Commercial Adoption of Open Source Software: An Empirical Study

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Abstract

There has been a dramatic increase in commercial interest in the potential of Open Source Software (OSS) over the past few years. However, given the many complex and novel issues that surround the use of OSS, the process of OSS adoption is not well-understood. We investigated this issue using a framework derived from innovation adoption theory which was then validated in an organisation which had embarked on a large-scale of adoption of OSS. The framework comprised four macro-factors – external environment, organisational context, technological context and individual factors. We then investigated these factors in a large-scale survey. Overall, the findings suggest a significant penetration of OSS with general deployment in two industry sectors – consultancy/software house and service/communication – and more limited deployment in government/public sector. However, the existence of a coherent and planned IT infrastructure based on proprietary software served to impede adoption of OSS. Finally, individual-relevant factors such as support for the general OSS ideology and committed personal championship of OSS were found to be significant.

1. Introduction

OSS has attracted a great deal of commercial interest since the term was introduced in 1998. However, most of the research to date on OSS has focused on the motivations of individual developers who contribute to OSS projects or has concentrated on specific OSS products and projects. In contrast, very little research has focused on the adoption of OSS systems in organisations. In the past, OSS deployment has tended to comprise back-office infrastructure systems. However, more recently OSS deployment has emerged in front-end applications – desktop applications such as word processing, spreadsheet and email, for example. One example of the use of front-end applications is Beaumont Hospital, a large public sector organisation, who have re-deployed the information systems (IS) infrastructure by using OSS packages [10].

Our objective in this study was to investigate the rationale behind the adoption of OSS so as to identify the factors which predisposed organisations to attempt such a risky endeavour, and those factors which militated against this. We drew on innovation adoption theory to derive an initial framework. This framework was then elaborated and changed to reflect the OSS adoption process in the particular context of Beaumont Hospital. We then constructed a survey questionnaire based on the framework with a view to investigating factors relevant to the OSS adoption process more generally.

2. A Framework for OSS Adoption

Research on the adoption of IT innovations has frequently drawn on innovation adoption theory [1], [2], [3], [12] & [20]. However, a weakness identified in much innovation adoption research has been an excessive focus on adoption at the individual level and not enough on the organisational level [5]. Swanson (1994) has also identified shortcomings in innovation adoption research in its failure to take adequate consideration of the business context and its integration with the overall environment. Bearing this in mind, we included environment, organizational, individual and technological factors in our framework (see Fig. 1). These initial factors were then investigated in the context of a large-scale adoption of OSS in a single case, Beaumont Hospital, and those factors which predisposed towards an increase in the extent of adoption of OSS are marked with (+) in Fig 1, while those factors which served to militate against the adoption of OSS are marked with (-). Below, we briefly describe in turn each of the framework factors and their relevance in the Beaumont Hospital context. These factors were subsequently operationalised into a survey questionnaire and the administration of this survey is discussed in section 3.

2.1 External Environment

This factor is proposed in both the work of Tornatzky and Fleischer (1990) and Chau & Tam (1997), and is also implicit in Swanson's (1994)

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conceptualisation. Given the extent to which OSS represents a paradigm shift in the overall software and business environment, an external focus is necessary. This includes factors such as general attitude to risk in the industry sector; the existence of high-profile successful exemplars of OSS adoption; government or institutional support; the need for transparency, value for public money, security; and the existence of industry-wide purchasing agreements with proprietary vendors, or industry-level standards in relation to IT architecture.

In more risk-averse industry sectors, one might expect to see more reluctance to engage with inherently risky implementations such as that represented by a new phenomenon like OSS which does not offer the traditional legal comforts of vendor-guaranteed hotline telephone support and written maintenance contracts. However, many European governments and public sector organizations, while generally considered quite risk-averse, have been very proactive in encouraging the adoption of OSS. Given the risks associated with the relatively unknown phenomenon of OSS implementation, institutional support for such initiatives could mitigate this.

