

## *Barriers and Enablers of OSS-on-the-Desktop Adoption*

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### ***Abstract***

This paper aims to identify the barriers and enablers to the adoption of Open Source Software (OSS) on the desktop by looking at a specific case namely Ninham Shand, a South African organisation. The study found that computer users and managers concur that reduction in costs was the biggest enabler for the adoption of OSS, and that the computer users were more concerned about the product functionality than technical support. The research also confirmed that the ignorance of OSS amongst computer users was a barrier to the adoption in Ninham Shand. The study has not succeeded in proving that business units that had used OSS perceive the barriers to adoption differently to business units that had used Proprietary Software.

***Keywords:*** *Open source software; OSS; OSS-on-the-desktop; Critical Success Factors; case study, desktop migration.*

### ***Introduction***

Organisations no longer appear to be as hesitant to use Open Source Software (OSS) as a feasible alternative to Proprietary Software (Lucas 2005; Haag, Baltzan and Philips 2006). Recent studies have indeed shown that, not only the awareness but also the market share of OSS is growing significantly (Wheeler, 2005). In South Africa, the work of The Shuttleworth Foundation (TSF) in particular has contributed to the increased interest and awareness of OSS in South Africa. But, while OSS has been accepted as a viable alternative to proprietary software (PS) in the network server market for some time, desktop usage of OSS still remains fairly limited. The high PS licensing and computer hardware costs in South Africa relative to the developed countries in combination with the several other perceived advantages of OSS have prompted several OSS on the desktop projects. But little is known about the true enablers and barriers associated with the migration to desktop OSS in South Africa (Bruggink, 2003; GITOC, 2003). This lack of knowledge was the inspiration for our research.

The aim of this study was to identify the perceived barriers and enablers to the adoption of OSS as a desktop computer standard within Ninham Shand. Ninham Shand is a privately owned South African engineering organisation that has been in operation for 73 years, and has offices across the country. The organisation had previously undergone a disruptive technology adoption process and wanted a more structured approach to evaluate the proposed adoption of OSS as a standard for desktop computers in the organisation.

Ninham Shand had successfully used OSS on the server computers for a number of years, and investigated the feasibility of adopting OSS as a desktop computer Operating System (OS) and application standard. The interesting fact about the Ninham Shand environment is that users are generally free to choose their desktop working environment. Full support is given to both OSS and PS environments. The users are mostly highly knowledgeable and

computer literate professionals, many with engineering qualifications. The focus of the study was thus on the perceptions of the computer users and business managers within the organisation.

### **Research Objectives**

The overall objective of this study was to identify the barriers and enablers to the adoption of OSS within Ninham Shand.

More specifically, the study aimed to achieve the following objectives:

- Assess the computer user and business unit manager perceptions of the biggest enabler for the adoption of OSS.
- Determine whether the computer users within the organisation perceived the product functionality of OSS as being more important than the product support.
- Determine if there is a difference in the perceived barriers to adoption in business units that had adopted OSS in comparison to business units that have not adopted OSS.
- Assess the computer user and business unit manager perceptions, knowledge and attitudes towards OSS technology to determine whether the level of knowledge was a barrier to the adoption within the organisation.

### **Prior Research**

#### **Open Source Definition and Context**

The Open Source Initiative (2005) defines OSS as software that is freely available and grants the rights to read, use, modify and distribute the source code for the software under the same conditions, without being discriminatory in any way. OSS must be distinguished from free and public domain software; Gacek *et al* (2002) provides the following overview of software categories.

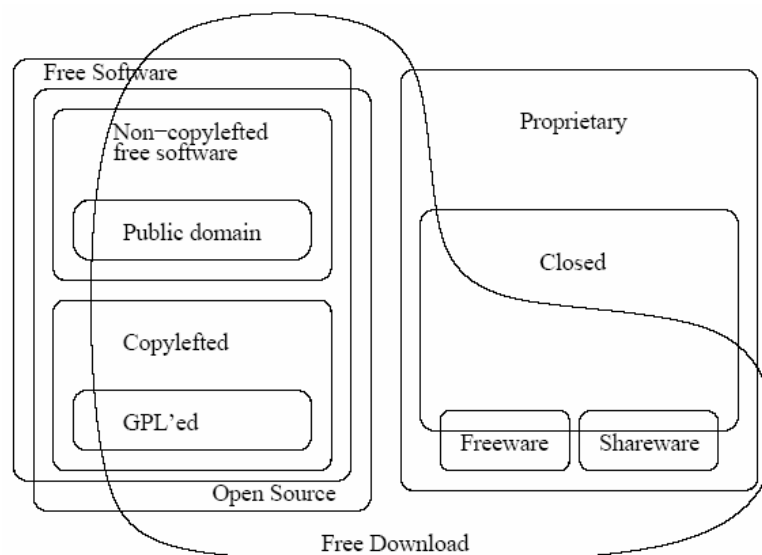


Figure 1: Software categories (Gacek *et al*, 2002)

Initially, the relatively small number of OSS applications available in comparison to the number of Proprietary applications available resulted in a low adoption of OSS applications on the desktop computer (Kenwood, 2001). More recently however, vendors of PS

increasingly consider OSS as a major threat to their business models due to the standards being implemented, the rate with which the software is being developed, and the interoperability of the software (Lucas, 2005).

