



## **OPAALS PROJECT**

Contract n° IST-034824

# **WP 12: Socio-Economic Models for Digital Economics**

## **Deliverable 12.11:**

### **Benefits and Drawbacks of Adopting an OS Strategy: An Examination of Value Creation and Value Capture in OS Business Models**



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**Short Description:**

The aim of this document is to examine the benefits and drawbacks of adopting an open source strategy and also investigate value creation and value capture in open source business models.

**Author:** Lorraine Morgan

**Partners contributed:** University of Limerick

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(1<sup>st</sup>) Thomas Kurz, Salzburg University of Applied Science, Austria

(2<sup>nd</sup>) Ossi Nykänen, Tampere University of Technology, Finland

**Dependences:**

<b>Achievements*</b>	This work was also accepted for journal publication in the Database for Advances in Information Systems. In addition the work was presented and published in the IFIP 8.6 Conference Proceedings.
<b>Work Packages</b>	Extensive contribution to Workpackage 12 and also the OPAALS community and larger research community as a whole.
<b>Partners</b>	All Partners – the adoption of OSS and the focus on value creation and value capture with open source business models have real implications for understanding digital ecosystems. Both issues were examined in the context of open innovation, which in itself is a useful concept in understanding ecosystems, particularly due to its emphasis on the importance of networking, community, knowledge and information sharing in an open, transparent manner

<b>Domains</b>	Domains of Open Source Software and Open Innovation are extensively discussed in this deliverable
<b>Targets</b>	Targets include: Domain researchers, OPAALS Community, Industry
<b>Publications*</b>	<p>Published:</p> <p>Morgan, L. and Finnegan, P. (2009) Open Innovation in Secondary Software Firms: An Exploration of Managers' Perceptions of Open Source Software, <i>Database for Advances in Information Systems</i></p> <p>Morgan, L. and Finnegan, P. (2008) Deciding on Open Innovation: How Firms Create and Capture Value with Open Source Software, IFIP 8.6 on Open IT-Based Innovation, Madrid, Spain, October.</p> <p>Under Review:</p> <p>Morgan, L. and Finnegan, P. (2009) Embracing Open Innovation: Open Source Software in the Secondary Software Sector, <i>International Journal of Open Source Software and Processes</i>.</p>
<b>PhD Students*</b>	Lorraine Morgan
<b>Outstanding features*</b>	The concept of OSS as a form of open innovation is a relatively new phenomenon, thus this deliverable has been very beneficial in providing a better understanding of the benefits/drawbacks of adopting an open strategy and how the benefits/drawbacks impact the adoption decision. In addition, as research on value creation and capture with OSS is limited, the deliverable has proved beneficial in this regard. The research carried out portrays a variety of firms' innovative business models surrounding OSS and the role of a value network in creating and capturing value. The work has also been accepted for journal publication and was also presented at the IFIP 8.6 Conference.
<b>Disciplinary domains of authors*</b>	Lorraine Morgan, University of Limerick

*The information marked with an asterisk (\*) is provided in order to address Recommendation n. 4 from the Year 2 review report*



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## **EXECUTIVE SUMMARY**

This deliverable compliments that of deliverable 12.5 (Case Studies of Inner Source) and consists of two key parts. Part one examines the benefits and drawbacks of adopting an OS strategy and presents a study of 13 managers in the secondary software sector in Europe. The study also highlights how managers' perceptions of the business and technical benefits and drawbacks of OSS influenced the technological, organizational, environmental and individual factors considered within the adoption process. The findings show that many of these factors are similar to those reported by previous work on the adoption of innovation, leading us to conclude that organizational processes for the adoption of open innovation are reliant on the practices for closed innovation despite frequently cited loss of organizational control associated with open innovation. The results are also useful for the OPAALS research community, the larger research community and companies interested in adopting as OS strategy as they provide a better understanding of how perceptions impact adoption which may in turn lead to more informed decision-making processes.

Additionally, part two of this deliverable presents an additional study of 9 managers and investigates the circumstances that motivate decision-makers to embrace an open innovation strategy such as OSS and the characteristics of OSS that enable or hinder a firm's ability to create and capture value. The paper concludes that there are many defining characteristics that have the potential to achieve value creation and value capture. However, there also exist many characteristics of OSS that have the potential to impede both. In addition, it was found that OSS offers a major example of how open innovation can change a business since collaborating as part of a value network appears to be crucial source of both value creation and value capture. This author believes that this part of the deliverable has huge relevance for the OPAALS research community as it provides an understanding of the innovative business models surrounding OSS, which in turn have direct implications for comprehending digital ecosystems. In particular, what stands out from this deliverable as being most transferable to the OPAALS community is the focus on collaboration and knowledge sharing in a value network in an open and transparent manner.

## **SECTION I – BENEFITS AND DRAWBACKS OF ADOPTING AN OSS STRATEGY**

### **1. INTRODUCTION**

The concept of open innovation, of which open source software (OSS) is a well cited example, challenges existing theories of innovation adoption due to changes in organisational control (cf. Chesbrough, 2003) and risk (cf. Chesbrough and Crowther, 2006). In addition, a fundamental change in inter-organisational activities is evident with the adoption of an open innovation strategy. It is accepted that an increase in the use of inter-organisational mechanisms in relation to any activity necessitates a re-examination of existing paradigms and perspectives, and the construction of new theory due to increased complexity and reduced routinization associated with supra-organisational goals (cf. Alter and Hague, 1993). This deliverable addresses the need to examine our theory of innovation adoption by investigating the effects of how managers perceive OSS impacts on adoption decisions by companies in the European secondary software sector. We thus studied managers in firms where software is used as a component in other products, such as embedded software in the automotive sector, consumer electronics, mobile systems, telecommunications and utilities (e.g. electricity, gas, oil). As the focus is on an open source approach to software rather than the adoption of particular OSS applications, we use the term OSS to refer to the range of open source applications.

## 2. LITERATURE REVIEW AND THEORETICAL FRAMEWORK

Despite the importance of inter-organisational co-operation in relation to servicing consumer needs for products and services (Okamura and Vonortas, 2006), organizations have been slow to harness the same type of external cooperation in relation to innovation (Lane and Probert, 2007). For most of the 20th century, innovation happened inside the business and companies rarely looked outside for new ideas or inventions (Tapscott and Williams, 2005). Innovation is the result of combining different knowledge sets (Nonaka et al. 2003; Tidd et al, 2005), and such knowledge is frequently to be found outside the organization (Chesbrough, 2003; De Wit et al. 2007). However, with the exception of notable examples of collective invention (cf. Allen, 1983; von Hippel, 1987), organisations have been slow to engage in open innovation (cf. Chesbrough, 2003).

According to Chesbrough (2004), a paradigm shift is taking place in how companies commercialise knowledge; characterised as a move from ‘Closed Innovation’ to ‘Open Innovation’. Closed innovation is a view that successful innovation needs control, and that firms need to be strongly self-reliant because of uncertainty with quality, availability and capability of others’ ideas. Chesbrough (2004) proposes that with the open innovation paradigm, (i) firms can, and should, use external as well as internal ideas and (ii) that internal ideas can be taken to market through external channels, outside a firm’s current business, to generate value. According to Chesbrough (2006), ideal businesses resist the ‘not invented here’ and ‘not sold here’ syndromes in favour of open innovation. They search outside their own companies for the best ideas, seeking input from other companies, which include competitors, as well as from customers, suppliers and vendors. Most importantly, new products are not the only tangible manifestation of open innovation. Services and process transformation are equally important facets, whether it is to create enhanced customer support or to support internal business efficiencies (BT, 2006). A popular example of open innovation in various sectors is open source software (Chesbrough et al, 2008; West and Gallagher, 2006). The open source software phenomenon has been around for some time. The Free Software Movement began its campaign in 1984 for free software, meaning software that respects users’ freedom and community, and explained that ‘free’ as in ‘free software’ means ‘free as in free speech’, and not ‘free as in free beer’. The central organising principle is that the software remains free of most constraints on copying and use common to proprietary software (Hissam et al., 2001). In other words, “no one owns the software in the ‘traditional sense’ of being able to command how it is used or developed, or to control its disposition” (Benkler, 2002). However, there was a widespread perception, especially in business, that free software was zero cost software. The term ‘open source’ was coined in 1998 to avoid this perception and to place the phenomenon on a more business-friendly footing than that associated with the somewhat confusing ‘free software’ term (Fitzgerald, 2006). A formal definition of OSS published by the Open Source Initiative, establishes that software can be called ‘open source’ if it and its source code can be freely modified and redistributed (Coar, 2006). Some of the key conditions of the definition are that (i) the source code must be available to the user, (ii) the software must be redistributable, and (iii) the software must allow modifications and derived works. The open source moment has pragmatically shifted the centre of gravity towards a more business-friendly and hybrid concept, and OSS is now rapidly changing into a viable alternative to proprietary software in commercial settings (Agerfalk et al., 2005).

Despite this transformation, however, issues surrounding the adoption of an OSS strategy have received little attention. While open source has transitioned into the realm of mainstream business, understanding the underlying dynamics and values of the model and how this translates into business value is less known (Feller et al., 2008; CANfloss Report, 2003). Instead, research on OSS has concentrated mainly on the motivations of open source programmers (Hars and Ou, 2001; Hann et al., 2002; Lerner and Tirole, 2002; Ye and Kishida, 2003; and Von Hippel and Von Krogh, 2003) and the organisation of specific products and projects (Fielding, 1999; Mockus et al., 2002; and

Koch and Schneider, 2002). Comparatively, little effort has been dedicated to studying the reasons behind business managers' decision to adopt, or conversely refrain from adopting, an OSS approach to software. Although some research has been conducted in the area of OSS adoption (e.g. Ven and Verelst, 2006; Goode, 2005; Dedrick and West, 2003; Varian and Shapiro, 2003; and Chau and Tam, 1997), these studies have either focussed on the adoption of specific open source products such as Linux and Apache, have been conducted with companies outside of Europe or have concentrated largely on public administrations and companies operating in the primary software sector. Moreover, there is a paucity of research on OSS adoption in Europe. This is rather surprising as 3/5 of OSS developers are in Europe and the region has a strong secondary software sector (Ghosh et al., 2006).

