Open Source Software implementation in the UK public sector: Evidence from the field and implications for the future

Teresa Waring[a],*, Philip Maddocks[b]

[a]*Sunderland Business School, University of Sunderland, St Peters Campus, Sunderland SR6 0DD, UK*
[b]*University of Newcastle Upon Tyne Business School, UK*

Abstract

Open Source Software (OSS) is a model of computer software development where the source code is available for programmers to view, read, modify and re-distribute without the property right restrictions of proprietary software. OSS has existed as a model for developing computer applications and software since the 1950s. However, OSS has only found its way into the public arena within the past decade due to some major projects gaining significant market share from commercial developers such as Microsoft. Research in the area of OSS has become more extensive in recent years and has examined areas such as motivation of programmers as well as the benefits of OSS. However, literature focusing on the actual implementation of OSS is more limited with only Fitzgerald and Kenny [(2004). Developing an information infrastructure with Open Source Software. *IEEE Software*, 50–55] providing any substantial analysis of how it might be achieved.

In this paper the focus is on OSS use and implementation within the UK public sector. This sector has a history of resource wastage and underperforming information systems. The underpinning issues of motivation and benefits to organisations will be addressed along with the difficulties that the UK Government faces in adopting an OSS strategy. Section 2 examines the existing literature in the area and explores why OSS should be adopted and implemented by the public sector in the UK. Section 3 considers the research approach taken and the results obtained from considering the implementation of OSS in eight

*Corresponding author. Tel.: +44 0191 5152325.
E-mail address: teresa.waring@sunderland.ac.uk (T. Waring).

government organisations. Section 4 concludes with a discussion and some implications for those organisations in the public sector who might wish to take this approach.
© 2005 Published by Elsevier Ltd.

1. Introduction

Open Source Software (OSS) is a model of computer software development where the source code is available for programmers to view, read, modify and re-distribute without the property right restrictions of proprietary software. This model allows constant innovation by individuals who may be geographically widely distributed. The resulting Open Source programs may be available free of charge, although depending on licensing arrangements this does not always hold true.

OSS has existed as a model for developing computer applications and software since the 1950s. The Internet was developed in Open Source environments (Newman, 1999). The UNIX operating system was developed in the 1970s as a simple operating system with re-usable code (Open Group, 2003). However, OSS has only found its way into the public arena within the past decade due to some major projects gaining significant market share from commercial developers such as Microsoft (Dubash, 2005).

The terminology 'free software' was created by the Free Software Foundation (FSF) formed in 1984 and the mission of this organisation as stated by the founder, Richard Stallman was 'to provide freedom to programmers' (UNESCO, 2001) lost when UNIX systems were largely commercialised and their source closed (Wheeler, 2003). This software was described as free as in 'free speech' not as in 'free beer' (GNU, 2004), meaning it could be sold but the underpinning code of projects must be available to allow future innovation. The name 'Open Source' came from a decision in 1997 of the OSS initiative that wrote the 'Open Source' definition that requires the availability of program source code and also includes rules on licensing and discrimination in OSS projects (Perens, 1997).

Research in the area of OSS has become more extensive in recent years and has examined areas such as motivation of programmers (Bonaccorsi & Rossi, 2003; Haruvy, Prasad, & Sethi, 2003; Hertel, Niedner, & Herrmann, 2003; Lakhani & Wolf, 2003; Lerner & Tirole, 2001, 2002) as well as the benefits of OSS (Kogut & Metiu, 2001; Spinellis & Szyperski, 2004). However, literature focusing on the actual implementation of OSS is more limited with only Fitzgerald and Kenny (2004) providing any substantial analysis of how it might be achieved. There are now white papers on OSS from the UK Office for Government Commerce and the NHS Information Authority (NHSIA) setting out plans for investigating and implementing OSS applications. Nevertheless, it appears that only Applewhite (2003) and McDonald et al. (2003) have provided any insight into the potential government benefits of using OSS.

In this paper the focus will be on OSS use within the UK public sector. This sector has a history of resource wastage and underperforming information systems (IS) and even as this paper is being written yet another Government system at the Department of Work and Pensions (DWP) has crashed leaving many people without benefits (BBC, 26 November 2004). The underpinning issues

of motivation and benefits to organisations will be addressed along with the difficulties that the UK Government faces with this type of strategy. Section 2 will examine the existing literature in the area and explores why OSS should be adopted and implemented by the public sector in the UK. Section 3 will consider the research approach taken and the results obtained from considering the implementation of OSS in eight government organisations. Section 4 concludes with a discussion and some implications for those organisations in the public sector who might wish to take this approach.

2. Open Source Software—rhetoric versus reality

In the modern software marketplace Microsoft is the dominant player and has made millions of dollars selling its proprietary software throughout the world. However, in recent years OSS has become widely acknowledged as a viable alternative and has been advocated as a better method for developing high-quality software than the traditional closed-source approach (Haruvy, Prasad, & Sethi, 2003). The questions many are now faced with are how far OSS will go to displace proprietary or 'closed-source' software and whether it will topple Microsoft and provide business with a viable alternative model of innovation in the software industry whereby individuals contribute freely to a public good, for rewards of prestige and status (Appelbe, 2003). Unfortunately, these rewards are in direct conflict with the interests of commercial business whose innovations are at least temporarily monopolised under intellectual property rights. McDonald et al. (2003) suggest that economic principles predict that the OSS model cannot succeed, as without licence payments for using the software no-one will develop or maintain it. However, Gacek and Arief (2004) counter this by arguing that OSS projects do not have to conform to a 'one size fits all' approach and characteristics and licensing can differ greatly. We will now consider the OSS paradox that appears to facilitate software developers working for the good of each other as well as society at large.