The adoption of the OSS by organisations to support critical applications is considerably easier on the server computers than on the desktop computers due to the transparent nature of the services provided by the server computer infrastructure. There are also less political factors to consider with the selection process for the server computer software, with the computer users not participating in the server software selection process (Dedrick and West, 2004). Holck *et al* (2004) also warn about the lack of inter-operability of desktop OSS applications with PS, with some advising to only use OSS at the desktop computer application level to access web sites, E-mail and basic financial spreadsheets (Maselli, 2003). Others (Haag *et al*, 2006; Scannell, 2003) maintain that desktop OSS has already come of age and supported this with the fact that the number of computers using OSS has already bypassed the number of computers using the Apple Mac environment.

### **The adoption of OSS in South Africa**

NACI (2004) examined the feasibility of using OSS within South Africa, and included guidelines for the use of OSS in the public, private and educational sectors. The report includes the development and business models regarding OSS, and their applicability to large, medium and small private enterprises in South Africa. It also focuses on the use of OSS in South Africa to bridge the “digital divide” that exists between developed and developing countries by proposing to increase the number of Information and Communication Technology (ICT) staff in South Africa.

The Impi Linux project was the first purely South African Linux Operating System (ImpiLinux.org, 2005). The Translate project (2005) attempts to bridge the digital divide by providing free software in each of the eleven official languages in South Africa.

Groeneweg and Kuper (2002) proposed that OSS is a viable alternative to PS in South Africa, but needs to overcome several factors before becoming a commercially accepted alternative. Gardiner *et al* (2003) investigate the usage of OSS as well as the reasons for the use or non-use of OSS.

GITOC (2003) proposed the framework for a phased approach to the adoption of OSS within the South African Government. The three-phased approach was designed to create a sustainable platform for the use of OSS as an alternative to PS. The Introductory phase would create knowledge and understanding of where and how OSS could be deployed within the Government. This would be followed by an Enabling phase which would include the growth and development of OSS products, culminating with a Maturity phase with identifiable levels of OSS implementation and certification within Government. Interestingly, the adoption of OSS by the South African Government was identified as an enabler to the adoption of OSS within Ninham Shand. Government was the biggest client for Ninham Shand, and would result in Ninham Shand adopting the same software in order to supply the documentation in the same format.

### **Technology Adoption**

The literature on technology adoption and diffusion is vast and a large number of adoption models have been suggested. This research does not aim to explore them all, but focuses on the Diffusion of Innovation. The Diffusion of Innovation model was chosen due to its

applicability to the case study, having business units in different stages of adoption and the various computer user perceptions on the attributes of OSS.

There are five stages through which a technological innovation must pass (Rogers, 2003):

1. Knowledge (exposure to its existence and understanding of its functionality)
2. Persuasion (the forming of a favourable attitude to it)
3. Decision (commitment to the adoption of the technology)
4. Implementation (of the technology) and
5. Confirmation (reinforcement based on positive outcomes of the adoption)