In the commercial area, adopting an open innovation process "includes various perspectives: (1) globalization of innovation, (2) outsourcing of R&D, (3) early supplier integration, (4) user innovation, and (5) external commercialization and application of technology" (Gassmann, 2006, p. 224). Consequently, in order to move towards open innovation, there is a need for organisations to utilise "both external and internal ideas to create value, while defining internal mechanisms to claim some portion of that value" (Chesbrough, 2003, p. xxiv). To do so, Gassmann and Enkel (2006) identify three core open innovation processes: (1) the outside-in process whereby a company's innovativeness can increase through the integration of suppliers, customers and external knowledge sourcing, (2) the inside-out process where companies can earn profits by bringing ideas to market and transferring ideas to the outside environment, and (3) the coupled process where companies can combine the outside-in and inside-out processes by working in alliance with complimentary partners where give and take is vital for success. There have been examples of the successful application of open innovation R&D processes in commercial settings such as consumer electronics (Blau, 2007), pharmaceuticals (Lane and Probert, 2007), as well as automobiles and computer hardware (Gwynne, 2007). Nonetheless, Chesbrough and Crowther (2006) found that companies that 'look outside' for technologies tend to minimise risk by investing in technologies that are often proven in other applications as opposed to 'new to the world' technologies. Open innovation practices are not limited to 'high-tech' sectors (Chesbrough and Crowther, 2006). However, Dahlander and Gann (2007) have argued that open innovation is far more complicated than it seems because it is not always that straightforward for organisations to have a high degree of openness and it can also be costly to implement. Thus, it is necessary to identify the benefits and barriers of an open innovation approach in order to provide credible insights for practitioners (Dahlander and Gann, 2007).

In exploiting OSS as part of an open innovation approach, companies such as HP and Sun have used an outside-in process by donating R&D to the Mozilla open source project while exploiting the pooled R&D and knowledge of all contributors (e.g. academics, user organizations, individual hobbyists) to facilitate the sale of related products. The result was that these firms maximised the returns from their innovation by concentrating on their own needs and then incorporating the shared browser technology into their own integrated systems. Other companies like IBM have often used an inside-out approach as part of its OSS initiative that represented spinouts in the 1990s and more recently, donated software patents to the OSS community. In addition, the aforementioned companies have also integrated elements of the coupled process by successfully co-operating with universities and research institutes in terms of both exploiting and sharing information and knowledge (West and Gallagher, 2006). It is clear that OSS plays a critical role in the business models for firms in high technology and other industries (Rajala, 2008; Overby et al., 2006). However, the use of OSS in commercial settings has led to managerial debate about the business value of OSS in comparison to proprietary software, particularly business and revenue models as well as strategic implications (Agerfalk et al. 2005). Whilst studies of adoption by Rogers (2003) and Geroski (2000) highlight the importance of how perceptions could influence the adoption of an innovation, there is little in the OSS literature that indicates whether managerial perceptions of OSS

have any impact on adoption. The common assumption that the perceived benefits and drawbacks of OSS are a contributing factor to OSS adoption relies heavily on anecdotal evidence found mainly in white papers, web articles, and practitioner papers. A review of such sources has identified the benefits and drawbacks shown in Table 1.

<b>OSS BENEFITS</b>	
Quality	Kenwood, 2001; Krishnamurthy, 2003; Varian and Shapiro, 2003; Forge, 2006
Security	Coppola and Neeley, 2004; Forge, 2006
Flexibility of Use	Varian and Shapiro, 2003; Krishnamurthy, 2003
Large Developer and Tester Base	Kenwood, 2001; Krishnamurthy, 2003
Low Cost	OGC Report, 2002; Fanini, 2005;
Flexibility Allowed by Licenses	Broersma, 2005
User Support from a Community	Krishnamurthy, 2003; Williams et al., 2005
Escape from Vendor Lock-in	Johnson, 2003; Hendrick, 2004
Increased Collaboration	Agerfalk et al., 2005
Encouraging Innovation	Howe et al., 2000; Wheeler, 2005
<b>OSS DRAWBACKS</b>	
Compatibility Issues	Webb, 2001; Guth, 2006
Security Risks	Herbsleb, 2002; Giera and Brown, 2004
Installation Problems	Webb, 2001
Lack of Expertise	Krishnamurthy, 2003
Version Proliferation	Krishnamurthy, 2003
Less User-Friendly	Kenwood, 2001
Lack of User Support	Webb, 2001
Lack of Ownership	Kenwood, 2001; Guth, 2006
Insufficient Marketing	Krishnamurthy, 2003
Giving Away the Source Code for Product	Hecker, 2000
Higher Training Investments	Giera and Brown, 2004

*Table 1 Review of the Benefits and Drawbacks of OSS*

### 3. RESEARCH DESIGN AND METHOD

An objective of this deliverable is to examine the benefits and drawbacks of adopting an OSS strategy. In the context of this objective, two research questions were formulated:

RQ1: What are the perceived benefits and drawbacks of OSS?

RQ2: How do these perceptions impact on the adoption of OSS?

The use of classical diffusion theory (cf. Rogers, 2003) to study organisations has been criticised for focusing primarily on simpler innovations being adopted autonomously by individuals and being less applicable to complex technologies and to technologies adopted by organisations (cf. Fichman, 1999). In addition, there are weaknesses in innovation adoption research in its failure to take adequate consideration of the business context and its integration with the overall environment (Swanson, 1994). It is therefore evident that the theoretical foundation for this deliverable needs to take into consideration specific factors such as the technological, organisational, and environmental circumstances of the organisation in addition to individual factors. Thus, this study began by drawing on the work of Tornatzky and Fleischer (1990). This model consists of three elements that influence the process by which innovations are adopted – the technology, organisation and environment. This framework has been elaborated on in relation to the OSS adoption process in studies carried out by Glynn et al., (2005), Dedrick and West (2003), and Chau and Tam (1997). The technological context relates to the technologies available to an organisation. Its focus is on



how technology factors influence the adoption process (Tornatzky and Fleisher, 1990). According to Rogers (2003), five technology factors influence the likelihood of adoption - relative advantage, compatibility, complexity, trialability and observability. Tornatzky and Klein (1982) have also carried out some related work spanning these five characteristics and several of these factors were mentioned by Dedrick and West (2003) as influencing OSS adoption. The organisational context looks at the structure and processes of an organisation that constrain or facilitate the adoption and implementation of innovations (Tornatzky and Fleischer, 1990). Organisational factors such as total cost of ownership (Varian & Shapiro, 2003), boundary spanners (Ven & Verelst, 2006), relevance to the organisation (Goode, 2005) and top management support (Glynn et al. 2005) could fall into this category. Tornatzky and Fleischer (1990) propose that the external environmental context, i.e., the industry, competitors, regulations, and relationships with governments, in which an organisation conducts its business presents constraints and opportunities for technological innovations. Research carried out by Chau and Tam (1997) and Dedrick and West (2003) found that environmental factors such as market conditions and available skills and services influence OSS adoption. Other factors such as lack of real world experience (OGC Report, 2002) and the need for a well-performing business model (Barnes, 2003) also appear to impact OSS adoption. Having considered the technological, organisational and environmental factors, we now examine individual factors. Classical innovation adoption theory also emphasises the importance of individual factors such as the presence of an OSS champion for innovation adoption (Glynn et al, 2005). Other factors identified in the literature that could be labelled as individual include uncertainty (OGC Report, 2002) and skills obstacles (Barnes, 2003). Table 2 draws from studies of innovation as well as from studies of OSS to present a conceptualisation of the factors that may affect OSS adoption.

## **Data Gathering**

This study was categorised as exploratory due to the scarcity of empirical work in the area of OSS adoption. Thus, Marshall and Rossman (1989) propose that either a case study or field study research methodology can be used. The researcher decided that a field study would be appropriate as it would facilitate the collection of data from a larger number of informants. A stratified sample was used (cf. Patton, 1990), in that we sought out key decision-makers in companies that had complete adoption, partial adoption and non-adoption of OSS. Three criteria for selecting interviewees were identified at the outset. First, the respondents should occupy roles that make them knowledgeable about the issues being researched; secondly, they should be able and willing to communicate with the researcher; and thirdly most of the interviewees should hold a managerial position in the company and preferably be involved in IT strategy. Thus, interviewees were senior decision makers with experience of assessing OSS adoption. Data collection was carried out using semi-structured interviewing based on a common protocol in 13 companies (see Table 3). In addition, the interviewees also shared the same definition of open source software as published by the OSI. Interviews were used in this study for a number of reasons. First, detailed information is acquired. Second, emotions, sensitive or privileged information can be investigated that respondents might not be willing to write about on paper for a researcher that they have not met (cf. Oates, 2006). Third, the interviewer can ask new questions that follow up interviewees' replies and can vary the order of questions and even the wording of questions (cf. Bryman and Bell, 2003). Finally, the interviewer is provided with rich, detailed answers. The interview guide approach (cf. Patton, 1990) was used to conduct the interviews, as it is more comprehensive and systematic for data collection than the purely conversational interview, and more flexible than the standardised, open-ended interview or the closed, fixed response interview. Interviewees were senior decision makers with experience of assessing OSS adoption. Interviews were carried out in person or by telephone, were tape-recorded and each interview lasted between forty-five minutes and two hours. Each interview was structured around 4 issues, with the interviewer asking probing questions based on responses. These 4 issues were: (a) the company's history of engagement with OSS, (b) the level of

adoption, (c) perceptions of benefits and drawbacks of OSS and (d) how such perceptions affected the adoption of OSS.

<b>Technological Factors</b>	
Relative Advantage	The level to which an advantage is perceived as better than the idea it supersedes (Rogers, 2003).
Compatibility	The degree to which an innovation is perceived as being consistent with the existing values, past experiences and needs of potential adopters (Rogers, 2003).
Complexity	The level to which an innovation is perceived as difficult to understand and use (Rogers, 2003).
Trialability	The degree to which the innovation can be tried and assimilated in small chunks over time (Rogers, 2003).
Observability	The level to which the results of an innovation are visible to the technology adopter (Rogers, 2003).
<b>Organisational Factors</b>	
Total Cost of Ownership	The cost of acquiring and using an innovation (Wouters et al., 2005).
Boundary Spanners	Individuals within an organisation who connect their organisation with external information and can bring the organisation in contact with new innovations (DePietro et al., 1990).
Relevance to the Organisation	Perception that the benefits of the innovation are relevant to the organisation (Goode, 2005).
Top Management Support	Senior management support the adoption of the innovation (Morisio, 2000; Glynn et al., 2005).
<b>Environmental Factors</b>	
Market Conditions	Competitive forces and levels of uncertainty in the market (Chau and Tam, 1997).
Available Technology Skills and Services	The availability of external skills and services that are required to utilise OSS (Dedrick and West, 2003).
Real World Experience	The level of understanding on how to migrate to OSS (OGC Report, 2002).
Well-performing business model	An explicit model for profitability (Barnes, 2003).
<b>Individual Factors</b>	
Uncertainty	Individual fear, uncertainty and doubt regarding the relative strengths and weaknesses of OSS (OGC Report, 2002).
Skills	Ability of the individual to use the innovation (Barnes, 2003).
OSS Champion	Someone with drive and charisma supporting the adoption (Glynn et al., 2005).