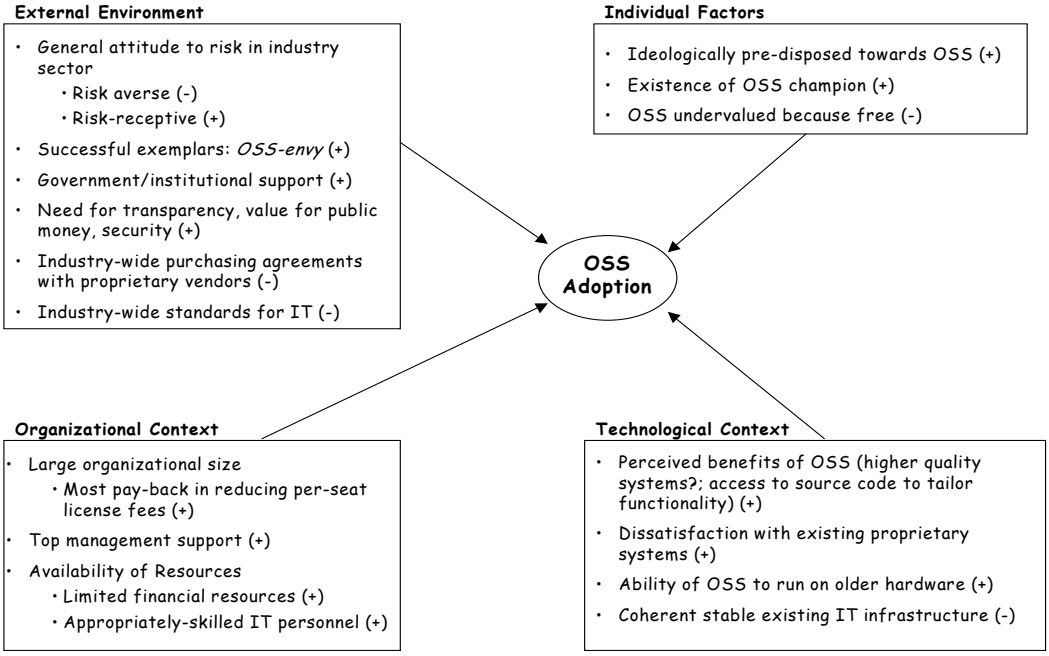

Fig 1: A Framework to Investigate OSS Adoption

Also, it is increasingly being suggested that where value for public money, public access and transparency is important, such as in government and health, that OSS is by definition an appropriate solution. The basic argument is that with closed source, one cannot be sure what Trojan Horses may exist which may eventually compromise security or citizen privacy.

In certain sectors which are highly regulated and where interoperability may be paramount, policies may exist in relation to IT infrastructure. Thus, a particular proprietary software application may ironically appear to offer a *de facto* standard for interoperability (this is quite arguable, however, as OSS is increasingly being promoted as a solution which guarantees interoperability). In some industry sectors, there may be bulk-purchasing agreements with proprietary software vendors. Also, certain standard architectures may exist which software packages in that industry must comply with. In the health sector, the HL7 standard for textual data and the DICOM standard for images are well known examples.

Beaumont operate in a public sector environment which is quite risk averse in relation to IT, as evidenced by a study of the adoption of IS development methods in the sector [9]. Funding for Beaumont comes from the Government through the Department of Health and Children (DoHC). The latter formulate policy on the use of IT within hospitals in their jurisdiction. Also, given that they represent several hospitals, the DoHC have bulk purchase agreements with various vendors, and seek to ensure interoperability with IT infrastructure in the various hospitals through the use of common platforms. The DoHC have recently mandated an infrastructure which requires that financial systems be drawn from the SAP family of proprietary applications. One might expect that a coherent IT infrastructural

policy which recommended the use of proprietary software would act against the deployment of OSS. This has indeed happened in Beaumont in that the DoHC will only provide funds if Beaumont implement the recommended SAP systems. Thus, Beaumont IT staff and end-users are faced with a situation whereby if they choose to implement the OSS Compiere financial system, which meets their needs functionally, they will have to do so without the possibility of using the savings that arise elsewhere, whereas adopting the proprietary systems would probably result in less inconvenience and does not affect their budget as the DoHC will fund the initiative. In such a scenario, it is very difficult for OSS to flourish.