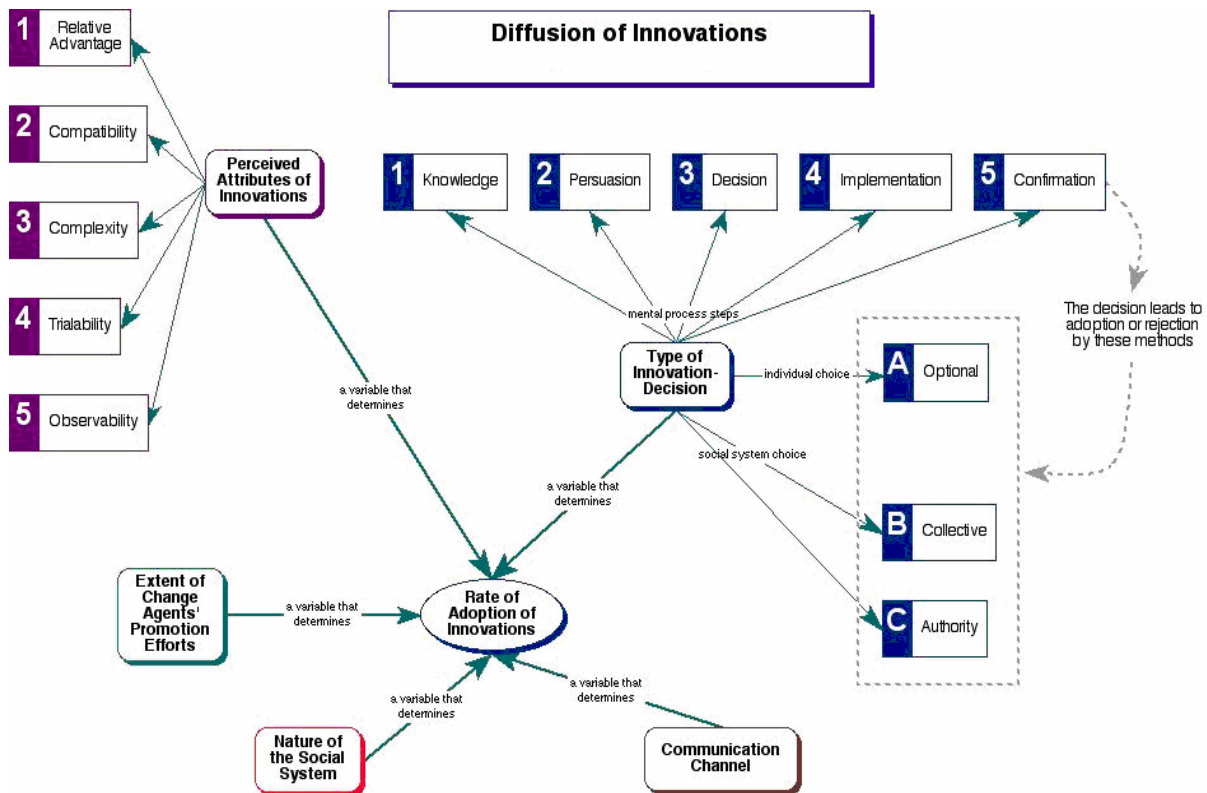


Figure 2: The Diffusion of Innovation Model (Rogers, 2003)

Rogers (2003) also suggests four main factors that affected the adoption of an innovation. Since these factors were considered to be applicable to our research, they are discussed in greater detail to illustrate the relevance to Ninham Shand.

1. **The innovation itself:** A number of business units within Ninham Shand had used OSS for twelve (12) months to evaluate the functionality of the software with respect to the functionality (complexity), compatibility and inter-operability of the software with PS.
2. **The communication channels used to spread the news about the innovation:** Ninham Shand wanted a more structured approach for evaluating the proposed adoption of OSS. This study investigated the perceptions of the computer users and the business unit managers to determine whether communication was occurring in Ninham Shand about the proposed adoption of OSS.
3. **Time:** The business units had tested the software for twelve months, and were in different stages with the tests due to different starting times for the adoption.
4. **The nature of the social system into which the innovation is introduced:** This study investigated the perceptions of the computer users as they would be most

affected by the adoption of the software. It was thus crucial that the computer users understood and supported the adoption process as it would be disruptive for the computer users to change to different software.

### **Barriers and Enablers for Technology Adoption**

A large number of barriers and enablers to OSS adoption have been suggested in the literature (e.g. Gardiner *et al*, 2003). This section lists those barriers and enablers that were considered to be relevant to the case study.

#### **Lack of compatibility (Barrier)**

Holck *et al*, (2004) proposed that the poor quality of OSS is a result of lack of interoperability and compatibility with PS. Driver (2005) added that the migration costs, resulting from lack of compatibility, of moving from an existing solution to OSS are a common barrier to the adoption of OSS.

#### **The lack of product support (Barrier)**

According to Dedrick and West (2004), there were no vendors that provided technical support for OSS. Holck *et al* (2004) concurred that one of the biggest barriers to the adoption of OSS was the relationship between the OSS vendors and the potential customers.

#### **The indirect costs associated with OSS (Barrier)**

Benson and Standing (2005) and Wang and Wang (2001) proposed that the indirect costs associated with OSS needed to be calculated to provide a clear indication of the cost benefits derived from using OSS. Driver (2005) concurred that the switching costs for an organisation to move from an established proprietary solution currently in use, to an OSS alternative, created a barrier to the adoption of OSS.

#### **The reduction in costs (Enabler)**

Driver (2005) proposed that the biggest enabler for the adoption of OSS is the low acquisition costs, even though the long-term costs have not yet been identified. This view was supported by Groeneweg and Kuper (2002) stating that reduced cost is a major benefit of adoption OSS within an organisation.

#### **The implementation of technical support structures (Enabler)**

According to Scannell (2003) and Kenwood (2001), the commercial backing of industry vendors has resulted in a more structured support channel for organisations. Kenwood (2001) proposed that the OSS support structure is stronger than PS due to the reliance on support from a single Proprietary vendor.

### **Research Methodology**

In the light of the discussion above, the research objectives were stated as the following hypotheses.