*Table 2 Factors that may affect OSS adoption*

Interview data was transcribed, generating 115 pages of field notes. Content analysis was undertaken using coding techniques proposed by Strauss and Corbin (1990). This approach encourages researchers to be flexible and creative (Sarker et al., 2000) while imposing systematic coding procedures (Strauss and Corbin, 1990). This form of analysis facilitates the development of substantive theory without prior hypotheses, and can be utilised in the absence of, or in conjunction with, existing theory (Strauss and Corbin, 1990; Urquhart, 1997). In the initial phase, ‘open coding’ was used to determine the main ideas in each transcript. These ideas were then grouped by significant headings (informed by the items in Tables 1 and 2) to reveal categories and sub-categories. The next step involved ‘axial coding’ which is the process of relating categories to their sub-categories. As a list of codes began to emerge, the analysis moved to a higher level of abstraction, looking for a relationship between the codes. Once a relationship had been determined, the focus returned to the data to question the validity of these relationships. The final step, ‘selective coding’, is the process of determining a core category; that category that is connected to most of the other categories.

Name	Business	Extent of OSS Adoption	Interviewees
Nokia Research Centre, Finland	Mobile Communications	Moderate use in telecommunications infrastructure and embedded applications. Uses Linux, Gnome and D-Bus, Debian, Python, Symbian, G-Streamer, OBEX and other OS components	Head of Software Technology
Phillips Medical Systems, The Netherlands	Supplier of medical equipment & devices	Limited. Involved in some OS projects. Hope to increase level of adoption	International Project Leader
Siemens AG, Germany	Large Engineering Multinational	Working on global software initiative – using open source model internally in business unit called corporate source	Program Manager
Sony Computer Entertainment Europe, UK	Manufacturers & Distributors of entertainment systems	Moderate use in servers and consumer products. Increasing levels of adoption. Presently use PostgreSQL, Apache & PHP, Linux, Sendmail, postfix	Linux for Playstation 2 Specialist
Vodafone, Spain	Mobile Communications	None. Collaborating with others to create Linux platform for mobiles	R&D Engineer Head of R&D
BSS Group PLC, UK	Specialist Distributor of heating and plumbing	Decreasing adoption. Abandoned previous use of OS email system. Now limited to Linux on servers	IT Contracts Manager
Combitech Systems, Sweden	Consultancy	Have used it in some projects, e.g. ECOS. Evaluating use in embedded systems	Lead Engineer
Conecta, Italy	Consultancy	Predominant – service built on OSS	Head of R&D
Eircom Group PLC, Ireland	Telecommunications	Some use of OS products in Technical support, e.g. JBoss app. server, MySQL	Technical Architecture Mgr
Eurocontrol Experimental Centre, France	Air Traffic Mgt	Limited to infrastructure. Evaluating further use in air traffic mgt.	Senior Researcher
Consult Comp. (pseudo), Switzerland	Consultancy	Specialises only in open source consultancy/training	Consultant
St. Galler Tagblatt AG, Switzerland	Media	Extensive – migrated entire SAP software environment to OSS. Now use Linux, MaxDB, MySQL, and Apache Tomcat	CIO
Supertramp, UK	Manufacturing	Extensive (100% open source shop). Use OpenOffice.org, Mozilla Web, Linux, and GIMP, Sendmail and Smoothwall	Tech. Director

Table 3 Companies Studied

The issues of trustworthiness (validity) and replicability (reliability) (cf. Denzin and Lincoln, 2000) were addressed as follows. First, the data analysis approach utilised rigorous *coding* and *memoing* processes providing an audit trail of the process by which conclusions are reached. Second, *venting* (cf. Goetz and LeCompte, 1984) was used as results and interpretations were formally discussed with respondents.

#### 4. FINDINGS AND ANALYSIS

As can be seen in Table 4 one or more aspects of the primary innovation processes as outlined by Gassmann and Enkel (2006) are evident in the study sites. For example, many of the companies

have opened up their internal innovation process by successfully gathering and integrating external sources of knowledge and competencies through successful collaboration and joint exercises with customers, suppliers, partners, and research institutes.

Name	Open Innovation Process	Description
Nokia Research Centre, Finland	Outside-in using elements of a coupled process	Integrates external knowledge & competencies. Have joint ventures/exercises with partners and collaborates with communities e.g. Eclipse
Phillips Medical Systems, Netherlands	Outside-in thinking	Collects and integrates external knowledge from research projects and universities. Also involved in research forums investigating OSS
Siemens AG, Germany	Outside-in thinking	In terms of corporate source initiative, integrates software development know-how from several of the operating companies that Siemens has
Sony Computer Entertainment Europe, UK	Outside-in using elements of a coupled process	Integrates external knowledge from customers for products and services. Successfully collaborated with another company in terms of producing Linux for PS3
Vodafone, Spain	Outside-in thinking	Successfully collaborated with Spanish government (received funding) and other companies to develop Linux mobile platform
BSS Group PLC, UK	Outside-in thinking using elements of coupled process	Strong cooperation with suppliers/customers. Contributes knowledge to external environment, e.g. research projects
Combitech Systems, Sweden	Outside-in	Collaborates with different software vendors. Involved in COSI, a Eureka project that aims to raise awareness of OSS and distributed development
Conecta, Italy	Coupled process	Integrates and externalises knowledge/competencies. Cooperation and collaboration with universities and research institutes
Eircom Group PLC, Ireland	Outside-in thinking	Often get involved in collaborative innovation projects, e.g. Eurescom where knowledge has been integrated into some of their mainstream products
Eurocontrol Experimental Centre, France	Outside-in thinking	Involved in task force investigating potential of OSS. Collaborates with universities and research institutes
Consult Comp. (pseudo), Switzerland	Coupled process	Integrates and externalises knowledge. Cooperation and collaboration with universities and research institutes
St. Galler Tagblatt AG, Switzerland	Outside-in	Integrates external sources of knowledge and competencies
Supertramp, UK	Inside-out using elements of a coupled process	Creation of spin-out company following successful adoption of OSS. Collaborates with other companies to deliver state of the art technology systems

*Table 4 Open Innovation Processes in Companies Studied*

The benefits and drawbacks of adopting an open innovation strategy such as OSS as perceived by those managers studied are outlined in Tables 5 and 6. These benefits and drawbacks are categorised as being primarily business or technical, and are ranked in order of the number of managers citing them as being relevant to their adoption decision. The ability to access the source code and modify it has resulted in many of the perceived technical benefits, e.g. security, quality and flexibility of use. The business benefits found were seen as very significant for the managers, particularly escaping vendor lock-in, increased collaboration, and innovation. Although many of the

benefits are similar to those found in the literature, some new findings also surfaced. These included improved harmonisation, extra functionality and establishment of de facto standards. The drawbacks include: poor documentation, less functionality, proliferation of interfaces and problems with finding the right staff and competencies. While it is recognised that the perceived benefits found in the study can be significant for adoption, there are also many drawbacks of OSS that have the potential to impede it. As can be seen from Table 6, only two of the technical drawbacks outlined in the existing literature (compatibility issues and lack of expertise) were perceived as drawbacks by those studied. Interestingly, perceptions of drawbacks regarding the software being less user-friendly, version proliferation and problems with troubleshooting/upgrading were not found. Indeed, OSS was seen to be positive in this regard. New issues in the form of poor documentation, less functionality and lack of roadmaps were perceived to be the primary drawbacks. Essentially, the business drawbacks were found to pose a bigger challenge than the technical drawbacks, with lack of support, lack of ownership and insufficient marketing ranking the biggest drawbacks to adoption. In order to fully understand how managerial perceptions of the benefits and drawbacks impact OSS adoption, the findings were interpreted in the context of the technology, the organisation, the environment and the individual.

<i><b>Benefit</b></i>	<i><b>Description of Benefit</b></i>	<i><b>No. of Respondents</b></i>
Quality (T)	High availability and dependability of applications, higher performance in terms of capacity and speed. Enhanced quality from peer reviews and the quality of developers / testers	13
Large Developer/Tester Base (T)	Very beneficial as it ensures that OSS is quality software and is up-to-date	13
Flexibility of Use (T)	Beneficial because it facilitates changes, customisation, experimentations and allows freedom of choice	12
Encourages innovation (B)	Access to the source code produces ideas and encourages technical innovation while also creating more opportunities for innovation.	12
Increases collaboration (B)	Greater collaboration from OSS facilitates product development, cooperation and exchange of knowledge, provides new ways of collaboration and permits sharing of expenses with other companies	12
Security (T)	High security due to the availability of source code, the reduced threat of viruses and extra awareness of security in design phase of products	11
Escapes vendor lock-in (B)	Highly beneficial as it facilitates freedom of choice, gives sense of control and provides independence from private vendors	11
Low Cost (B)	In terms of reduced licensing fees, upgrades, virus protection and the cost of the whole package, i.e. service and software	7
Compatibility (T)	Great interest in conserving formats for better interoperability	6
Flexibility by licenses (B)	Has a significant impact on reducing capital expenditure in company	6
Extra business functionality (B)	Beneficial because it results in ability to keep teams small which in turn improves productivity and communication	2
De facto standards (B)	Establishes de facto standards results as many organizations work together to create applications rather than relying on a software market leader.	2
Harmonisation (T)	Improved harmonisation in interoperability and practices/operations	1

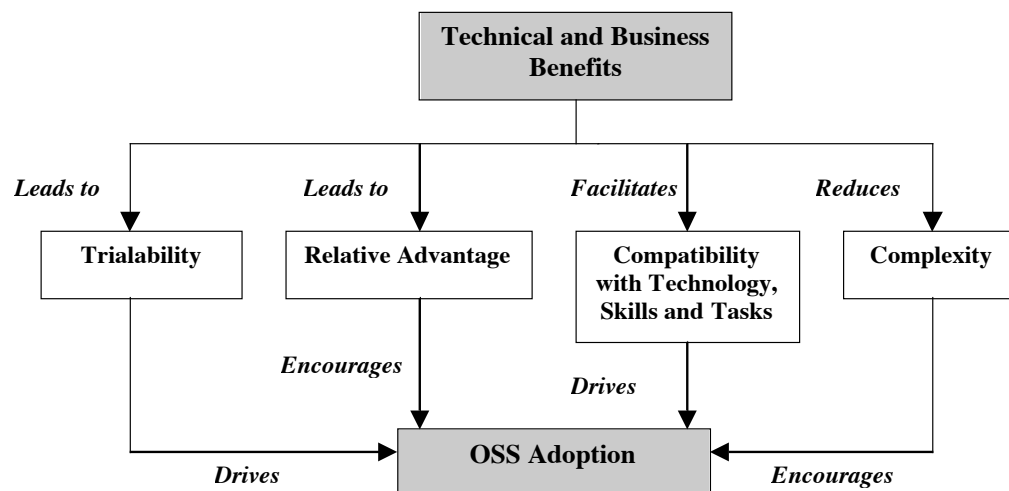
*Table 5 Perceived Benefits of OSS ('B' or 'T' denoted that benefit is primarily regarded as being business or technical)*

<i><b>Drawback</b></i>	<i><b>Description of Drawback</b></i>	<i><b>No. of Respondents</b></i>
Insufficient marketing (B)	No one organization owns it all. OSS has no marketing budget which results in it being driven primarily by word of mouth	13
Lack of support (B)	No safety net as there is no support and no company to back it up	11
Lack of ownership (B)	Inability to hold someone responsible or accountable for problems	11
Lack of Expertise (T)	Employees lack OSS expertise – may be more about lack of awareness	6
Poor documentation (T)	Documentation outdated or may have died in development	5
Finding staff/ Competencies (B)	Can be difficult to find staff and develop competencies to work with OSS	5
Compatibility Issues (T)	Some compatibility problems with current technology, skills and tasks	4
Access to the source code (B)	Some are uncomfortable with releasing source code for products. Lack of knowledge in relation to this issue	3
Proliferation of Interfaces (T)	Results in confusion in deciding which one to choose	2
Lack of Roadmaps with OSS Products (T)	Makes it difficult for companies to see any strategic direction	2
Less Functionality (T)	Level of integration not as good as Microsoft	1

*Table 6 Perceived Drawbacks of OSS ('B' or 'T' denoted that drawback is primarily regarded as being business or technical)*

### Technological Context

Four technological characteristics were evident in this study as influencing the adoption decision: trialability, relative advantage, compatibility, and complexity. Observability was not seen as relevant. The manner in which the technical and business benefits and drawbacks impact these four areas are outlined in Figures 1 and 2.