2.2 Organisational Context

Organizational context is identified as a factor in many recent studies of innovation adoption, probably reflecting the reservations expressed by Eveland & Tornatzky (1990) and Fichman (1992) of the need to broaden the focus beyond the individual level. This factor includes such issues as organizational size, top management support, and availability of resources (e.g. limited financial resources, or a pool of OSS-literate IT personnel).

Organization size appears relevant in that the few published cases of OSS implementation all tend to trumpet the number of desktops that will be converted from proprietary to OSS. This is based on the economic savings in reducing the per-seat license fees being paid for many proprietary applications, an issue we return to below. Also, large organisations are likely to have access to a pool of specialist IT staff who can assist in solving technical issues that arise in OSS implementation.

Top management support is undoubtedly critical for radical, high-risk initiatives such as OSS deployment as it contravenes the traditional model where ongoing support is legally guaranteed by a vendor. Indeed, top management support is likely to become even more important in the future as OSS adoption moves out of the domain of invisible infrastructure systems to visible, high-profile desktop systems, and overall IS infrastructure. Limited availability of financial resources is obviously an important consideration for OSS. Certainly, the negligible purchase price of OSS and the savings that can be achieved have frequently been cited as a factor. Another important resource-related issue is that of availability of appropriately-skilled, OSS-literate personnel. At present, it has been argued, somewhat controversially, that the costs of finding appropriately trained personnel for proprietary applications are lower than for OSS [16], which could serve to discourage OSS implementation. However, this is not axiomatically the case in the long-term. The increasing popularity of OSS among university students, for example, should ensure a supply of OSS-literate personnel, even in the short-term.

As already mentioned, previous research in the public sector reveals a tendency towards quite a conservative organizational culture. Thus, Beaumont might not be expected to embark on risky initiatives such as OSS deployment. Beaumont, however, in common with sister hospitals and many other public sector organizations, faced serious budget cuts which made radical action a necessity if anything approaching the same level of IT service was to be preserved.

Top management support was also a significant factor. 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 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.

Limited financial resources as also a significant issue. Similar to many other organizations worldwide, Beaumont's IT budget had 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 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

Another factor that was influential in Beaumont's adoption of OSS was the availability of appropriately skilled personnel. A number of key staff – particularly in the computer operations department – rapidly adapted to the new OSS environment. It also helped that Beaumont already had a strong experience of 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.

2.3 Individual Factors

Classical innovation adoption theory emphasises the importance of individual factors for innovation adoption. Thus, we have included individual level factors in our model. This is further justified on the basis that OSS has such a strong underpinning arising from ideological motivation [6], and this typically occurs at the individual level. The charisma and drive of the OSS champion may also be a significant factor influencing OSS adoption.

Individual ideology has been significant in Beaumont. The IT manager readily emphasized that their fundamental underlying principle in OSS adoption was the desire to get the best possible return for the tax-payers' money as the hospital was largely funded from Government funds each year. He has undoubtedly been the driving force and OSS champion within Beaumont.

It is worth mentioning that there was quite a lot of resistance to OSS from the potential users of these systems in Beaumont. One of the key complaints from the administrative staff and users who moved to an OSS platform was that they feared being de-skilled if they didn't have skills in popular proprietary applications. In fact, users readily admitted that they would have preferred not to have switched from the proprietary desktop systems to OSS. One user admitted that when Star Office was proposed, there was a widespread perception that this was a cheap and antiquated package from "Jurassic Park" which would have limited functionality. Thus, not everyone sees OSS as a leading-edge initiative. However, users claim to have gotten up to speed very quickly and now state that they are happy to continue with the OSS systems, and it is seen as a very useful additional skill to add to a resumé.