2.1. The OSS paradox

One of the most challenging aspects of the OSS movement that economists have difficulty in explaining is the motivation for people to contribute to an OSS project without financial remuneration. It appears to be against economical logic and has been the subject of many research studies (Ljungberg, 2000; Lerner & Tirole, 2002; Raymond, 2001). One suggested reason for this paradox is the existence of altruism whereby programmers within the OSS communities believe they are supporting their community by labouring in this way (Kogut & Metiu, 2001; Lakhani & von Hippel, 2003; Lerner & Tirole, 2001). Other researchers are not so sure that altruism on it own explains the actions of so many disparate and geographically diverse programmers. Bonaccorsi and Rossi (2003) suggest altruism may explain the actions of OSS programmers who become involved in projects in their leisure time, 'hobby programmers', but by itself altruism is not enough to explain the actions of people who devote considerable time and intellect to projects. Dasgupta and David (1994) have likened OSS development to the scientific/academic system of research and discovery, and closed-source software to technological innovation. This technological model would indicate that traditional rewards for innovation as maximisation of

profits by securing program intellectual property rights. Therefore, maximum profits come from suppression of knowledge or know-how. However, even this model is not that simple. Bezroukov (1999) claims that members of both the scientific and OSS communities are driven not by monetary rewards, but by 'other competitive motives' such as status and reputation and this appears to be supported by Mustonen (2003) and McDonald et al. (2003). A more critical view of motivation has been suggested by Kogut and Metiu (2001) and Von Krogh and von Hippel (2003). They propose that many OSS developers are hostile to the privatisation of software and wish to see their work remain open and available to all. Nevertheless, many businesses are increasingly becoming attracted to OSS, even those developing proprietary software. Lerner and Tirole (2001) suggest three reasons for this: to better know the competition, to make money on complementary services and support to OSS programs and to attempt to influence the development of a project to favour their company.

2.2. Benefits of OSS

There are benefits of OSS that apply to programmers, business users and societies. Some of the advantages affect several stakeholders and some are specific to one group alone. This next section, however, will look at the benefits to business users and in particular to public sector organisations.

2.2.1. Little cost

Gonzalez-Barahona (2000) suggests one of the biggest attractions of OSS for business is the perceived availability at little or no cost and indeed even some of the highest-profile OSS programs are available to download freely from the Internet. Titterton (2003) states that 70% of business users are motivated primarily by cost savings. Spinellis and Szyperski (2004) believe that the low cost of OSS has contributed to the widespread adoption of sophisticated development platforms including GNU/Linux. However, the main cost advantage comes after acquisition— OSS offers lower total system cost than closed-source models. This does not mean that there are no costs associated with this type of development as programmers who develop OSS have to release and support programs themselves (Murphy, 2001).

2.2.2. Reliability

Murphy (2001) and Carnall (2000) state that reliability is often cited as one of the most important benefits of OSS. Reliability in the software context means the absence of faults that lead to incorrect operations, loss of information or system failures. The reliability of OSS is enhanced with the availability of the source code to other programmers who can identify problems and propose solutions.

2.2.3. Customisability

Linked to reliability is the issue of customisability. Krishnamurthy (2003) argues that as the source code is available to all, individuals or organisations can modify the program to meet specific needs. This becomes especially important to organisations located in certain sectors such as healthcare or other public bodies. The customised software can be re-distributed into the OSS community, tested, improved and then fed back to these organisations at a fraction of the cost of customisation of closed-source systems.

2.2.4. Licensing

In 1997 when the 'Open Source Definition' was written there was also criteria produced for what constituted OSS and what did not (Perens, 1997). It included rules about the licensing of software. There are currently 51 different licences recognised by the Open Source Initiative (www.opensource.org/licenses/), with six of the licences in mainstream business use. Microsoft, in comparison, only offers two licences, though they have been revising their licences in an attempt to increase their competitive position (Thomas, 2002). There are four different components differentiating the licences: whether they allow the OSS to be combined with proprietary software; whether modifications can be made private and not returned to the author; whether the software can be re-licensed by anyone; whether it contains special privileges for the original copyright holder (Krishnamurthy, 2003). The freedom given by the different licences means users can customise or re-distribute software as required, whilst also giving businesses the authority to sell modifications and enhancements as proprietary software (although it is not in the spirit of OSS). The licensing benefit over proprietary software providers means that large organisations, governments and schools who cannot afford to pay large licence fees may switch to cheaper OSS solutions. There is some evidence in the UK, Europe, the Far East, Russia, South Africa and South America that this in fact is happening particularly in government departments and the biggest reason is cost savings made on licensing agreements (Enav, 2003; Galli, 2003, 2004).

2.2.5. Greater choice and control for end-users

OSS is creating a competitive alternative to proprietary software and providing end-users with a wider range of software options which are continually under improvement. These packages compare favourably with the many commercial offerings (Ulrich, 2003). Linux can run in many different contexts and on many platforms from mainframes to PCs and palm-top devices (Bloor, 2003). As the source code is accessible programmers can customise the product or fix bugs. This prevents users from becoming locked into a vendor who controls source code and potentially can dictate the hardware platform (The Economist, 2003). Many would argue that OSS is more reliable than proprietary software because of the high level of peer review involved in developing it (Rapoza, 2002; Vowler, 2003). In a similar manner the security of OSS can also be claimed to be higher than that of proprietary software due to the extensive peer scrutiny that identifies and corrects weaknesses in the source code (Krishnamurthy, 2003). Un-planned security benefits also arise from the fact that the OS Movement has earned a respected reputation in the software industry which means it faces fewer Internet-based security attacks (Markus, Manville, & Agres, 2000; Rogers, 2002). According to Bloor (2003), OSS is a guarantee against buried 'espionage software' which is a major reason why so many governments are showing interest in it.