*Figure 1: Impact of Benefits on OSS Adoption in the Technological Context*

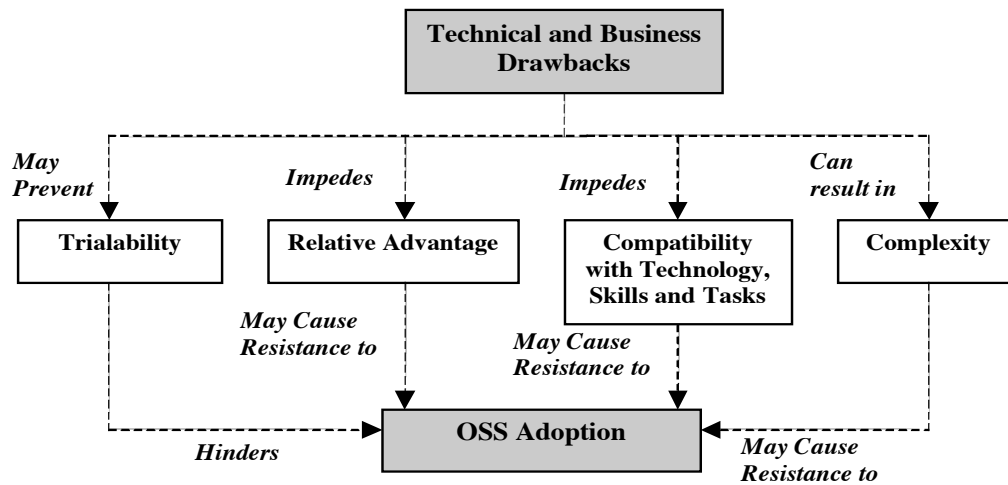


Figure 2: Impact of Drawbacks on OSS Adoption in the Technological Context

The analysis reveals that *Trialability* was a driving force in the adoption decision as the technical and business benefits associated with OSS have led to trials and experimentations by managers in nine of the companies studied. On the technical side, the reliability of OSS appeared to be a real positive influence while on the business side, the low cost and opportunities that OSS provides for innovation were also significant. In some cases, adoption of OSS has led to further trialability of more open source projects. For instance, the IT Manager at Sony Computer Entertainment explained that they had experiences of staff using some software out of interest that turned out to be directly relevant to the company. Several of the companies pointed out that they considered OSS less difficult to try out than proprietary software because the software can be downloaded from the Internet, without any cost. As the Technical Architecture Manager in Eircom pointed out “having the software available for free that one can play around with is seen as useful”. The Technical Manager at Supertramp explained that prior to fully migrating to OSS, he had invested three months carrying out some feasibility testing on OSS. Although this manager had broad experience in Unix systems, he pointed out that “although most of my lifetime experience has been working in IT, I did find the learning curve quite steep and hard work”. The CIO at St. Galler Tagblatt explained that they had not carried out any trials on the software as they had consultants that were very helpful in providing pre-implementation advice. As this manager indicated “we worked with very skilled partners. And these partners knew Linux especially well for SAP”. It can therefore be said that the availability of support and services was a significant factor in reducing the requirement for trialability in this company. However, four of the companies viewed technical drawbacks such as poor documentation and business drawbacks such as insufficient marketing as potential hindrances to trialability of OSS projects occurring whatsoever in the organisation.

The *Relative Advantage* was seen in terms of hardware and software costs as well as the technical benefits outlined in Table 5. The CIO at St. Galler Tagblatt explained that adopting open source resulted in 40% cost savings on infrastructure along with lower costs for software licenses and freedom of choice in their new server hardware. In terms of software costs, adopting OSS enabled Supertramp to wipe £15,000 off their licensing budget and re-invest in the development of their systems. Surprisingly, for the Project Leader at Philips Medical Systems, the R&D Engineer and Head of R&D at Vodafone and the Senior Researcher at Eurocontrol, the low cost of software was not a significant factor in deciding whether to adopt OSS. They indicated that quality in terms of high reliability and performance, and flexibility of use were all main advantages of OSS and would be seen as contributing factors to OSS adoption. At the same time, the experiences of several

managers revealed that technical drawbacks such as lack of expertise, and business drawbacks such as training investments for staff and user support would have a negative impact on relative advantage.

For the majority of the managers the decision to adopt OSS was greatly influenced by the *Compatibility* of the software with their current technology, skills and tasks, supporting the findings of Dedrick and West (2003). Many of the technical benefits and drawbacks (mainly compatibility) are a huge influence in this area, while some business drawbacks (particularly lack of support and skills obstacles) appear to be a barrier to ensuring compatibility with the current technology, skills and tasks. According to the Technical Director in Supertramp, “the amount of compatibility for running applications wasn’t available when the company adopted OSS and still isn’t”. However, this manager was already very experienced with Unix, which resulted in the migration to OSS being less complicated. The IT Contracts Manager of the BSS Group stated that if the company were to introduce more open source products, they would have to ensure 100% compatibility. For example, he suggested that even if they were told something was 95% compatible, he would not be able to recommend it internally because in relation to the remaining 5%, there was a very good chance of staff coming back and saying it didn’t work. While many of the companies had, or could foresee, no problems in terms of compatibility with the current technology, important issues in terms of compatibility with current skills and tasks arise. According to the IT Manager at Sony Computer Entertainment “not all developers in the European market are as comfortable or happy with using OS based operating systems packages. A lot of them are only familiar with proprietary operating systems, and they were not happy that they had to invest extra time and resources in getting people who were familiar with the open source solutions”.

In the organisations that had adopted OSS, technical drawbacks such as lack of expertise resulted in *Complexity* issues while some of the business drawbacks in relation to finding the right staff and developing the right competencies, training and lack of support also had a compounding affect, thus making OSS adoption difficult. For example, the CIO at St. Galler Tagblatt explained that the software is more difficult to understand and use and although their system programmers were familiar with Unix, there was quite a significant investment in training them on Linux. Several of the other managers believed that there may be some complexity issues in adopting OSS due to lack of understanding of OSS. However, some technical and business benefits of OSS have the potential to reduce complexity problems. For example, the low cost of acquisition of OSS often makes it possible for the company to invest in training for staff. This coupled with staff motivation to learn something new and become more innovative also assist in reducing complexity problems.

## **Organisational Context**

In support of findings from Goode (2005), Varian and Shapiro (2003), Ven and Verelst (2006) and Glynn et al. (2005), organisational factors were frequently cited by managers as impacting the adoption decision. Figures 3 and 4 outline how the technical and business benefits and drawbacks influence these areas.