- H1: Reduced costs, above all else, is the biggest enabler for the adoption of OSS in Ninham Shand.
- H2: Computer users are more concerned with OSS product functionality than the product technical support.
- H3: Business units that use OSS will rate the perceived barriers to OSS differently to those business units that do not use OSS.
- H4: Ignorance of OSS is a factor that limits the adoption of OSS in Ninham Shand.

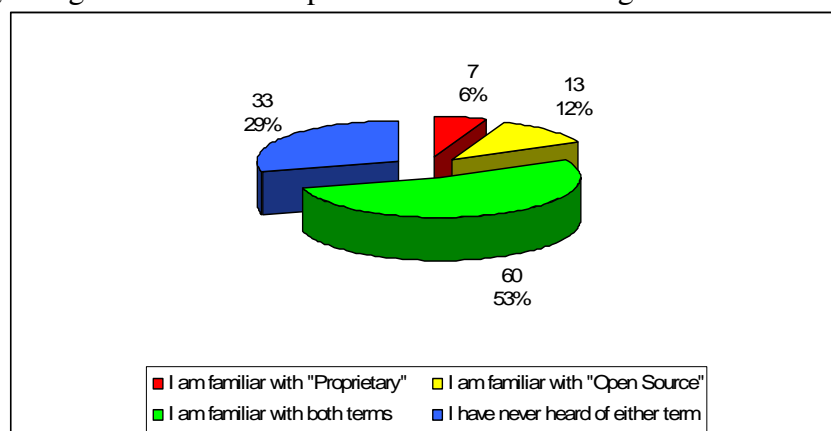
The research followed a quantitative approach using an online questionnaire targeted at all computer users in Ninham Shand. The questionnaire was used to gather large amounts of data in a structured manner from the computer users for investigation and analysis, and was a typical strategy used with deductive research. The instrument used was an amended version of the instruments used by Gardiner *et al* (2003), Groeneweg & Kuper (2002), Schmidt (2005) and Wichmann (2002), with the questions reworded for applicability to the study. The approximate target population was 400 people. An online version of the questionnaire (available from the researchers) was placed on the organisational Intranet web site. An e-mail notification was sent to the sample group notifying them that the questionnaire was available and requesting their participation in the survey. In total 113 questionnaires were completed, and were used for the data analysis.

As an independent validation exercise, semi-structured interviews with the 12 business unit managers were of Ninham Shand also held. Although a detailed discussion and analysis of the data gathered in these interviews falls outside the scope of this paper, some of the high-level findings will be indicated in the discussion below where applicable.

### **Data Analysis and Findings**

#### **Descriptive Analysis**

Firstly the computer user understanding of OSS and PS was examined. As shown in Figure 3, 35% of the respondents were not familiar with OSS. This indicated a significant level of ignorance regarding OSS for the computer users within the organisation



*Figure 3: Understanding of Proprietary and OSS*

Interestingly, almost half of the respondents (53 out of 113) turned out to be using OSS (Figure 4). This is not representative of the sampling frame since only 16% of all computer users use OSS. This can possibly be explained by the fact that OSS users were most pronounced (positively or negatively) about their experiences and thus more inclined to respond. Note that the classification of users into OSS/PS users was based on the list provided by Ninham Shand since a number of the respondents was not sure whether they were using OSS or not.

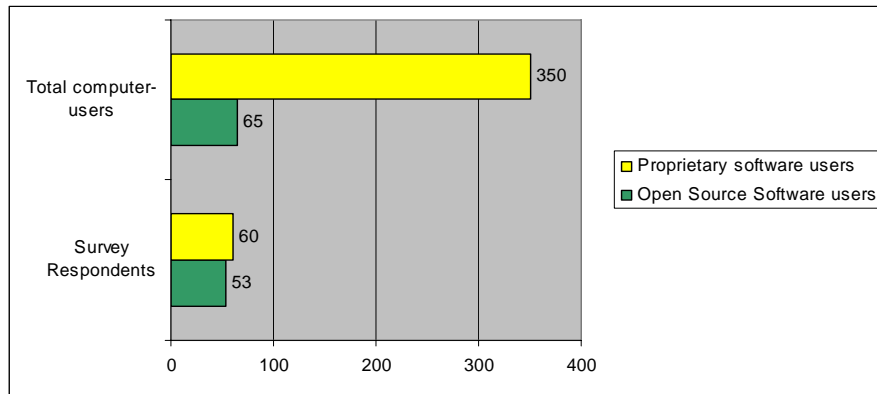


Figure 4: Computer users vs. survey respondent use of OSS and PS.

Because the choice of desktop environment was not forced as an organisation-wide decision by top management, respondents were queried as to why they chose their particular desktop environment (figure 5).