Another important issues in terms of individual ideology also came to light in relation to the fact that OSS costs so much less than proprietary systems, and the feeling that user departments are under-valued in some respect in being asked to settle for a less expensive solution than that being used perhaps by their counterparts in other hospitals. This serves to heighten the expectation that since there is no such thing as a free lunch, the OSS systems must have flaws which will eventually emerge.

2.4 Technological Context

At this level, the focus is on factors such as the technological benefits of OSS, perhaps higher quality software, as has been argued, or the advantages of access to source code, dissatisfaction with existing systems, the ability of OSS to run on older hardware, and the existence of a coherent stable IT infrastructure.

Several studies have emphasised the high quality of OSS (Neumann, 2004; [15], 2004), although after the initial euphoria has died down, a number of rigorous studies, based on analysis of the actual code, have questioned the assumption that OSS products are automatically of high quality (e.g. [19]. Access to source code has also been identified as the critical issue in OSS [23]. It is clearly the key facilitator of OSS development, and organisations may see access to source code as a way of adding desired functionality. Much has also been made of the fact that OSS can run very efficiently on older hardware, perhaps reflecting the ingenuity and skill of the OSS hackers who have to make do with modest hardware often. This could be a significant argument in favour of OSS for organizations that do not have leading-edge hardware platforms. Countering the above, the existence of a coherent, stable and planned existing technological architecture could mitigate against the adoption of OSS. That is, if an organization have a coherent technical architecture in place, then OSS deployment may be more difficult to initiate as it may run counter to existing policy. The inertia and inconvenience posed by switching from a stable and coherent architecture of proprietary software to OSS may be perceived as problematic. Also, as already mentioned, the existence of mandatory standards, in relation to architecture for example, could act as a constraint against OSS adoption.

Beaumont have 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. However, this heterogeneity of platforms and packages resulted in less inertia and fewer constraints in the move to OSS than would have arisen if there had been a long-term, stable and coherent IT infrastructure in place.

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" (notwithstanding the DoHC decision to mandate SAP). Thus, even though they have been seeking OSS solutions, Beaumont are more guided by the zero or low cost availability rather than open source code.

3. Research Methodology

As described above, the first phase of the research involved the derivation of a framework to study OSS adoption, based on innovation adoption theory. This initial framework was then validated in a single case context, Beaumont Hospital, which had embarked on a large-scale adoption of OSS. A questionnaire was then constructed from the framework. As well as background demographic information, the factors underpinning each of the constructs in Fig. 1 above was operationalised as a statement and respondents were asked to rate their agreement or disagreement with each statement on a 6-point Likert scale. The questionnaire was then pre-tested over several months prior to the survey on a mixture of both students and people from industry. A representative sample of organisations, for whom a named individual responsible for the IT function was available to us, was constructed. This resulted in a total sample size of 350

organisations. We received 111 usable responses, which represents to a response rate of 32%, which is actually quite high for surveys in this area.

Given that the questionnaire involved a good deal of nominal or categorical scale data, non-parametric methods for testing statistical significance were the most appropriate. However, even where the data involved interval or ratio scales, there are certain conditions with respect to normality of distribution and homogeneity of variance which need to be satisfied before parametric tests are appropriate. An inspection of the findings revealed that the requisite conditions with respect to normality and variance were not satisfied for most factors. Furthermore, given that these tests were being carried out on sub-groups of a relatively small sample, non-parametric tests for contingency analysis and analysis of variance were used.