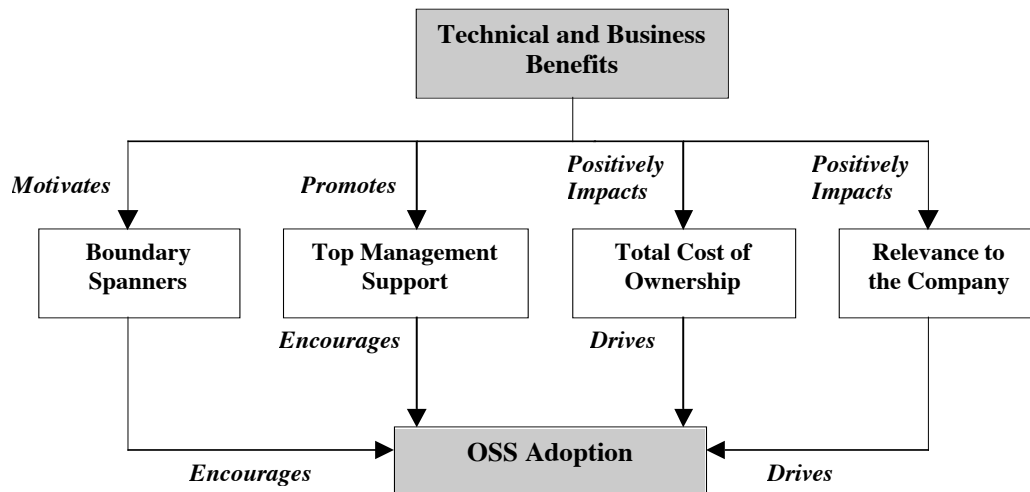


Figure 3: Impact of Benefits on OSS Adoption in the Organisational Context

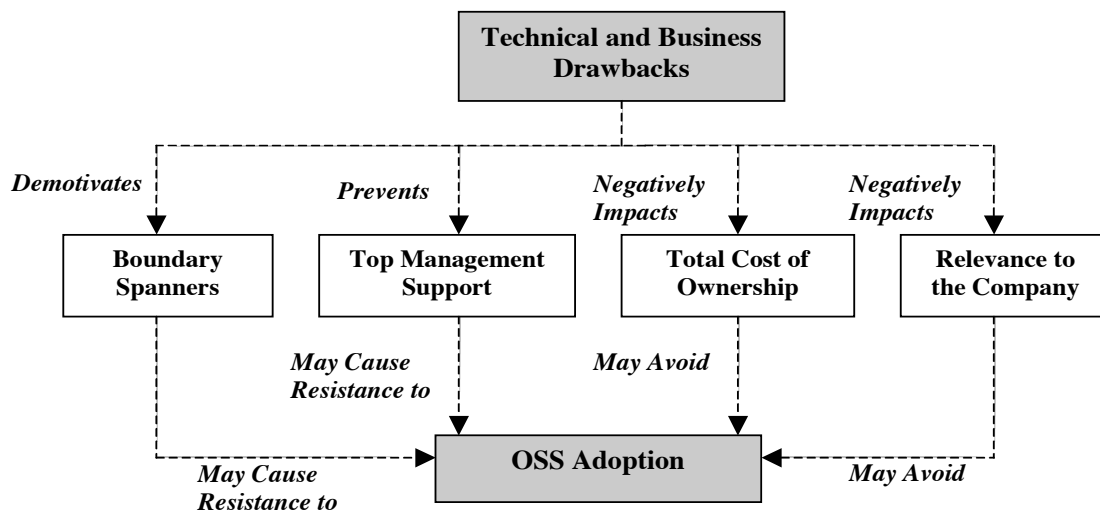


Figure 4: Impact of Drawbacks on OSS Adoption in the Organisational Context

The analysis revealed that the adoption of OSS is primarily a bottom-up initiative in most of the companies, and that the presence of *Boundary Spanners* is very important. In many cases, a number of employees in the company possess knowledge and understanding of OSS, and aid its introduction. It also became apparent that the perceptions of technical and business benefits of OSS have been influential in motivating and convincing these boundary spanners to ‘spread the word’ in the company. For example, the IT Manager at Sony Computer Entertainment explained that she was not a lone voice “gunning for open source” as there were other others in the company supportive of it. Therefore, she added that she did not have to be evangelical internally in the company. As is typical of open innovation, many of the boundary spanners in the companies are investigating open source with other EU companies and universities. The business benefit associated with increased collaboration allowed by OSS appears to be very influential in this regard. However, two of the companies explained that the lack of ownership and support associated with OSS may often de-motivate boundary spanners in encouraging the adoption of an OSS strategy.

The study revealed that the *Total Cost of Ownership* (TCO) was relative to technical benefits such as reliability and performance, and business benefits such as low cost and escape from vendor lock-in. However, technical drawbacks such as lack of expertise, and business drawbacks in relation to training investments and finding the right staff have the potential to negatively influence TCO calculations. Some managers in companies that had adopted OSS revealed that it was not possible to make a formal TCO calculation. However, the CIO at St. Galler Tagblatt calculated a saving of €340,000 with cost savings of 40% on infrastructure. According to the Technical Director at Supertramp, the lower costs associated with OSS adoption was “tremendous”. For the migration to OSS, the company worked within a budget of £30,000 and felt they had got the assessment pretty right. This Technical Director pointed out that if the company had not migrated to OSS, the budget on hardware and software would have meant that their investment in staff and staff capabilities would have been quite significantly less. By adopting OSS, he added that the company could invest more money back into the business process and make that more efficient. While the Technical Architecture Manager at Eircom revealed that the cost of acquisition of OSS is low, he pointed out that the TCO may be just as high as proprietary software because of the investment needed in support. However for four of the managers, lower cost was not the main driver in adopting OSS. Rather low cost combined with some of technical benefits, i.e. reliability and quality, were seen as more important. For example, the IT Manager at Sony Computer Entertainment revealed that the company had the budget and cost was not a consideration in the adoption decision. She added that the company was more interested in what would get them the most functionality and the most time on the most stable platform.

All of the managers believed that senior managers must see the *relevance* of OSS to their business if they are to endorse its adoption. On the other hand, if drawbacks dominate, senior managers will reject OSS. According to the Project Manager at Siemens, relevance to top management means that they must see the strategic business benefits for the company to go that way. The low cost of OSS and the flexibility allowed by licences were contributing business benefits for many of the companies. For the companies with a big budget, the technical benefits of OSS adoption were seen as more relevant by management.

The study revealed the necessity of *top management support* for OSS adoption. It was evident that the benefits and drawbacks of OSS have a critical influence on whether top management support its adoption. According to the Program Manager in Siemens “unless companies have the support of top management, OSS would not work because inherently companies like Siemens have a tendency to cling on to what they have”. The Head of Software Technology at Nokia also explained that they have the support of top management because they want to learn more about OSS in terms of where it can be used and how it benefits the company. At present some of the drawbacks that impede top management support for OSS adoption are the difficulty involved with finding the right staff and developing the competencies necessary to work with open source. Other drawbacks include the lack of ownership and lack of support issue. The managers in companies where OSS had been adopted revealed that top management were supportive of its adoption because of the lower cost associated with it.

## Environmental Factors

The environmental factors found in the study that impact OSS adoption are also in line with those of Chau and Tam (1997), Dedrick and West (2003), Barnes (2003), and the OGC Report (2002). The manner in which the benefits and drawbacks influence these factors are illustrated in Figures 5 and 6.

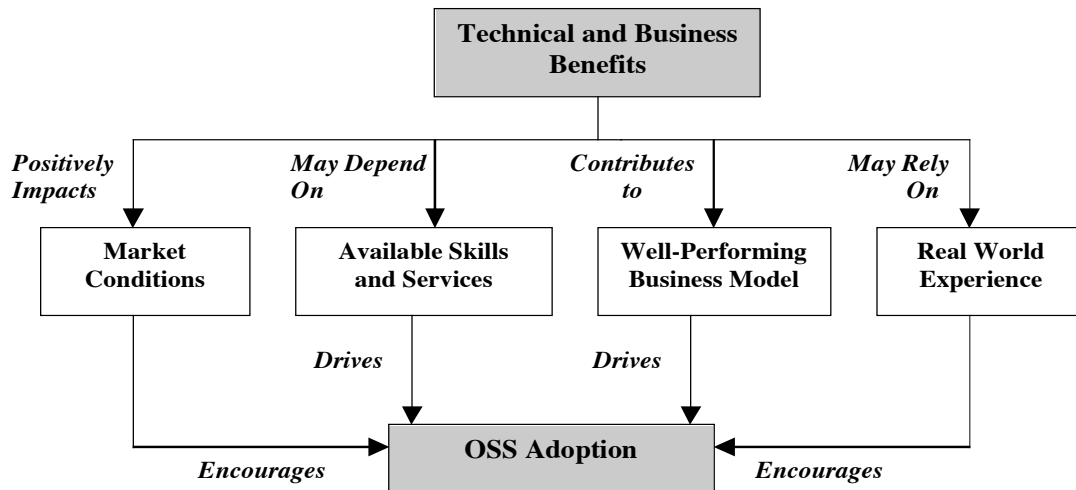


Figure 5: Impact of Benefits on OSS Adoption in the Environmental Context

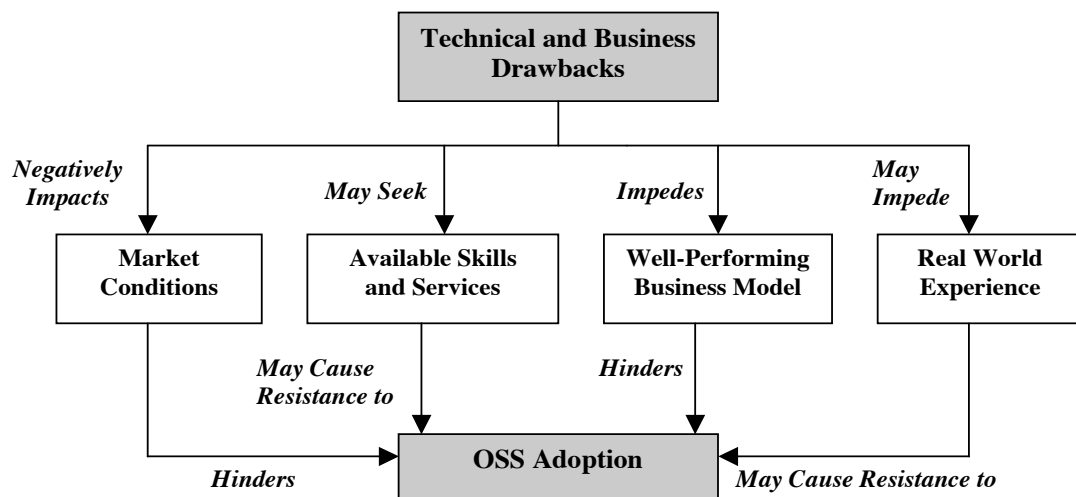


Figure 6: Impact of Drawbacks on OSS Adoption in the Environmental Context

Most of the managers believed that when adopting open source software, *market conditions* have to be considered. Again the technical and business benefits and drawbacks have a significant influence on market conditions because they can impact, positively or negatively, the way the business is conducted. According to the IT Manager at Sony Computer Entertainment, the reason behind adopting Linux for Playstation arose out of consumer demand for the product. In her words “they wanted this product, they wanted to be able to have Linux running on their machine and to be able to run OSS”. For the customers, the quality and flexibility of use of OSS was beneficial here. The Lead Engineer at Combitech reflected that if there is widespread adoption of open source, then this

would become of high strategic importance to the company. Interestingly, the IT Contracts Manager at BSS Group suggested that “it’s a bit of a ‘me too’ environment”. In other words, if one company has a very successful product, other companies will want to avail of it. He believed that because there is not a lot of companies doing a ‘me too’ in relation to OSS products, this hinders its adoption. This Manager also mentioned that there is a completely different mindset involved when buying open source products that are available in the market. In his words “there is a good chance of being sacked for ‘buying’ open source...is the way the mindset runs”. Similarly the Head of R&D at Conecta revealed that most companies tend to stay with the ‘tried and true’, resisting anything new.

The *availability of external support and services* in adopting OSS was mentioned by most of the managers as being extremely important, as certain business drawbacks such as the lack of user support and lack of ownership were of particular concern to them. This in turn encouraged some of the companies to seek out available skills and services. For example, both the CIO at St. Galler Tagblatt and the IT Contracts Manager at BSS Group considered vendor support contracts to be very important, especially at the start of the adoption phase. The availability of support services appeared to be more important to managers in the larger organisations such as St. Galler Tagblatt, Eircom and the BSS Group that have the budget to buy support. However, according to the Head of R&D at Conecta, for many companies it is difficult to find expertise - companies providing support in the way they do for commercial software. He pointed out that “it’s very easy, if you need to buy support for Microsoft Exchange, you simply go through the website and search. For OSS there is no easy way to find other companies providing support. There are too few, usually very small”. The IT Contracts Manager of the BSS Group pointed out that the marketplace is not bombarded with companies who specialise in installing open source software only because “it’s not commercially sensible. Most people want to promote the Microsoft world because it benefits their pocket ...you need lots of add-ons ...to keep it all in good order. So anybody that has got commercial add-ons wouldn’t go anywhere near the open source market because there is no money in it, because there is a low cost of acquisition and it doesn’t cost a lot to run so you can’t make any money in it”. Taking these views into consideration, it can therefore be said that while some the technical and business benefits of OSS, e.g. quality and low cost are attractive to many managers, these could be considered potential drawbacks for consultants if they were to deal only in OSS.

