to the fore in this study, with Beaumont acknowledging that, given their budgetary constraints, ideology played a lesser role, and that zero or low cost was much more important to them than open source.

While Beaumont is sufficiently satisfied with their first phase implementation to plan the second phase, the first phase implementation was not without problems. There was resistance from staff who feared being deskilled through not having experience with popular commercial software packages. Also, Beaumont is a little worried that their operations staff who have amassed considerable experience in OSS deployment may now be poached by other organizations. The importance of changing the mind set in relation to the new support paradigm implied by OSS is also significant. By and large, reliance on a standard maintenance contract is not an option, and bulletin boards may be the main source of support. Thus, it is hardly surprising that support from top management is critical. Also, even though OSS may be available at little or no cost, organizations should not expect maintenance and support to be available at a lesser cost than would apply for commercial software. Indeed, OSS represents a very good opportunity for small software companies all around the world to treat it as an infrastructure component, like the highway or telecommunications lines, and then use it as a bootstrap to build a service and support business model on top.

Much has been made of the danger of free riders to the OSS movement in the form of consumers who use OSS products without contributing back sufficiently to the community. Beaumont, despite its overall pragmatic approach, is keen to contribute to OSS. However, they recognise that they are not in a position to contribute code to most of the applications they use, but they are willing to contribute applications developed from their own application domain in an OSS mode. This is a very significant development in that it has often been assumed that OSS products will not emerge in certain vertical domains as they will not be perceived as an “itch worth scratching” by most developers. Also, the fact that Beaumont is now considering developing their payroll application in an open source fashion is extremely interesting as the conventional wisdom would suggest that payroll be a package acquisition for all organizations now. Overall, this should lead to a significant bootstrapping phenomenon as more and more OSS applications become available to organizations. This in itself will lead to problems of categorization of OSS products and appropriate tools to help find suitable applications, but from an OSS point of view, these are problems it would be nice to face.

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