The issue of non-response bias was investigated through the use of late respondents as surrogates for non-respondents, and comparison of a random sample of these late responses with a random sample of 'normal' responses [22]. This analysis revealed that the only questions on which the late respondents differed significantly from early respondents was in relation to extent of experience with OSS and extent of deployment of OSS with late respondents scoring lower in these categories. This indicates that late respondents were less experienced in OSS and less committed to OSS deployment. Thus, if late respondents are reasonable surrogates for non-respondents as suggested, then it appears that the non-respondents were less likely to have adopted OSS and hence would be less relevant to our survey.

4. Analysis of Survey Responses

4.1 Demographic Factors

As can be seen from Table 1, respondent organisations represented a wide range of industrial sectors, with the largest numbers coming from the Consultancy/Software House

category (61%). In terms of organization size, the largest cohort was the 21-to-100 category with 30%. In terms of length of experience with OSS, 69% had between 1 and 5 years experience, with 7% of respondents having more than 5 years experience of OSS

Table 1 Demographics of Respondent Organisations.

Business Category		**No. of Employees**	
Constr/Manuf/Distrib	4%	1 to 5	22%
Consultancy/Software House	61%	6 to 20	21%
Wholesale/retail trade	2%	21 to 100	30%
Finance/insur/real estate	3%	101 to 500	11%
Govt/pub sector/education	10%	501 to 1000	3%
Service/communications	9%	1000+	13%
Other	11%		

Length of OSS Experience	
Less than 1 year	24%
1 – 5 years	69%
Greater than 5 years	7%

We analysed the extent of adoption of OSS by industry sector, organisation size, and length of experience with OSS. The results suggest that the consultancy/software house and service/communications sectors have gone farthest in relation to OSS adoption. There has been limited deployment of OSS in the

government/public sector category. Also, larger organisations were more likely to achieve general deployment of OSS, which ties in with the increasing returns that can be gained by adoption of OSS in large organisations.

4.2 Analysis of Facilitators and Inhibitors of OSS Assimilation.

As can be seen from Fig 1 above, we have derived a set of factors which may be posited as 'facilitators', in that they are likely to increase the assimilation of OSS (represented as (+) in Fig 1), and 'inhibitors' which are more likely to impede the assimilation of OSS (represented by (-) in Fig 1. These effectively represent a set of independent variables which influence the dependent variable, OSS assimilation. In this study, we asked respondents to rate the level of OSS assimilation achieved in relation to OSS adoption. Table 1 indicates how this was assessed. Initially, we sought to investigate whether some of these variables might be inter-correlated as this could lead to potential problems with multi-collinearity when forming the eventual model. Thus, we calculated the Spearman rank correlation coefficient for all pairings of independent variables. Spearman rho values in excess of .7 indicate variables which may be multi-collinear and which require further analysis. All variables were well below the .7 value apart from one pair of variables: *Staff resistance due to fear of being deskilled if using OSS instead of commercial packages* and *Perception of work under-valued if using 'cheap' OSS products*. These variables seem indeed to be related, although they had been identified independently by different staff in different work situations within Beaumont. To further test this pair of variables, we performed a chi-square test for independence and calculated Cramer's v to measure the association between the variables.

Table 2 Level of OSS Assimilation (adapted from Fichman & Kemerer, 1997 [8])

Level	Criteria
Awareness	Key decision makers aware of OSS
Interest	Organization actively committed to learning more about OSS
Evaluation/Trial	Organization has acquired specific OSS products and has initiated evaluation or trial
Commitment	Organization has committed to use a specific OSS product in significant way or for a production project
Limited Deployment	Organization has established a program of regular but limited use of the OSS product
General Deployment	Organization is using OSS product for at least one large and mission critical system

The chi-square value of 171.699 and the Cramer's v value of .622 confirm a strong association between these variables (a Cramer v value in excess of .5 indicates a strong association). Thus, it suggests that only one of these variables will be necessary in the final model