2.2.6. Support from major companies

In the past many businesses have been reluctant to invest in OSS because of the lack of support and training available. Now this is changing as major IT companies begin to support OSS (Butcher, 2003). IT suppliers such as IBM, Hewlett-Packard and Oracle have pledged to support Linux and are providing this support through Red Hat and SuSE (Anon, 2003). This approach benefits the suppliers whose business models now include revenue from supporting OSS, and also benefits the users who are reassured that support will be available.

2.3. Disadvantages of OSS for business

There are many issues that surround the use of OSS but the disadvantages that were identified over the last few years have, on the whole, been resolved by the ongoing efforts of committed OSS developers. This section will only consider current disadvantages and focus specifically on how this relates to business users and the public sector.

2.3.1. Version proliferation

This is a major issue for proprietary software users but it is even more problematic for the users of OSS. Taft (2004) quotes Chris Stone, vice chairman of Novell Inc., who cautions OSS users to 'look out for the viral effect' which describes the way OSS packages have been known to fork when programs cannot resolve their differences and continue with two separate projects. Fortunately for the users of Linux there has been an absence of major version proliferation due to the control certain individuals have kept on the project (DiBona, Ockman, & Stone, 1999).

2.3.2. Complex and numerous licences

This has already been discussed as a benefit to business users. However, some licences require OSS users to re-contribute to the OSS community by releasing new/amended code or by supporting developers. Many business users do not have the technical ability to understand the code and rely on outsourcing customisations or software maintenance, yet are still legally responsible for ensuring the licence requirements are met. Alternatively, businesses using OSS may develop improvements which, depending upon the licence, may have to be released, raising implications for business intellectual property rights and competitive advantage (Vowler, 2003).

2.3.3. Implementation issues

It is claimed that one of the major worries for OSS users, particularly at corporate level, is there is no single person responsible for the development of the product who can be contacted to resolve problems (Vaughan-Nichols, 2004a, b). There are still problems with some of the smaller OSS packages where demand is less and no-one has taken responsibility for providing documentation and support. Ulrich (2003) is concerned that non-technical users struggle with a bewildering amount of functionality and this is supported by Taft (2004), who believes that businesses may have difficulty going up the learning curve let alone decipher the source code to customise packages. This is even more acute in the public sector where many years of outsourcing have seen the de-skilling of the IT workforce.

For many OSS is perceived as too difficult for business users and companies such as Microsoft are willing to promulgate this myth (Bradbury, 2003). Bradbury (2003) also points out that in certain areas of business such as accounting there are no OSS solutions and in others development cannot be advanced because of restrictions of software patents by commercial developers. One of the worries associated with switching to OSS and implementing new packages is that it will not be compatible with other software (Adshead, 2003; Moores, 2003). This is also a concern when it comes to hardware. Although hardware manufacturers have tended to keep their hardware specifications secret, a number are beginning to release the information. OSS-based drivers are now available but still the majority of peripheral items are only delivered with Microsoft drivers.

Therefore, users need to find Linux or Macintosh drivers independently—which can be difficult (Ulrich, 2003).

2.3.4. High short-term costs of switching to OSS

Although the long-term costs for OSS have been found consistently lower than those of proprietary software, the short-term costs can be high during the transition. The software needs to be acquired, installed, customised and then staff may require training (Vaughan-Nichols, 2004a, b). Additionally, if organisations lack the resources and talent to manage the software it could easily become costly to maintain (Coffee, 2003). A study by Gartner (Lambert, 2003) found that increases in service and management costs outweighed the benefit gained through not paying licence fees. However, the study failed to take into consideration different business situations where additional service/management costs may not be required, or the licence fees form a much larger percentage of IT costs and therefore are not negated.

2.4. OSS in the public sector

Much of the literature on OSS tends to be from the individual user or business perspectives but there is now a growing body of literature that advocates the increased implementation of OSS in the public sector and particularly focused on local and central government as well as the NHS. Applewhite (2003) argues that governments' have an obligation to spend taxes wisely and therefore OSS should be adopted in the public sector given its perceived lower cost. This is particularly pertinent when the UK Government spends over £7.1 billion yearly on IS and could potentially make big savings on systems that would represent better value for taxpayers money (Carnall, 2000). Fitzgerald and Kenny (2004) believe that the OSS solution in their Irish Hospital study could save 20 million Euros over 5 years. McDonald et al. (2003) suggest that health service performance could be improved by having a 'vibrant and pervasive OSS movement in medical informatics' as developers would have real-life test situations for their products. In more general terms Ziff Davis (2002) argues that democratic governments are publicly accountable to all its citizens and the underpinning philosophy of OSS is congruent with this approach and therefore OSS could benefit all.

The emergence of OSS, with the promise of relative longevity compared to proprietary software, could be seen to present an opportunity for the public sector to shift away from the 'short-termism' of management thinking and plan strategically for future requirements. However, it is a contested view. Spinellis and Szyperski (2004) argue that adopting OSS can lead to organisations paying less attention to strategic requirements planning. Alternatively, Carnall (2000) writing within the context of the NHS suggests that OSS may provide security against specialist healthcare application providers going bankrupt and leaving the client (NHS) with problems, which may involve great cost to remedy.

Banahan and Taylor (2003) show that the top benefits to government are lower total cost and avoiding 'lock-in'. However, the study also shows the complexity of public sector IT as ease of system management was low as a perceived benefit but that 65% of public sector organisations in London planned future use of OSS, mainly in infrastructure.