The issue of having a *well-performing business model* was also evident amongst those studied. According to the Technical Architecture Manager in Eircom, “the key thing is why should I be interested in doing it? What makes it better for me? And it’s nothing to do with open source per se. I mean proprietary can offer just the same thing but they’re just better at getting their message out, not necessarily having a better quality product”. Again, the fact that OSS is insufficiently marketed can be viewed as an impediment. For instance, the Technical Director at Supertramp believed that proprietary vendors do not want to see open source come to market because they feel it encroaches on their business model, so they ramp up their marketing efforts to try and stop this occurring. However, he believed that companies who are building businesses based around OS products utilising the service model will start to push things forward in the market more. The IT Manager at Sony also revealed that she did not think a company could have a successful business model, product based, with open source unless they were providing a good service using open source. It is evident that the availability of support and services are extremely important in order for a successful business model to transpire.

Most of the managers believed that senior management would like to see more *evidence of real world experiences* in terms of the benefits and drawbacks of OSS and case studies on successful and unsuccessful migration from proprietary software to OSS. It is apparent that real world experience from other companies that have adopted OSS can be perceived by senior management as a safety-net comfort factor. For example, the Lead Engineer at Combitech remarked that they would like to see more examples of companies that have successfully migrated from proprietary to

OSS because the success of others is always ‘good marketing’. Likewise the Technical Director at Supertramp reported that, at the time of the company’s migration to OSS, they would have liked to have seen more case studies of other companies that had ‘put their toe in the water first’. At the time of this company’s migration to OSS, there were no real reference files or case studies available so the Technical Director had to speak with some open source advocates. The fact that OSS is insufficiently marketed could be one drawback in terms of the availability of real world experience. However, the Head of Software Technology at Nokia believed that often companies are normally hesitant to talk about the failures they experience with OSS adoption.

### Individual Factors

In support of finding from the OGC Report (2002), Barnes (2003) and Glynn et al. (2005), it was found that individual factors such as presence of an OSS champion, skills obstacles and uncertainty impact adoption. Figures 7 and 8 outline how the benefits and drawbacks influence these factors.

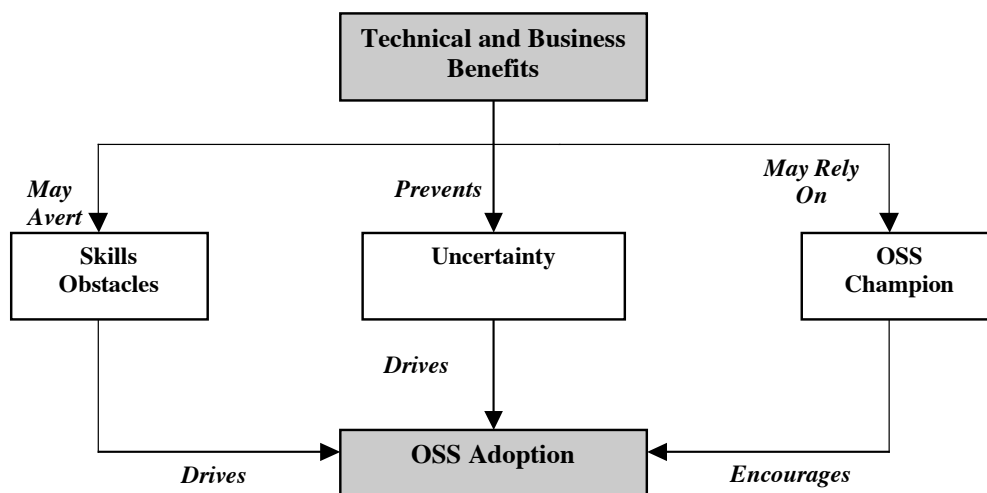


Figure 7: Impact of Benefits on OSS Adoption in the Individual Context

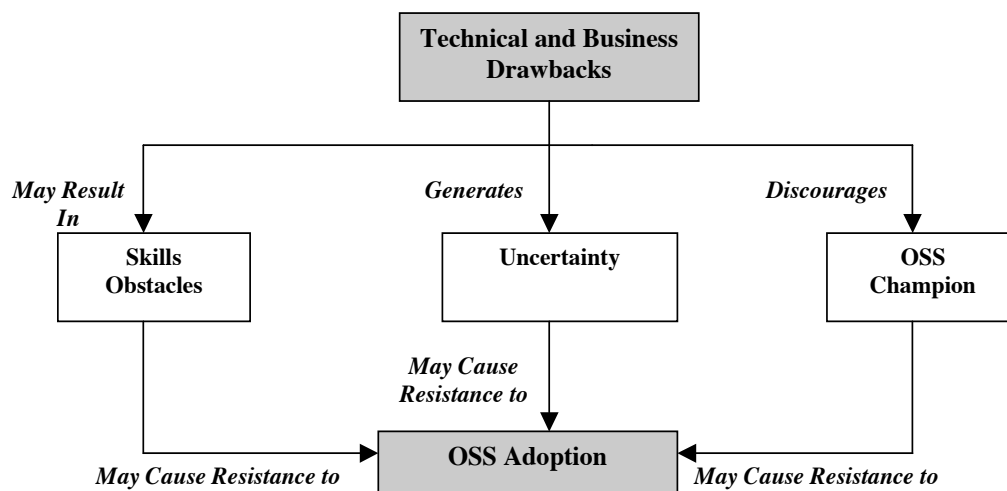


Figure 8: Impact of Drawbacks on OSS Adoption in the Individual Context

The analysis revealed that *skills obstacles* are an important factor to take into consideration when adopting OSS. The Lead Engineer at Combitech believed that there might be some resistance in the company if they were to replace Windows with Linux for instance. However, he added that this would be a learning curve and the benefits of open source might kick in. Similar beliefs were evident in Philips Medical Systems and Vodafone. However, for the companies that had adopted OSS, e.g. St. Galler Tagblatt and Supertramp, skills obstacles did not present too much of a barrier. As already mentioned, St. Galler Tagblatt had engaged the help of consultants. In addition many of the staff in several of the companies had experience in working with Unix so the switch over to Linux and open source was considered relatively straightforward. However, according to the IT Contracts Manager at the BSS Group, the end users were not aware that they were using an open source system because it was only used on servers and behind the scenes, so to them, they were working in a Microsoft environment. In the case of St. Galler Tagblatt, the CIO explained that employees were happy to move over to OSS because they got new systems, in terms of disc space, storage, hardware and servers. He also added that the employees had worked on several operating systems so the change did not bother them. For Supertramp, the Technical Director revealed that no resistance was encountered from staff because, at that stage, they were fed up with the reliability problems and issues that were happening in the company. According to him “there was this sense of if somebody could just fix this for us, we will embrace it and we don’t really care what it looks like”.

Issues related to *uncertainty* proved to be inhibiting factors in half of the companies studied. The R&D manager at Vodafone expressed some uncertainty about the whole issue of giving away the source code. Again, it can be suggested that the technical drawback associated with giving away the source code can generate uncertainty and negatively impact managers’ perception of the software. Thus companies might resist adopting OSS. In addition, managers in both Philips Medical Systems and Eurocontrol revealed that employees had doubts about OSS adoption. The Senior Researcher in Eurocontrol explained that because OSS is unknown, it is very likely staff will have the wrong idea about it and so there is fear. However, the Technical Director at Supertramp explained that proper leadership and motivation is important in preventing these feelings of uncertainty, otherwise one could have a “mutiny on their hands”. Similarly, the Consultant at Consult Comp. explained that there needs to be an awareness of what is actually being introduced and people need to know what the benefits are.

The findings revealed that the charisma and drive of an *OSS champion* was a significant factor influencing open source adoption in two companies, Supertramp and Conecta. For example, the Technical Director at Supertramp had the knowledge and awareness of OSS benefits that was critical in an initial conversation with top management of the business benefits of open source. In the other companies it was difficult to make a distinction between boundary spanners and project champions. However, it is obvious that OSS champions need to realise the benefits of OSS if they are to invest the time and effort needed for effective adoption. Such effort involves sustaining top management support in order to stimulate adoption.

## **5. SUMMARY**

Section I of this deliverable revealed that open innovation practices are already in operation in all of the companies studied, revealing the need to increase innovativeness by opening up internal software innovation processes. Interestingly, there were no significant differences between the perceptions of managers in companies with different levels of OSS adoption of the benefits and drawbacks of OSS. For example, the majority of managers believed that quality, security, flexibility of use and escape from vendor lock-in were significant benefits of OSS, while there was also some conformity in terms of the perceived drawbacks, e.g. lack of ownership, lack of support, OSS being insufficiently marketed. In addition, it was apparent that managers favoured technical

benefits such as quality over business benefits like low cost. Overall, the study has contributed to understanding the adoption of open innovation by systematically investigating the impact of managerial perceptions of the benefits and drawbacks of OSS on the adoption of an open source approach to software. The results are also useful in providing a better understanding of how perceptions impact adoption which may in turn lead to more informed managerial decision-making processes.

It is evident that the technical benefits of OSS (e.g. quality, flexibility, security) are perceived to outweigh the technical drawbacks (e.g. concerns with documentation, expertise), and that the business benefits (e.g. encouraging innovation/collaboration and escaping vendor lock-in) make OSS a very attractive option for businesses. However, it is also evident that there are still business drawbacks (insufficient marketing, support and ownership) that hinder adoption. Arguably, such drawbacks stem from the community-based peer-production processes that drive OSS development, and thus such concerns may prevail longer than previous concerns with technical expertise and documentation. However, this issue may be dealt with by (i) OSS proponents addressing such issues and (ii) organisations reconsidering the appropriateness of how they evaluate risk and control in relation to the adoption of open innovation. In calling for further research on OSS and open innovation adoption, it is acknowledged that this study focussed only on managers' perceptions of the benefits/drawbacks of adopting an OS strategy. Thus, future research should include a more integrated perspective, e.g. perceptions of developers, end-users etc.

## **6. LESSONS LEARNED AND RELEVANCE TO OPAALS COMMUNITY**

What have we learned so far? Well, this deliverable demonstrates that the dominant managerial perceptions of business and technical benefits are in keeping with the assessment of OSS as a form of open innovation. For example, greater collaboration and innovation are at the heart of open innovation in general. Thus, particular business benefits allowed by OSS, the most palpable ones being increased collaboration, escape from vendor lock-in and encouraging innovation, permit companies to team up with other companies, customers, universities, research institutes etc. to overcome certain adoption factors like technological complexity and facilitate product development. Even so, the dominant perceived drawbacks concern issues of reduced organisational control, increased risk and increased inter-organisational complexity associated with open innovation. Nevertheless, the study provides empirical support for theories associated with traditional (closed) adoption of innovation (i.e. Rogers, 2003; Tornatzky and Fleischer, 1990) in explaining the adoption of an open innovation strategy such as OSS. This suggests the applicability of such theories to the adoption of open innovation despite the organisational risks and complexity associated with open innovation. While this part of the deliverable has been extremely relevant to the OPAALS community in terms of explaining the benefits/drawbacks of adopting an OS strategy, the author felt that additional research should investigate the circumstances that motivate firms to even consider an open innovation strategy like OSS. After all, deciding to embrace and sustain an open innovation strategy like OSS will require managers to reconsider the key processes for value creation and capture in the company. Indeed it was felt that such an examination would greatly improve the OPAALS community and indeed the wider research community's understanding of OSS as a form of open innovation and also open innovation in general. Thus, part two of this deliverable concentrated on understanding some of the business models surrounding OSS, in particular how firms create and capture value with on open source approach to software.