Given that all the other variables seemed to be independent of each other, we performed bi-variate correlations on the set of nine facilitator variables and the set of eight inhibitor variables. The results are presented in Tables 2 and 3 below. Table 2 identifies the variables which correlated most significantly with OSS assimilation at the .01 level of significance. The correlation coefficients are quite high, ranging from .324 to .382. The technological benefits of OSS emerged as the most significant facilitator. Access to source code has been identified as the critical enabling factor for OSS (Young, 1999). Organisations may see access to source code as a way of adding desired functionality, and removing dependency on a software vendor. The importance of availability of OSS-literate IT personnel was also highly significant. While, studies of total cost of ownership (TCO) of OSS have been ambiguous to say the least, training of personnel is one of the biggest

cost factors in these studies. The importance of top management support also emerged as in important variable. Indeed, top management support is likely to become even more important in the future as OSS adoption moves out of the domain of invisible infrastructure systems to visible, high-profile desktop systems, and overall IS infrastructure. Personal support for OSS ideology was also found to be an equally important variable, Thus it appears that the charisma and drive of an OSS champion may be a significant factor influencing OSS adoption. The remaining facilitators (*Limited financial resources ensure OSS a consideration* and *Sense of shared adventure between IT staff and end users embarking on a high profile radical initiative*) were not found to be significant even though these had been identified as extremely important in the Beaumont case study. Finally, the expectation that OSS adoption might be easier due to large organisational size was in fact found to be negatively correlated with OSS assimilation (although not significantly so). This is somewaht surprising as larger organisation would see to have more to save through the deployment of OSS in per-seat license savings. Also, given that large organisations have large IT departments often, one might expect that they would be more likely to have an available pool of OSS-literate IT personnel. However, it is also the case that large organisations are likely to have advantageous agreements with proprietary software vendors, one of the inhibitors discussed below.

Table 3 Influence of Facilitators on OSS Assimilation

Variable	Spearman Rho
Technological benefits of OSS outweigh its disadvantages (e.g. ability to tailor to precise needs, transparency)	.382**
Availability of OSS-literate IT personnel	.363**
Top management support for OSS adoption	.332**
Personal support for OSS ideology	.332**
Network externality benefits from OSS (e.g. availability of extra functionality developed, or support from other OSS users of the same products)	.327**
Existence of a committed and respected OSS champion in-house	.324**
Limited financial resources ensure OSS a consideration	.155
Sense of shared adventure between IT staff and end users embarking on a high profile radical initiative	.017
OSS adoption is easier due to large organisational size (e.g. greater savings possible)	-.121

**Correlation is significant at the 0.01 level (2-tailed).

Table 3 below presents the analysis of the inhibitors on OSS assimilation. As can be seen from the table, all the correlations are negative as expected, with a number appearing as quite significant (.317 to .573). The most significant correlation emerged in relation to the perception of work being under-valued if using 'cheap' OSS products. The next most significant factor was that of to the change of operating model implied by OSS, that is the departure form the normal model of maintenance supplied by a vendor under contract. Also, the fear of deskilling if not au fait with popular proprietary packages appeared to be quite a significant inhibitor. The lack of a successful exemplar of OSS adoption in the respondent industry sector also appeared to an important inhibitor. This confirms the importance of the 'me too' phenomenon, and may also reflect a lack of pressure from organisations to experiment with OSS if competitors do not do so, as they do not have to worry about possibly losing some competitive advantage that may arise from OSS deployment. Staff also seemed unwilling to tolerate the temporary inconvenience that might arise through the deployment of new technology. Another significant inhibitor seemed to occur when an organisation had a favourable arrangement with a proprietary vendor (e.g. bulk purchasing discount). A similar factor, that of the existence of existence of a coherent, stable and planned existing technological architecture, was also found to militate against the adoption of OSS. The final inhibitor, that of an organisation being in a risk-averse sector, was not found to be significant. Thus the argument that risk averse organisations might not embrace the type of risk involved in OSS deployment was not supported.