When looking at implementing OSS the UK Government appears to lag behind many others. Applewhite (2003) lists countries including China, India and Norway where OSS is more

established and identifies 24 countries that have passed or considering laws encouraging OSS use. Germany in particular is seen as a leader, and this is reflected in adoption not only by the public sector but also large businesses. Mathieson (2003a) suggests that up until 2001 the UK Government had shown little enthusiasm for OSS and of the 20 largest local authority websites only eight (40%) used Apache, compared to 67% of all websites worldwide. However, the EU is increasingly adopting more OSS as there is better awareness of its potential benefits (Griffith, 2003).

In the UK Office of Government Commerce (OGC, 2002) particularly identifies 'laziness' as a reason for continued widespread use of proprietary software. OSS is often not supported by marketing and promotion of the level of proprietary alternatives and therefore does not provide an obvious solution. NHSIA (2002) argues that although there are increasingly more applications for healthcare on the market many public sector managers are reluctant to investigate their potential use even though Peeling and Satchell (2001) conclude that the flexibility offered by OSS can help to reduce considerably their 'IT legacy' problems.

In government departments Schofield (2001) suggests that OSS is not being widely as adopted as Ministers would like because of 'comfort' factors. This manifests itself in government IT managers sticking to software that they know and excluding any possibility of innovation or change (Windley, 2003). Banahan and Taylor (2003) extend this with a further factor—'no track record' and 'no available support'. McDonald et al. (2003) believe these views are so engrained in the government culture that major public institutions will continue to get their enterprise-wide IS from large vendors for the foreseeable future and any OSS used will be additional modules to these large systems. One major concern for the public sector is the lack of expertise in IT and in particular OSS development. Windley (2003) notes that over a long period of time government departments and the NHS have stopped developing their own systems and increasingly relied on IT consultants for this development. Very often these consultants are tied into software and hardware vendors and this may create functional and suitability problems.

In summary much of the literature on OSS in the public sector has focused on the potential benefits of this approach but there is little research that would indicate the extent to which OSS is being adopted by public organisations and what the realised benefits are. Section 3 describes the research carried out to examine this issue and the framework employed to analyse OSS use in public sector organisations.

3. Research approach

As yet there is little academic research available in the public domain that focuses on the UK public sector adoption of OSS. However, there are widely dispersed projects that are being undertaken by a number of public organisations that are beginning to be reported in practitioner journals. Some of these projects have been part of the UK Government pilot study on OSS (http://www.ogc.gov.uk/oss/Report-v8c.htm, accessed 29 December 2004). This paper analyses some of these projects to provide evidence of what is happening and the implications for other organisations in the public sector with regards to OSS.

The eight case studies examined in this investigation are six local government and two central government cases (Table 1).

Table 1
Public sector case studies

Organisation	Description
Central Scottish Police	Installed 30 servers with Linux to run StarOffice. This replaced Microsoft Office and was rolled out to 1000 users.
Dundee City Council	Has standardised on Linux for its back-office systems and replaced a large server farm from a number of suppliers with one IBM z800 mainframe running Linux.
Newham Council (London)	Part of the government trials of OSS and used Linux in desktop and server packages against proprietary products including Microsoft.
Nottingham City Council	Developed a Linux-based e-mail server for 7500 users.
Penwith District Council (Cornwall)	To develop an innovative network based on desktop terminals and StarOffice software covering 240 users at eight key council sites.
Powys County Council	Development of the National Grid for Learning program to bring affordable Internet access and e-mail to 4000+ rurally based teachers and students.
Department for Works and Pensions	Has installed a Linux-based online purchasing system to facilitate the purchase of stationary and forms with future expansion planned to cover other goods.
National Police 'VIPER' project	Electronic video identity parade developed by West Yorkshire police based on a cluster running the Linux operating system.

Data for all of these case studies were collected in document form from a number of publicly accessible websites and various published literature sources both academic and practitioner.

To facilitate analysis of OSS use in these organisations the authors have devised three tabular matrices to consider implementation of hardware, software and benefits identified to the organisation. The data from the individual case studies were then entered into each matrix against the criteria. Yin (2003, p. 133) explains this as 'cross-case synthesis'. As much of the data are qualitative in nature it is difficult to give exact figures particularly for the degree of implementation of hardware and software. Therefore, the authors have devised a scale of 'whole', 'partial' or 'none' when defining levels of implementation. 'Whole' indicates adoption throughout the organisation; 'partial' indicates some implementation in limited areas of the organisation; 'none' refers to no implementation whatsoever. These criteria are applied in Tables 2 and 3 and can be found in Appendix A at the end of the paper.

The authors recognise that this approach to case study analysis has its limitations. First the case study method used is the 'snapshot' view of the data and whilst the cases are recent they do not provide an ongoing analysis of the implementation in those organisations. Silverman (2001) also believes that the interpretation of research reports may focus on a few pieces of evidence selected by the researcher and it is important to consider all data. Case studies generally originate from different authors and unlike other forms of data collection such as surveys and structured interviews where the research design is determined by the researcher case studies may have varying amounts of relevant data. There is also the issue of validity. The secondary nature of the case

studies used generates the question of whether the case studies are an accurate picture of the organisations. The validity is increased by having multiple data sources (Bryman & Bell, 2004; Silverman, 2001). We adopted this approach in this study.

4. Discussion and analysis of case studies

The factual analysis of the case studies is provided in tabular form at the end of the paper in Appendix A and it is with reference to that Appendix A that much of this discussion is focused.