## **SECTION II – VALUE CREATION AND VALUE CAPTURE IN OS BUSINESS MODELS**

### **1. INTRODUCTION**

As Chesbrough and Appleyard (2007) suggest, the very concept of OSS requires firms to rethink their strategy. The shift of focus from ownership to one of openness requires a reconsideration of the processes that facilitate value creation and value capture. Single-handedly, the emergence of OSS poses a puzzle for conceptions of organizational theory. Our traditional understanding of the organization has been that individuals organize their productive activities in two ways, either as employees in firms, following directions of managers or as individuals in markets responding to market signals (Coase, 1937). Open source software, however, does not rely on markets or traditional managerial hierarchies to organize production (Benkler, 2002). Like other forms of open innovation, OSS involves collaboration between firms, suppliers, customers and makers of related products to pool software R&D (West and Gallagher, 2006), something that has huge resonance within the OPAALS community. Furthermore, existing research is based on the experiences of IT firms based in the US despite Chesbrough and Crowther's (2006) assertion that open innovation practices are not limited to 'high-tech' sectors. Consequently, little is known about the circumstances that motivate decision-makers to embrace an open innovation strategy such as OSS and the characteristics of OSS that enable or hinder a firm's ability to create and capture value. Given the fact that 3/5 of OSS developers are in Europe and the region has a strong secondary software sector (FLOSS Report, 2006), section two of this deliverable concentrated on (a) investigating the reasons why companies in the European secondary software sector embrace OSS as a form of open innovation and (b) examining the characteristics of OSS that facilitate or prevent value creation and value capture. In the addition, the importance of a value network for successful value creation and capture is also explored.

### **2. LITERATURE REVIEW AND THEORETICAL FOUNDATION**

According to Agerfalk et al. (2005) the open source movement has pragmatically shifted the centre of gravity towards a more business-friendly and hybrid concept, and, in commercial settings, OSS is rapidly transforming into a viable alternative to proprietary software. Indeed this accommodation with the commercial mainstream may be a harbinger of an end to the current dominance of a proprietary, closed source software model (Fitzgerald, 2006). However, Chesbrough and Appleyard (2007) suggest that the very concept of open source software represents phenomena that require firms to rethink their strategy. The shifting of focus from ownership to the concept of openness requires a reconsideration of the processes that underlie value creation and value capture, and thus necessitate consideration of the issue at the level of a business model (cf. Chesbrough and Appleyard, 2007), although the consideration of such issues using value chain analysis (cf. Porter 1985), transaction cost economics (cf. Williamson, 1981), dynamic capabilities (cf. Teece et al., 1997) and the resource-based view of the firm (Barney, 1991) may also prove useful. However, such approaches are based upon ownership and control as the key levers in achieving strategic success (see Table 1.0). Consequently, all focus largely within the firm, or within the value chain in which the firm is embedded, and by doing so take no notice of the potential value of external resources that are not owned by the firm in question (Chesbrough and Appleyard, 2007). Chesbrough (2003a) asserts that firms need a business model to profit from innovation as a successful business model may offer more value to the customer or completely replace the old way of doing things (cf. Magretta, 2002). According to Osterwalder and Pigneur (2002, p. 2) a business model can be defined as "a description of the value a company offers to one or several segments of customers and the architecture of the firm and its network of partners for creating, marketing and delivering this value and relationship capital, in order to generate profitable and sustainable revenue



streams". For these researchers, a business model is "the missing link between strategy and business processes" (p. 3). Findings from studies carried out by West and Gallagher (2006) and West (2007) suggest that companies exploring new or disruptive technologies, like OSS, must often identify a new or adapted business model. Thus, the fundamental question for a firm's business model is 'how does the firm create value for the customer while simultaneously extracting some of the value for itself?' However, it has been found that the use of open source by firms generally begins in ways that does not disrupt their fundamental business model, or comes at a time when their existing business model is so threatened that they are forced then to make radical changes (West and Gallagher, 2006). On the whole, the comprehension of issues surrounding OSS business models appear inadequate. While researchers such as Rajala (2008), Onetti and Capobianco (2005), Krishnamurthy (2005), Koenig (2004) and Hecker (2000) have undertaken much research to refine and elaborate OSS business models, revenue generation has been the main focus for most of this research; neglecting other aspects of the business model such as the value component.

Prior research has identified three key elements of a business model: value creation, value capture and a value network (West, 2007, Chesbrough, 2006, Shafer, et al., 2005, Morris et al. 2005, Chesbrough and Rosenbloom, 2002 and Teece, 1986). Open innovation explicitly incorporates the business model as the source of both value creation and value capture. Value creation is a universal dimension found in recent conceptions of business models (West 2007), and necessitates identifying a relevant customer segment, the value proposition for those customers, and the ways in which the business model will provide that value (Chesbrough and Rosenbloom, 2002; Morris et al., 2005; Shafer et al., 2005). In West's (2007) study of OSS business models in IT vendor firms, business buyers were identified as the relevant customer segment, and lower costs and avoidance of vendor lock-in were identified as the key value propositions. In addition, as business buyers expect a richer "whole product" solution including integration, customization, integration, support and other services, OSS vendors had the opportunity to combine priced and unpriced complementary assets to create value (West, 2007). Complementary assets, also called complementarities (Amit and Zott 2001), are those assets (such as resources, capabilities, know-how, goods or services) that surround the successful commercialization of an innovation (Teece, 1986; Dodgson et al., 2008). However, the above definition of value creation contains some shortcomings in that it focuses largely on value created for the customer only. As Lepak et al. (2007) point out, it would be remiss to believe that the customer is the sole target of value creation as there are many other potential targets for value creation, e.g. employees, shareholders, wider society etc. Moran and Ghoshal (1996, p. ) also agree with this and suggest that "the more value a firm creates, the more likely it is to benefit from some of that value in the form of appropriable, if transient, rents. And what the innovator does not get in rents, society gets in progress". Lepak et al. also propose that various stakeholders will have different perspectives as to what is valuable and thus the value created will be evaluated in different ways. Hence, this research focuses on value created for all stakeholders in the process, i.e. the organization, customer, OSS community etc.

Value capture or value appropriation explains how a firm captures value from its value creation in order to sustain the business model (cf. West, 2007). Some of the key steps in formulating a value capture strategy are defining a revenue model; ensuring the cost structure is consistent with the customer's perception of value (Amit and Zott, 2001), and establishing durable external relationships between the firm and customers and third parties (Chesbrough and Rosenbloom, 2002). However, OSS has a lower formal appropriability than proprietary software because the source code is available for reuse and modification by competitors, complementors and customers. In answer to this, West (2007, p. 179) found that for firms utilizing OSS, "the business model depends on selling complementary goods or services to capture value, or leveraging tacit knowledge or other intangible sources of advantage over rivals". Helander and Laine (2006) also argue that in order to understand value creation and value capture in the context of OSS, value needs to be defined in non-monetary as well as monetary terms. The notion of other benefits besides

those of monetary value is important as money may not be the prime motivator. Instead, the capture of non-monetary benefits like access to high quality software, superior technical knowledge and human resources outside the firm may be considered just as significant.

Open innovation also both enables and builds on inter-organisational collaboration, often referred to as a value network (West and Gallagher, 2006) or ecosystem (Adner, 2006). Powell (1998) argues that, in times of changing and complex knowledge-bases the locus of innovation will be found in networks rather than in individual firms. According to Simard and West (2008), value networks are key conduits through which knowledge flows from the environment to the firm and vice versa. Laursen and Salter (2006:146) further argue that, “openness to external sources allows firms to draw in ideas from outsiders to deepen the pool of technological opportunities available to them”. Dahlander (2004) also proposes that in addition to inter-organisational relations, it is relations with users and developers that constitute the OSS community that is important for the firm. However, with the exception of West and Gallagher (2006) and West (2007), academic research on value creation, value capture and value networks in OS strategies is rather sparse. Furthermore, literature articulating the central characteristics of OSS that enable or hinder value creation and value capture is quite limited. Thus, section two of this deliverable attempts to address this gap by firstly investigating the circumstances that motivate European firms to embrace an open innovation strategy such as OSS. Secondly, it will identify the characteristics of OSS that enable or impede a firm’s business model to create and capture value.

### **3. RESEARCH OBJECTIVE AND METHOD**

The objective of section two was to (i) examine the circumstances that motivate decision makers in commercial firms to embrace an OSS strategy and (ii) identify the characteristics of OSS that enable or hinder value creation and value capture. Due to the relatively novel phenomena being examined and the scarcity of empirical work in the area, the study was categorised as exploratory and again, a field study was considered most appropriate. All thirteen companies that participated in part 1 of the deliverable were contacted again, with nine of them agreeing to partake in the study (see Table 7). Interviews were carried out in person or by telephone, were tape-recorded and each interview lasted between forty-five minutes and two hours. As needed, follow up questions were asked by phone or email. A copy of the transcript was sent to each of the interviewees afterwards for validation purposes. As with the first field study, content analysis was undertaken using the coding techniques proposed by Strauss and Corbin (1990).

### **4. FINDINGS**

#### **4.1 Circumstances that Motivate Decision-Makers to Embrace an OSS Strategy**

The study revealed that the circumstances that motivated decision makers to embrace or to consider embracing an OSS strategy varied. In the case of Supertramp, the Technical Director explained that prior to OSS adoption, booming sales meant their proprietary based IT systems were becoming overloaded and customer service was suffering as a result. He pointed out “the company’s problem was that its market share was growing and the business was growing so rapidly...the systems that we were using just were not going to scale and the scalability was what was required”. Microsoft, at the time, were bringing out a volume licensing programme which meant that the company was starting to feel the push towards being moved on to this upgrade path. As the Technical Director further explained “we were looking really at quite a significant budget, something in the region of about £15,000. This was quite an expense but we were also struggling with scalability and reliability issues and they were probably contracting more value from the business than just facing the licensing costs”. This finding tends to support those of West and Gallagher (2006) who

proposed that the use of OSS by firms comes at a time when their existing business model is so threatened that they are forced then to make radical changes. This was one of the things that drove the decision to adopt OSS in the company because they knew they “could go from 10 to 40 users without any more licensing costs, proprietary software costs and that the system would more than likely deliver it” (Technical Manager, Supertramp). Similar to Supertramp’s case, the CIO at St. Galler Tagblatt explained that the company was attracted to the enormous cost saving potential of OSS. Previous to OSS adoption, the company found the cost of software licensing and major hardware and software upgrades quite challenging. As part of an IT Strategy in 2003, the company decided to migrate the existing SAP software environment and third-party system maintenance applications to Linux while implementing MaxDB as a cost-effective alternative to their previous database system. As the CIO in the company explained “in this strategy we declared that we wanted to use Linux whenever possible and Windows when we had to. And we wanted the cheaper Unix but with the stability of Unix. And so SAP is running out of Linux since 2004 without any problems”.