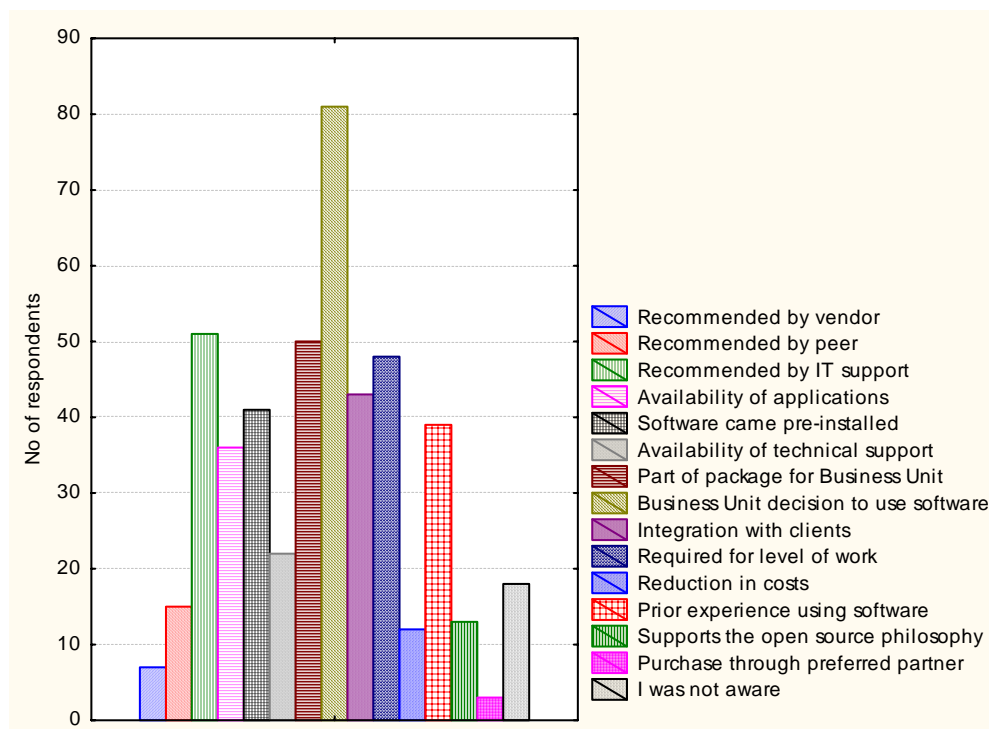


Figure 5: How did your business unit choose the software it is currently using?

It is interesting to see that, although most respondents indicated a combination of factors, in more than 70% of the cases the business unit as a whole strongly motivated the decision.

The respondents were also questioned about their experience with Proprietary and OSS prior to joining the business unit.

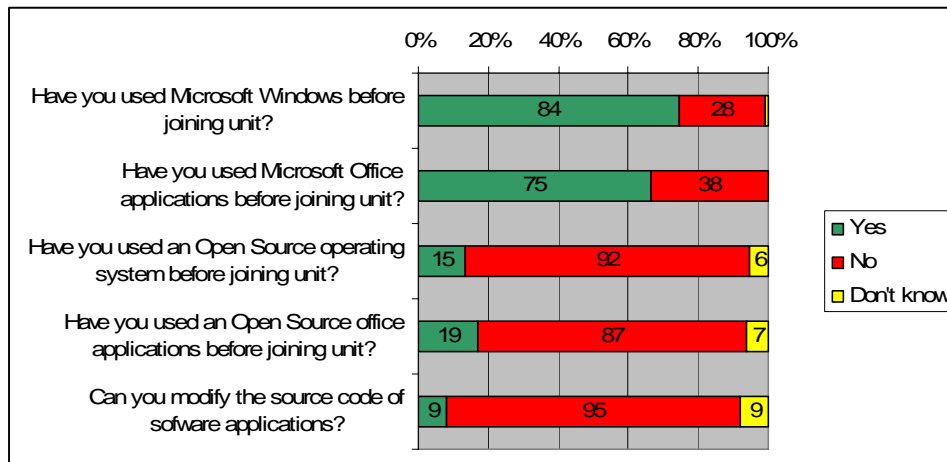


Figure 6: Prior knowledge and use of OSS and PS

The majority of the respondents had previously worked with PS (Microsoft) prior to joining the business unit, whilst more than 75% of the respondents had no prior experience with OSS. This lack of prior experience can be assumed to have contributed strongly to the lack of knowledge regarding OSS within the organisation.

### Hypothesis 1: Cost savings

The first hypothesis to be tested was:

H<sub>1</sub>: Reduced cost is the biggest enabler for the adoption of OSS in Ninham Shand.

In order to test this, the respondents were provided with a list of enablers for the adoption of OSS, and were requested to rank this. The top ranking item selected was given a weighting of 10; the next item a weighting of 9 etc. Users were asked to rank at least the first five factors, leaving the option of not ranking those that were not applicable. The cumulative score was used to determine the biggest enabler to the adoption of OSS. This method allowed the hypothesis to be tested by using a rank correlation to identify the most important enabler for the computer users.