4.1. Implementation success

It would appear from our research that the degree of public sector OSS implementation is still rather scant and where it has occurred, as in the case studies, there has been a selective approach adopted. The Central Scottish Police (http://www.sun.com/software/star/staroffice/6.0/successstories/) suggest that their pilot implementation was successful and they want to take it further and open it out to over 1000 users. Penwith Council has switched the majority of their desktops to OSS whilst Nottingham Council has implemented a major e-mail system for more than 7500 staff. Linux tends to be the operating system of choice and is used as the platform for running a variety of software. The most innovative implementation from the case studies examined was the National Police Force 'Video Identity Parade Electronically Recorded' (VIPER) project where live identity parades have been replaced with video-based ones, whereby a mix of suspect and volunteer images are shown to witnesses at local police stations. Storage of more than 1,00,000 images of suspects and volunteers as well as the ability to transmit 100Mbytes of video files up to 100 times a day has put Linux to the test but the National Police Force have been more than happy with its performance (Vowler, 2004). Even so, the overall degree of implementation of OSS is variable between individual organisations as are the applications for which it is being used.

If we now examine why public sector organisations use OSS there is no real consensus of rationale. Having identified from the literature the main criteria or benefits that OSS has over proprietary software we found that only five of them were important in four or more of our case study organisations. These were long and short-term savings, reliability, scalability and customisability. Other benefits appeared to be more specific to individual projects, such as avoiding proprietary 'lock-in' and system longevity. We will now consider these in more detail.

4.2. Low cost

When considering the benefits of OSS the majority of the case study organisations identified cost as an issue. Seven of the eight cases found short-term savings from moving to OSS and all of them predicted long-term savings. Titterton (2003) has suggested that 70% of all OSS users are motivated primarily by cost savings. In the public sector Applewhite (2003) has stated that governments have an obligation to spend tax payers money wisely and this is evidenced by the

explicit need to make cost savings in the case studies. This is also congruent with the research carried out by Banahan and Taylor (2003), who have found that lower cost is the primary perceived benefit of OSS to local government. Short-term savings across the organisations studied included no/lower licensing fees and no/reduced implementation costs. Long-term savings can be made on maintenance costs and from the negligible cost of upgrading proprietary software. Newham council, sponsored by Microsoft, was the only case study that did not identify short-term savings. Their argument for this was that existing proprietary software would not interface with the Linux systems they tested and that would trigger an upgrade of hardware thus incurring extra cost if OSS was introduced (Savvas, 2003).

In the three organisations where figures were quoted on estimated savings from the use of OSS the level of savings were significant. Penwith council expected savings of £1.2 m over 5 years; the larger Nottingham Council estimated savings in the region of £1 m/year compared to similar councils using proprietary software; the National Police VIPER project expected costs to fall from £1000 per ID parade to £150. These figures only represent three public sector organisations, but show the significant level of savings that can be made by using OSS. However, it is important to note that OSS is not cost free. Young (2004) is clear that there are hidden costs applicable to OSS and these are associated with staff. Competent Linux professionals are scarce and organisations may incur substantial costs if they have to buy in these skills from consultancy agencies.

4.3. Reliability

Five of the case study organisations identified reliability as a benefit to them and in particular this was linked to lowering maintenance costs. This supports the view of Murphy (2001) and Carnall (2000) that reliability is one of the most cited benefits of OSS. It is believed that the shutdown time of systems is reduced with greater reliability afforded by OSS systems. Dundee City Council explained that their system is used by citizens to pay council tax and rents and therefore reliability is critical (Cooter, 2003). This view of reliability was supported by the OGC and the DWP who also use OSS solutions because of their portability and low licensing costs (Mathieson, 2003b).

4.4. Scalability

This was seen to be a benefit to four of the case study organisations, including the two central government departments. The scalability of OSS enables easy expansion of systems to more users. This is particularly important when considering the size of the public sector (the DWP employs 1,00,000 people across the UK). These organisations need the ability to test systems at pilot sites based on smaller numbers of users and when the system is embedded and relatively trouble free it can be easily rolled out to larger groups.

4.5. Customisability

The ability to customise software was seen as a benefit in four of the organisations under study. Using OSS enables the organisations to provide tailored applications instead of the limited choice that proprietary software packages may offer (Powys County Council, 2004). Customisation also

means that cost savings may be achieved when organisations do not have to buy proprietary software packages containing applications they do not need. Krishnamurthy (2003) suggests that accessing source code and modifying applications to specific needs is essential for the public sector and should save money in the long term. Thus, when the government makes changes to taxation or payments that affect the systems having access to source code should make upgrades relatively easy and not require the development of new systems.

4.6. Other findings

Almost all of the case studies were reticent to mention that avoidance of proprietary 'lock-in' would be an advantage of using OSS. This is rather surprising as Banahan and Taylor (2003) listed this equal with cost as the most important perceived benefits of OSS to local government. Even the government policy document on OSS states that 'the UK Government will seek to avoid lock-in to proprietary IT products and services' (OGC, 2002). However, it could be that the case study organisations are still very early in the project lifecycle and have not had sufficient time to evaluate the investment. Once the projects are seen to be successful then they may not want to tie themselves to the likes of Microsoft again.

Lerner and Tirole (2002) said that OSS projects had on average longer life spans than proprietary software. This should theoretically enable organisations to strategically plan for future systems development. However, only one organisation stated longevity as a benefit. Although this is low it should not be surprising in the public sector where politics imposes 'short-termism' and long-term planning rarely happens.