Table 4 Influence of Inhibitors on OSS Assimilation

Variable	Spearman Rho
Perception of work under-valued if using 'cheap' OSS products	.573**
Changing operating model to OSS might be problematic (e.g. no contracted maintenance support)	.525**
Staff resistance due to fear of being deskilled if using OSS instead of commercial packages	.498**
No other successful OSS examples in the industry sector	.446**
Staff unwilling to tolerate 'teething problem' with OSS products	.380**
Organisation has a favourable arrangement with a proprietary vendor (e.g. bulk purchasing discount)	.374**
Current IT infrastructure coherent and based on proprietary software	.317**
Organisation in a risk averse industry sector	.089

**Correlation is significant at the 0.01 level (2-tailed).

5. Summary and Conclusions

In terms of the four macro-factors in the framework (external environment, organisational context, technological context and individual factors), the findings are revealing. Major influences in the external environment were the network externality effects that could be achieved by collaboration with the larger open source community in reciprocal fashion. Also, awareness of other organisations that were adopting OSS was considered important. This could be a reflection of the perception of the safety-net comfort factor that others are also taking the risk. It. Alternatively, it might be an indication of a worry that others might achieve some competitive advantage through OSS, thus prompting a 'me too' scenario.

In relation to organisational context factors, the current climate of financial cutbacks was deemed to be a factor, with the zero cost aspect of OSS making it attractive. Also, the availability of OSS-literate personnel was seen as important. This probably ties in with the individual championship aspect also. Interestingly, it also suggests a situation whereby OSS-literate personnel become a premium as organisations strive to deploy OSS, and retaining such staff could become a major challenge.

In terms of technological factors, the ability to modify source code and the transparency of access to the code were rated as important. However, the risk that the new mode of operating required by OSS, such as the changed model of maintenance and support in the absence of a traditional vendor was seen as a significant factor impeding the adoption of OSS. Likewise, it seems some inertia could arise in situations where there is a coherent and planned IT infrastructure based around proprietary software.

In terms of individual factors, the importance of support for OSS ideology and the existence of an OSS champion were rated as most important. Again, as already mentioned this factor relates well to the availability of OSS-literate personnel.

Interestingly, the finding in the Beaumont case of a perception in some quarters that the OSS represents a cheap and amateur solution, thereby undervaluing one's work was not supported by this study

Overall, the framework factors have been very illuminating in investigating OSS adoption. The vast majority of respondents had quite a significant length of experience of OSS. Also, the general deployment of OSS on production systems had been achieved in two industry sectors (consultancy/software house and service/communications). The level of interest in OSS is significant and suggests that OSS has a major role to play in the future in these organisations

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Appendix

Questions used to determine the validity of the framework:

- **External Environment**

1. Organisation is in a risk-averse industry sector.
2. No other successful OSS examples in that industry sector.
3. Organisation has a favourable arrangement with a proprietary vendor (e.g. bulk purchasing discount)
4. Network benefits from OSS community (e.g. availability of extra functionality developed, or support from other OSS users of the same products)

- **Organisational Context**

1. OSS adoption is easier due to large organisational size (e.g. greater savings possible)
2. Top management support for OSS adoption
3. Limited financial resources ensure OSS a consideration
4. Availability of OSS-literate IT personnel
5. Sense of shared adventure between IT staff and end users embarking on a high profile radical initiative

- **Technological Context**

1. Current IT infrastructure coherent and based on proprietary software
2. Benefits of OSS outweigh its disadvantages (e.g. ability to tailor to precise needs, transparency)
3. Changing IT infrastructure to OSS might be problematic (e.g. no contracted maintenance support)

4. Staff unwilling to tolerate 'teething problem' with OSS products

- **Individual Context**

1. Personal support for OSS ideology
2. Existence of a committed and respected OSS champion in-house
3. Staff resistance due to fear of being deskilled if using OSS instead of commercial packages
4. Perception of work under-valued if using 'cheap' OSS products.