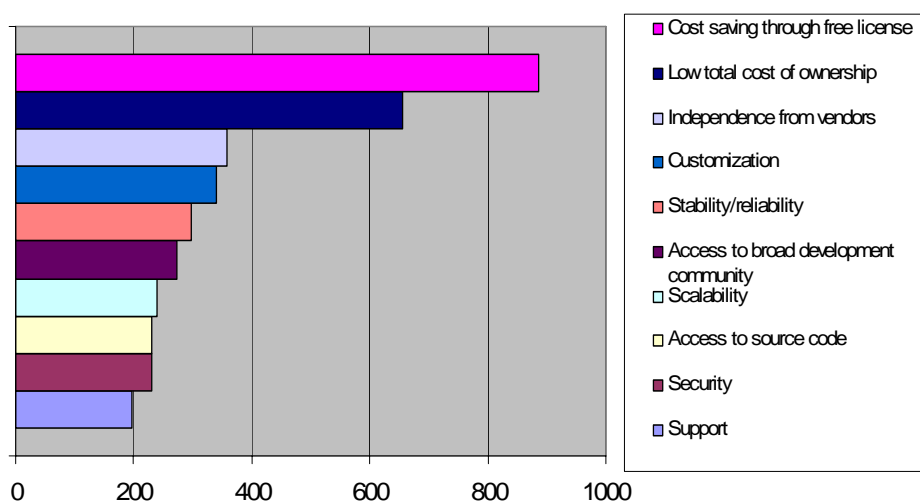


Figure 7: The enablers for the adoption of OSS

The results indicate that cost saving was indeed by far the biggest enabler to the adoption of OSS. In support of this finding, interviews with all the business unit managers identified the

reduction in costs as the biggest enabler for adopting OSS. The hypothesis ( $H_1$ ) was thus accepted as correct.

### Hypothesis 2: Product functionality

The second hypothesis ( $H_2$ ) to be tested was:

$H_2$ : Computer users are more concerned with OSS product functionality than the product technical support.

The corresponding null hypothesis which tested was that the computer users are equally concerned with OSS product functionality and technical support. The computer users were asked to rate the importance of a large list possible factors (as identified in previous research) relating to OSS adoption. These test items were answered using a five point Likert scale ranging from Very Important to Not Important. Figure 8 shows the mean ranking for the various items.

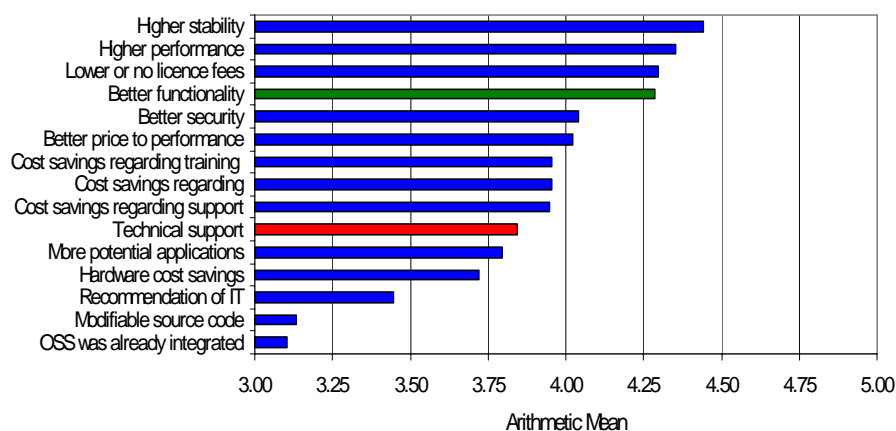


Figure 8: Responses for product functionality and technical support

It is evident that functionality rated much higher than technical support. In order to test the statistical significance, the data was analysed using the Mann-Whitney U test to compare two independent samples. The analysis of the data indicated that there was a statistical significance between the computer user responses regarding product functionality and technical support.

Table 1: Mann-Whitney test for difference between functionality and technical support.

	U	Z	p-level	Valid N Group 1	Valid N Group 2
Functionality / Support	2948	-2.5306	0.01139	96	79

The p-value of 0.011 leads us to reject the null-hypothesis and strongly supports the hypothesis that computer users were more concerned about product functionality than support. Note that information collected through the semi-structured interviews with the business unit managers supported this finding in that the managers identified the biggest barrier to the adoption of OSS was the lack of product functionality (including compatibility and inter-operability) with PS.

The compatibility and inter-operability of OSS with the Ninham Shand client software was crucial to the success or failure of any adoption plans for the organisation. The organisation had already experienced a disruptive technology adoption, and the managers would not support any proposed adoption plans unless the perceived problems regarding compatibility and inter-operability were resolved.