The government policy on OSS (OGC, 2002) states that the government will consider OSS and proprietary solutions together and then 'value-for-money' will be taken into account. However, the take up of OSS in the public sector is still very low even when the benefits of low cost and value-for-money can be demonstrated. Also the government policy does not appear to apply to the NHS where proprietary software has been imposed on all Hospitals and Primary Care Trusts through the local service provider framework and where OSS has not even been considered. This maybe a symptom of the lack of 'joined-up' government where few lessons are learnt and there is a culture of 'sticking to what you know' (Windley, 2003). Or it could be that government IT departments have been de-skilled over a number of years through outsourcing that the ability to develop OSS or any other software is not a core competency of the organisation. This would appear to indicate that despite all of the government rhetoric about OSS central departments may be tied into proprietary software for the foreseeable future and it maybe in the smaller local council organisations where the innovation takes place as development will be on a smaller scale.

5. Conclusion

Open Source Software (OSS) is increasing in popularity as it has the potential to reverse the virtual monopolies of some of the major proprietary software suppliers. This monopoly has to some degree stifled software creativity and allowed certain powerful individuals to dictate industry standards and policy. OSS has to some extent revived the enterprise spirit of the programming

community and has started to bring competitive choice and freedom back to the software marketplace. In addition OSS's development process is creating innovative products that are reliable, secure, practical and have high usability and performance ratings. Users are now not only benefiting from the OSS revolution but also from the improved proprietary software development that is being forced upon suppliers in order to maintain competitive advantage. Technical support for OSS is growing and businesses are gaining in confidence in the knowledge that their software has a future and that they as an organisation will have some say in and some control over its direction. From a UK public sector perspective where money is not freely available OSS may provide the means to develop products and services that are cost effective and manifestly robust. However, OSS may never have a large take up in central government departments unless there is a determined effort to restore some of the IT competencies lost over many years to outsourcing and share the organisational knowledge needed to integrate OSS applications with current applications.

The big question is how do you reverse this trend without growing the large Government IT departments of the 1980s? This is a very difficult question and one that has no immediate answer. The Government of the UK would need to overhaul its national IT strategy and pull back from some of its outsourcing deals with companies such as EDI. This could take years and would mean a huge investment in a new IT infrastructure. In the NHS the National Programme for IT project has put even more power into the hands of 'strategic partners' such as Accenture and has forced the various PCT and Hospital Trusts to accept systems that they have had very little consultation in developing (Computer Weekly, 26 February 2005). Realistically, the current UK Government cannot be seen to falter on these programs and therefore in the short term this is unlikely to happen. OSS implementation will only take place where there is a degree of autonomy and where the IT skills are readily available. Thus, we are looking at Local Government organisations. If, however, these organisations were to band together they might be able to exert a certain amount of pressure on Central Government. This may come about if regional assemblies gain authority. The outlook for OSS in the UK public sector is still uncertain and may never become established.

Appendix A

OSS hardware platforms and implemented in the case studies are given in Tables 2 and 3.

Table 2
OSS hardware platforms in the case studies

Organisation	Desktops	Networks	Main frames
Central Scottish Police	Partial Implementation of OSS applications on 400 desktops	Partial 30 OS servers	None
		1 server in every branch office to run desktop applications	

Table 2 (continued)

Organisation	Desktops	Networks	Main frames
Department of works and pensions	None	Partial IBM servers	None
Dundee City Council	None Links to mainframe	None No servers used	Partial IBM z800 mainframe—creates virtual servers in one box
Newham Borough Council	Investigated the move of 5000 staff desktops to OS	None	None
Nottingham City Council	None	Partial 2 servers—Xeon E-mail network initially for 7500 of 16,000 staff	None
Penwith District Council	Partial 240 OS Sun Ray terminals	Partial Sun solaris servers	None
Powys County Council	Whole 100 PCs providing various services	Whole Powys network linking to remote access servers providing resources to support schools	None
National Police VIPER project	None	None	Partial IBM GPFS (General Parallel File System)

Table 3
Open Source Software implemented in the case studies

Organisation	Operating systems	E-mail programs	Desktop/office software	Other software
Central Scottish Police	Linux	None	StarOffice suite available to 1000 users	HylaFax OSS fax system
Department of works and pensions	Linux	None	None	Purchase and payment procurement system
Dundee City Council	Linux	None	None	Payroll/HR system
Newham Borough Council	Trialled Linux	None	None	None
Nottingham City Council	Suse Linux 8.0	EXIM mail and HORDE interface	None	None

Table 3 (*continued*)

Organisation	Operating systems	E-mail programs	Desktop/office software	Other software
Penwith District Council	Unknown	Partial Sun solaris servers	StarOffice	None
Powys County Council	Slackware Linux	EXIM mail	None	Apache and MySQL
National Police VIPER project	Redhat 7.1 Linux	None	None	Video Identity Parade Electronically Recorded software (VIPER)

References

Adshead, A. (2003). *Software: MG Rover takes Sun Staroffice for test drive as alternative to Microsoft product*. Computer Weekly, Reed Business Information Ltd. 28 October, p. 18.

Anon. (2003). *Linux rises to every challenge*. Computer Weekly, Reed Business Information Ltd. 19 August, p. 28.

Appelbe, B. (2003). The future of Open Source Software. *Journal of Research and Practice in Information Technology*, *35*(4), 227–236.

Applewhite, A. (2003). Should governments go Open Source? *IEEE Software*, 88–91.

Banahan, M., & Taylor, G. (2004). *Report for London Connects into the potential benefits from the use of Open Source Software within the London Boroughs*. http://www.openforumeurope.org/publications/london_connects_report/index.html, accessed 13/02/2004.

Bezroukov, N. (1999). *Open Source development as a special type of academic research (critique of vulgar Raymondism)*. First Monday, 4(10). http://www.firstmonday.dk/issues/issue4_10/bezroukov/#b3, accessed 13/02/2004.

Bloor, R. (2003). *Linux is the only option for standardisation*. Computer Weekly, Reed Business Information Ltd. 28 October, p. 18.

Bonaccorsi, A., & Rossi, C. (2003). Why Open Source Software can succeed. *Research Policy*, *32*, 1243–1258.

Bradbury, D. (2003). *Could your firm use Open Source Software?*. Computer Weekly, Reed Business Information Ltd. 6 September, p. 30.

Bryman, A., & Bell, E. (2004). *Business research methods*. Oxford: Oxford University Press.

Butcher, T. (2003). *How does Open Source pay?*. Computer Weekly, Reed Business Information Ltd. 20 March, p. 32.

Carnall, D. (2000). *Open Source Software in healthcare*. http://www.carnall.demon.co.uk/OpSrcHth.htm, accessed 20/02/2004.

Coffee, P. (2003). *Answering Open Source questions*. eWeek, Ziff Davis Media Inc. 27 January.

Cooter, M. (2003). *Dundee Council opts for Linux*. http://www.techworld.com/news/index.cfm?fuseaction+displaynews&NewsID = 728, accessed 21/03/2004.

Dasgupta, P., & David, P. (1994). Towards a new economics in science. *Research Policy*, *23*(5), 487–521.

DiBona, C., Ockman, S., & Stone, M. (1999) (1st ed.). *Open Source: Voices from the Open Source revolution*. UK: O'Reilly.

Dubash, M. (2005). *IT managers just love Open Source*. http://www.techworld.com/opsys/news/index.cfm?NewsID = 3633.

Enav, P. (2003). *Israeli Government picks Open Source productivity suite over Microsoft*. eWeek, Ziff Davis Media Inc. 30 December.

Fitzgerald, B., & Kenny, T. (2004). Developing an information infrastructure with Open Source Software. *IEEE Software*, 50–55.

Gacek, C., & Arief, B. (2004). The many meanings of Open Source. *IEEE Software*, 34–40.

Galli, P. (2003). *Open Source. On rise in government*. eWeek, Ziff Davis Media Inc., 10 July. http://www.eweek.com/article2/0,1759,1189729,00.asp, accessed 29/12/2004

Galli, P. (2004). *Microsoft takes on Linux in ad campaign: Microsoft's Windows operating system versus Linux*. eWeek, Ziff Davis Media Inc., 5 January. http://www.eweek.com/article2/0,1759,1426248,00.asp, accessed 29/12/2004.

GNU. (2004). *Free as in freedom*. http://www.gnu.org, accessed 28/02/2004.

Gonzalez-Barahona, J. M. (2000). *Free Software/Open Source: Information society opportunities for Europe?* http://eu.conecta.it/paper/paper/html, accessed 17/02/2004.

Griffith, B. (2003). *Public sector IT chiefs favour Open Source*. Computer Weekly, 28 October, p. 24.

Haruvy, E., Prasad, A., & Sethi, S. P. (2003). Harvesting altruism in Open Source Software development. *Journal of Optimising Theory and Applications*, *118*(2), 381–416.

Hertel, G., Niedner, S., & Herrmann, S. (2003). Motivation of software developers in Open Source projects: An Internet-based survey of contributors to the Linux kernel. *Research Policy*, *32*, 1159–1177.

Kogut, B., & Metiu, A. (2001). Open Source Software and distributed innovation. *Oxford Review of Economic Policy*, *17*(2), 248–264.

Krishnamurthy, S. (2003). A managerial overview of Open Source Software. *Business Horizons*, 47–56.

Lakhani, K., & von Hippel, E. (2003). How Open Source Software works: 'Free' user-to-user assistance. *Research Policy*, *32*, 923–943.

Lakhani, K., & Wolf, R. (2003). *Why hackers do what they do: Understanding motivation and effort in Free/Open Source Software Projects*. MIT Sloan Working Paper No. 4425-03. http://ssrn.com/abstract = 443040, accessed 20/02/2004.

Lambert, M. (2003). *Audit will prove Microsoft best for council*. Computer Weekly, Reed Business Information Ltd. 28 October, p. 24.

Lerner, J., & Tirole, J. (2001). The Open Source Movement: Key research questions. *European Economic Review*, *45*, 819–826.

Lerner, J., & Tirole, J. (2002). Some simple economics of Open Source. *The Journal of Industrial Economics*, *50*(2), 197–234.

Ljungberg, J. (2000). Open Source Movements as a model for organising. *European Journal of Information Systems*, *9*, 208–216.

Markus, M. L., Manville, B., & Agres, C. E. (2000). What makes a virtual organisation work? *Sloan Management Review*, *42*, 13.

Mathieson, S. (2003a). *Return to the source*. http://www.guardian.co.uk/online/story/0,3605,989511,00.html, accessed 01/03/2004.

Mathieson, S. (2003b). *Government in free-for-all*. The Guardian. http://www.guardian.co.uk/online/story/0,3605,928083,00.html, accessed 18/03/2004.

McDonald, C. J., Schadow, G., Barnes, M., Dexter, P., Overhage, J. M., Mamlin, B., et al. (2003). Open Source Software in medical informatics—why, how and what. *International Journal of Medical Informatics*, *69*(2/3), 175–184.

Moores, S. (2003). *Linux is winning its guerrilla war (gaining market share on Microsoft)*. Computer Weekly, Reed Business Information Ltd. 30 January, p. 28.

Murphy, T. (2001). *Evaluate Open Source risks*. http://www.ftponline.com/wss/2002_10/online/tmurphy/, accessed 29/12/2004.