**Hypothesis 3: Difference in perception of barriers between adopters and non-adopters.**

The third hypothesis (H<sub>3</sub>) to be tested was:

H<sub>3</sub>: Business units that use OSS will rate the perceived barriers to OSS differently to those business units that do not use OSS.

Ninham Shand had previously had a disruptive technology adoption, and the management was investigating a more structured approach to minimise the disruption to the computer users. The study therefore was very interested at identify the barriers for the computer users so that they could be removed. Ninham Shand had been testing OSS for twelve months within some business units, and investigated whether the perceived barriers were different in those business units that were using OSS in comparison to those that business units that were using PS.

The organisation provided the list used for the grouping of the computer users into business units that used OSS and business units that did not use OSS. The study investigated the responses from the two groups for each of the following barriers:

- Lack of compatibility (with other packages and client requirements)
- Lack of skilled employees (training would be required for staff)
- Lack of support by external service providers
- Employee resistance (to the adoption of a new package)

The chi-square test was used to test for significance for each of the above barriers. The aim of the tests was to determine whether there was a significant difference by comparing the ranking of the barrier in the top three positions (“high”) vs. the bottom positions (“low”). (The last column in the table indicates which proportion of *all* survey respondents ranked the barrier as one of the top three.)

*Table 2: Perceived barriers to OSS according to PS versus OSS users.*

Possible Barrier to Adoption	PS users		OSS users		Overall (% of ALL respondents)	
	High	Low	High	Low	High	Low
Lack of compatibility with other packages and client requirements	28	15	23	13	45%	25%
Lack of skilled employees (training would be required for staff)	22	15	20	13	37%	25%
Lack of support by external service providers	22	16	23	10	40%	23%
Employee resistance (to the adoption of a new package)	22	14	19	8	36%	19%

Initially, the lack of compatibility with other packages and client requirements was identified in interviews with the business unit managers as a possible barrier to the adoption of OSS. Although the lack of compatibility remains a concern overall (with 45% of all respondents rating it as one of the top 3 barriers), there does not appear to be any difference in the user perceptions between those that use PS and those that use OSS. The chi-square value

associated with the two groups is a very low 0.0129 indicating no association between PS and OSS users' perceptions.

In the interviews, the business unit managers stated that the computer users would not require formal training to use the software, but would need an internal technical resource for any queries. Although this was somewhat contradicted by the 37% of overall respondents who did rate it as a fairly significant barrier, there was again no difference in the perception of lack of prior skills i.e. whether formal training would be required for staff between PS and OSS user groups. The corresponding chi-square value was a very low 0.0096.

One of the biggest potential barriers to the adoption of OSS was the relationship between the OSS vendors and the potential customers (Holck *et al* 2004). The lack of support by external service providers was also identified as a significant problem in a number of other South African case studies (Brink, Roos, Weller & Van Belle, 2006). However, the data from the survey did again not indicate any difference between the two types of users. Although the chi-square value was a slightly higher 1.060, it is still far short of the 3.84 required for significance at the 5% confidence level.

Finally, employee resistance to the adoption of a new package was also checked. Although this was rated overall as the relatively lowest barrier, there was again no significant difference of ratings between the two groups (chi-square = 0.582).

Thus the analysis of the results indicated that there was no statistically significant difference in the rankings of barriers to OSS adoption between the OSS and PS groups of users.

#### **Hypothesis 4: Ignorance of OSS limits adoption of OSS**

The final hypothesis (H<sub>4</sub>) to be tested was:

H<sub>4</sub>: Ignorance of OSS is a factor that limits the adoption of OSS in Ninham Shand.

In order to determine the knowledge of the computer users regarding OSS, the computer users were questioned regarding the understanding of OSS and PS, as well as the software used in their business units.

As Figure 3 (above) demonstrates, the majority of the respondents (12% + 53% = 65%) indicated that they were familiar with "OSS". Note, however, that this is probably not representative for the entire organisation as the ratio of OSS to PS computer users in the study was different to the ratio for the organisation as a whole (refer to figure 4).

The respondents were also asked to select the type of software that they were using. The responses provided to this question were then compared to the information provided by Ninham Shand regarding the actual business usage statistics. The results indicate that 32% of the respondents did not know what type of software they were using. Perhaps not surprisingly, this statistic corresponds neatly with the proportion of users who are unfamiliar with the term OSS (35%).