Mustonen, M. (2003). Copyleft—the economics of Linux and other Open Source Software. *Information Economics and Policy*, *15*, 99–121.

Newman, N. (1999). *Origins and future of Open Source Software*. http://www.netaction.org/opensrc/future, accessed 20/02/2004.

NHS Information Authority. (2002). *Open Source Software and the NHS: White paper*. http://www.nhsia.nhs.uk/def/pages/features/I_250202.asp, accessed 20/02/2004.

Office of Government Commerce (OGC). (2002). *Open Source Software: Guidance on implementing UK Government Policy*. http://www.ogc.gov.uk/embedded_object.asp?docid = 2498, accessed 20/02/2004.

Open Group. (2003). *The Unix system: History and timeline*. http://www.unix.org/what_is_unix/history_timeline.html, accessed 29/02/2004.

Peeling, N., & Satchell, J. (2001). *Analysis of the impact of Open Source Software*. http://www.govtalk.gov.uk/docuemts/QinetiQ_OSS_rep.pdf, accessed 20/02/2004.

Perens, B. (1997). *The Open Source definition*. http://www.opensource.org/docs/definition.php, accessed 17/02/2004.

Powys County Council. (2004). *Powys County Council and Open Source Software*. http://www.telecentres.com/opensource/, accessed 16/03/2004.

Rapoza, J. (2002). *eWeek Labs: Open Source quicker at fixing flaws*. eWeek, Ziff Davis Media Inc. 30 September.

Raymond, E. (2001). *The cathedral and the bazaar*. UK: O'Reilly.

Rogers, J. (2002). *Public sector IT chiefs welcome Whitehall's Open Source stance*. Computer Weekly, Reed Business Information Ltd. 1 August, p. 6.

Savvas, A. (2003). *Council trials find Open Source offers no short-term cost savings*. Computer Weekly. http://www.computerweekly.com/Article126774.htm, accessed 20/03/2004.

Schofield, J. (2001). The Old ways are the best? The durability and usefulness of bureaucracy in public management. *Organisation*, *8*(1), 77–96.

Spinellis, D., & Szyperski, C. (2004). How is Open Source affecting software development? *IEEE Software*, 28–33.

Silverman, D. (2001). *Interpreting qualitative data* (2nd ed.). London: Sage.

Taft, D. K. (2004). *Industry leaders have 'open' debate (industry overview)*. eWeek, Ziff Davis Media Inc. 20 January.

The Economist. (2003). *Microsoft at the Powerpoint: Open Source Software (Microsoft versus Linux contd.)*. Economist Newspaper Ltd. 13 September, p. 59.

Thomas, D. (2002). *Open Source is not a bargaining chip*. Computer Weekly, Reed Business Information Ltd. 14 March, p. 2.

Titterton, G. (2003). *Users reveal benefits of Open Source*. Computer Weekly, May 6, 2003. http://www.findarticles.com/cf_dis/m0COW/2003_May_6/101269983/p1/article.jhtml, accessed 22/03/2004.

Ulrich, B. (2003). *If you don't do Windows*. eWeek, Ziff Davis Media Inc. 25 November.

United Nations Educational Scientific and Cultural Organisation (UNESCO). (2001). *Free Software history*. http://www.unesco.org/webworld/portal_freesoft/open_history.shtml, accessed 6/03/2004.

Vaughan-Nichols, S. J. (2004a). *Novell embraces Open Source*. eWeek, Ziff Davis Media Inc. 21 January.

Vaughan-Nichols, S. J. (2004b). *2004: The year Linux grows up (or blows up) industry overview*. eWeek, Ziff Davis Media Inc. 26 November.

Von Krogh, G., & Von Hippel, E. (2003). Special issue on Open Source Software development. *Research Policy*, *32*, 1149–1177.

Vowler, J. (2003). *Finding out the hidden costs of Open Source*. Computer Weekly, Reed Business Information Ltd. 22 April, p. 29.

Vowler, J. (2004). *Linux on parade*. http://www.computerweekly.com/articles/article.asp?liArticleID = 128898&liArticleTypeID = 20&liCategoryID = 1&liChannelID = 5&liFlavourID = 2&sSearch = &nPage = 1, accessed 16/03/2004.

Wheeler, D. (2003). *Why Open Source Software/Free Software? Look at the numbers*. http://www.dwheeler.com/oss_fs_why.html, accessed 04/03/2004.

Windley, P. (2003). *Barriers to Open Source in government*. http://www.windley.com/2002/07/25.html, accessed 20/02/2004.

Yin, R. K. (2003). *Case study research: Design and methods* (3rd ed.). London: Sage (Applied Social Research Methods Series).

Young, K. (2004). *Is it time to rely on Linux?* The Guardian. http://society.guardian.co.uk/e-public/story/0,13927,1154915,00.html, accessed 20/03/2004

Ziff Davis Media Inc. (2002). *Open Government requires Open IT*. http://www.eweek.com/article2/0,1759,522648,00.asp, accessed 29/12/2004.

Teresa Waring is Associate Dean of Business and Management at Sunderland Business School. She holds B.Sc. and M.Sc. degrees from Durham and Sunderland Universities, respectively, and a Ph.D. in Information Systems (IS) from Northumbria University. She has over 15 years experience in research and teaching in the area of IS at Newcastle University and Northumbria University. Her research and consultancy experience includes both the public and private sectors with the main focus on the UK National Health Service. Current research areas include the application of Critical Social Theory to develop emancipatory approaches for IS implementation, the relationship between organisational culture and technology and the use of participative action research within IS.