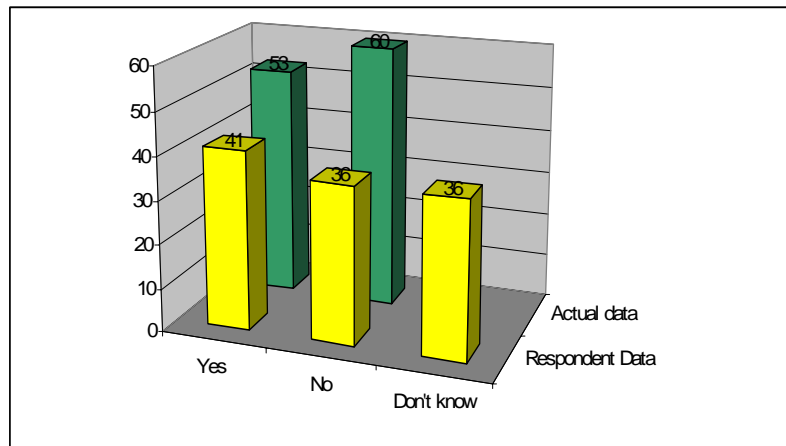


Figure 9: number of users using OSS and PS

The respondents were then asked to select the most appropriate statement applicable to a set of statements regarding OSS. The respondents were requested to select whether the statement applied to OSS, PS, both or none (Figure 10).

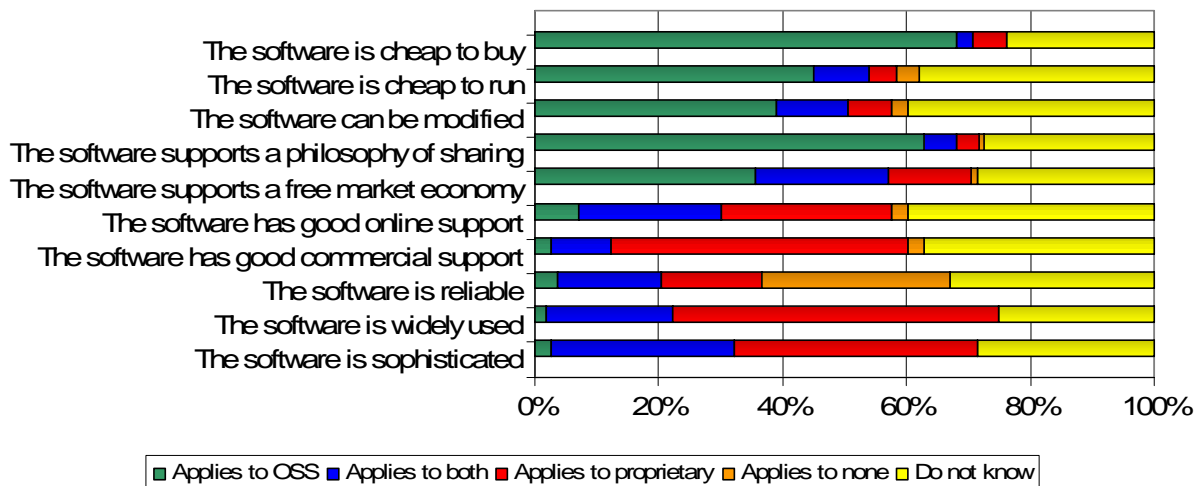


Figure 10: perceptions of computer users using OSS and PS

The number of responses received for each item in the “Do not know” category varied from 23% to 39% across each of the statements. In total, the number of responses for “Do not know” counted for 32% of the responses, and coincided with the number of responses (32%) that did not know what type of software they were using.

The business unit managers who were interviewed proposed that the ignorance of OSS would be disruptive to the adoption of OSS within the organisation. If the computer users were using PS and did not know what OSS was, they would be hesitant to adopt the new technology. The business managers further proposed that knowledge of OSS by the computer users would facilitate a smooth adoption of the technology within the organisation.

It is thus suggested that the ignorance of OSS was a barrier to the adoption. The results of the computer questionnaire confirmed that ignorance of OSS existing in a high number of respondents (32%). The hypothesis (H<sub>4</sub>) should therefore be seen as supported by the data.

## **Conclusions**

The adoption of a new technology within an organisation is often very disruptive. This study used a structured approach to identify the perceived barriers and enablers to the adoption of OSS as a desktop computer standard in a single organisation where the choice to adopt OSS on the desktop was free but fully supported. The study focussed on the perceptions of the computer users, which were directly affected by the adoption of the new technology, as well as the business unit managers that would need to finance and support the adoption.

This research study had following findings.

- The business unit managers and computer users agreed that reduction in costs was the biggest enabler for the adoption of OSS.
- The computer users were more concerned with the product functionality than the technical support.
- There was no significant difference in the perceptions of business units that used OSS and those that used PS.
- Ignorance of OSS was a factor that limited the adoption in Ninham Shand

As a welcome side-effect, the study also increased the level of OSS knowledge in the organisation.

Possible areas for further research are to repeat the study in other organisations to see if the findings can be generalised. A longitudinal study in Ninham Shand would also be useful to determine whether there are any changes to the perceived barriers and enablers to the adoption of OSS.

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