Name	Business	Extent of OSS Adoption	Respondent	Organisation Size
Conecta, Italy	Consultancy	Predominant – service built on OSS	Head of R&D	10
Eircom Group PLC, Ireland	Telecommunications	Some use of OS products in Technical support, e.g. JBoss app. server, MySQL but quite limited adoption	Technical Architecture Mgr	7000
Eurocontrol Experimental Centre, France	Air Traffic Mgt	Limited to infrastructure; evaluating further use in air traffic mgt.	Senior Researcher	2700
Nokia Research Centre, Finland	Mobile Communications	Extensive use in telecommunications infrastructure and embedded applications	Head of Software Technology	1200
Phillips Medical Systems, Netherlands	Supplier of medical equipment & devices	Limited; involved in some OS projects; hope to increase level of adoption	International Project Leader	30000
Sony Computer Entertainment Europe, UK	Manufacturers & distributors of entertainment systems	Extensive use in servers, consumer products etc. – increasing levels of adoption	Technical Specialist	1000
St. Galler Tagblatt AG, Switzerland	Media	Extensive – entire SAP software environment	Chief Information Officer	650
Supertramp Ltd., UK	Manufacturing	Extensive (100% open source)	Tech. Director	50
Vodafone, Spain	Mobile Communications	None; collaborating with others to create Linux platform for mobiles	R&D Engineer Head of R&D	1250

*Table 7 Companies Studied*

For SCEE, the Technical Specialist explained that open source software was not at the core of their business plan or activities (which revolves around developing and releasing Playstations and Playstation games, and the sale of software). Rather the use of OSS in products arose out of consumer demand for the product (thousands of requests from open-source programmers who believed that this product could make a significant contribution). This finding is in line with Chesbrough’s (2006) suggestion that one business model that makes good business sense is to be very open with technologies that are not inputs to the core activities of the firm but still are complementary. For SCEE, it can be said that customer perceptions were the value drivers for this

company, thus one of their reasons for deciding to embrace OSS. As this Technical Specialist revealed “they wanted this product, they wanted to be able to have Linux running on the machine and to be able to run OSS”. However, it can also be suggested that the use of OSS by this firm began in such a way that would not interfere with their core business model, thus supporting findings from West and Gallagher (2006). This Technical Specialist further explained that the Linux kit was not really made as a significant revenue source for the firm but rather, “it was made with a sort of business plan that we would break even on it. What it would do is give people a chance to get familiar with our platform from a development point of view so that people who go into the industry to make PS2 software do a better job because they have had the chance, with little cost to themselves, to get familiar with our hardware. So it was more of an intellectual game than a financial one”. Similarly, the Head of R&D at Conecta explained that when they started out as a consulting company in 1995, they were not particularly oriented towards OSS. However, in the first few months, they received several requests for the creation of Internet nodes using OSS. Thus, the introduction of OSS in this company was mainly driven out of customer requests.

According to the Head of Software and Technology at Nokia Research Centre, there are two major efforts where the company has embraced OSS. One concerns the telecommunications infrastructure and products where Linux is used as one of the primary platforms and the other is Linux embedded applications. The Head of Software and Technology in this company pointed out that one of the main reasons for embracing OSS was top management’s desire to learn more about the software, i.e. where it could be used and how. Another reason was that the company favoured components that were developed by active communities and used by many. The Project Leader at Philips Medical Systems also revealed that while the company has limited adoption of OSS at present, it is inevitable that they will have OSS in their products in a few years because he viewed this as the only way to get all the software that the company needs.. Presently there are some bottom-up initiatives underway and the company is currently looking at the business values and problems of introducing OSS. For Vodafone, the R&D Engineer explained that while they have not yet adopted OSS, they are interested in it and see it as a new way of collaboration that will allow them to do more things from a technological point of view, e.g. develop a new operating system for mobile phones. The R&D department in this company has already begun projects in open source where they have established much contact with members of the open source community. Similarly, the Project Leader at Philips Medical Systems felt that adoption of OSS would facilitate cooperation and collaboration with an OSS community and enable distributed collaborative development over company borders. In addition, the senior researcher in Eurocontrol explained that while adoption of OSS is presently limited to infrastructure, they are currently researching the benefits of OSS for their core business which is air traffic management. He felt that adopting OSS in this domain would improve the harmonisation of practices and operations and also help improve quality

In contrast to the above, the Technical Architecture Manager at Eircom explained that there was no formal policy in the company around OSS adoption and that it “crept in by osmosis”. This manager felt that OSS was not a viable business approach per se and viewed it only as a development model. As he explained “it’s not a question of OS versus proprietary. We want to introduce better quality software to meet our needs. We wouldn’t really discriminate on the development model used and that’s all OSS is in our books, a development model which produces generally very high quality software”. He further explained that “you can stand over a proprietary solution, by and large, because you can see how well the company is funded and how much they’re spending on R&D and where they are bringing the product to and why, what’s driving them and you can see their profitability and so on. And you can understand that that’s a natural business model that we’re all aware of. You can’t see that in a lot of open source products so you don’t know where it’s going to end up”.

## 4.1 Value Creation

It was found in the study that there were many characteristics of OSS that facilitated value creation for the companies. For Supertramp, the business processes were the value drivers and thus, the focus on creating value was to improve the efficiencies of those business processes. Implementing OSS greatly enhanced the efficiency of their business processes, which in turn dramatically improved productivity and customer service. The lower costs associated with OSS was seen as very beneficial in this case. The Technical Director in the company explained that one of the advantages of implementing OSS was the ability ‘to utilise the flexibility of OSS and make it match the business process. And the low cost of it has meant that we could spend more of our budget on analysing the business model in the first place’. He further added that if the company had continued using proprietary systems, this would have resulted in more hardware and software upgrades which would have meant that their investment in staff and staff capability being quite significantly less than it is today. Similarly, the R&D Manager at Conecta explained that the total cost of ownership for their server solutions and found that the costs with OSS tend to be much lower. the CIO at St. Galler Tagblatt also revealed that the total cost of ownership for the company is dramatically lower than that of their previous proprietary Unix environment and calculated savings of €340,000 a year as a result from moving to Linux. The Technical Specialist at SCEE explained that the value creation in utilising OSS was ‘the fact that we can do some of the research using existing OSS tools, create some of the products based on OSS systems and run out support sites using OSS is an extra saving that we would lose otherwise’ (Technical Specialist, SCEE). By using OSS, the company could better afford an in-house team of website developers who were able to create the custom development that the company needed to increase the value of their services to developers. Therefore the quality of the product was better and produced in less time and with fewer resources than it would otherwise need.

According to West (2007) customers expect a richer whole product solution, e.g. integration, customisation and support. One mechanism for creating some value is the use of complementary assets (cf. Teece, 1986). The Technical Specialist at SCEE pointed out that the lower costs associated with OSS facilitated the creation of an infrastructure that encourages participation and collaboration between the company and their customers. The company provides support websites (all running on OS based software) that give support to their customers for PS2, PSP, and PS3. As the Technical Specialist explained “the whole support infrastructure that we have for developers working on games for those machines is based around our support infrastructure, our websites, our newsgroups, instant messaging services and those are all running on OS based software”. She further explained that the Linux for PS3 provides an option for third-party system software to be installed on the PS3 system instead of the system provided by SCEE, thus leveraging its value creation to customers. The R&D Manager at Conecta also explained that initially the value creation for the customer ‘was really a question of cost. Not so much the cost of licenses but the cost of the whole package, service and software and so on’. However, he revealed that after a few years the customer is also pleased with the flexibility they have to modify everything with little overhead. The Head of Software and Technology at Nokia Research Centre also pointed out that the company finds it beneficial to use OSS in some of their consumer products because in addition to saving time and money, it allows the company to shape their products according to market needs. The use of OSS in their product creates value to the customers as it offers them upgraded software, enhanced features as well as improved performance. For some of its products, Nokia releases the code to the open source community which enables both knowledge sharing and collaboration, in addition to creating value that is seen as beneficial to the community. In addition, the Head of Software and Technology at Nokia Research Centre considered the low cost of OSS extremely valuable as it allowed the company to share expenses with other companies that they had made joint ventures with, thus enabling more value creation in the company.

The quality, reliability, security and performance of OSS were also perceived by all of the companies as particularly important characteristics in facilitating value creation. For example, respondents pointed out that the quality of developers, the enhanced quality from peer reviews and the quality of OSS tools and software was superb, hence enabling their respective companies to create more value. The Technical Manager in Supertramp explained that by migrating to OSS, in addition to dramatic cost savings, the company “didn’t have any data corruption and all of a sudden we had all of our data in one place, both financial and customer relationship management. It really transformed the way the business process was”. In terms of the quality of OSS packages, the Technical Specialist at SCEE explained that they had a lot of examples where they were able to pick up something that was an already established and proven tool and a serious contender with other licensed software alternatives in the market. This in turn gave the company the ability to get a whole platform of functionality together by using software that had “been reviewed and used in anger by other people” (Technical Specialist, SCEE). Similarly, the Technical Director at Supertramp found the quality of support, available knowledge and willingness of the open source community quite remarkable and pointed out that he did not see that level of support availability from proprietary companies. However, while the Technical Architecture of Eircom viewed quality as one of the benefits of OSS, he also stated that this could only be applied to top-tier, mature open source products like Linux, Apache and MySQL. Similarly, the Head of Software and Technology at the Nokia Research Centre also agreed that some open source products like Linux have established themselves over the years but many of them are not as mature.

With regard to the reliability of OSS, the Technical Manager at Supertramp explained that “when they brought their enterprise resource planning system server down, which was running RedHat Linux, for a hardware upgrade, it had 1,011 days of time on it as it never had to be rebooted”. Also in relation to the stability and security of OSS it was found that in comparison to proprietary packages, there was no need to install anti-virus software on everything as there was no need for it. As the Head of Software and Technology at Nokia Research Centre explained “in terms of security, there are advantages because there are less viruses and worms and whatnot around compared to Windows”. The Technical Specialist at SCEE also pointed out that “we know people are able to see how the software works, what the back end is like and really we are quite big subscribers to not going for security through obscurity but security through proper methods”. In terms of performance the Technical Director for Supertramp explained that by switching from Windows to Samba, the performance capacity over the networks for file sharing greatly improved. He also found that their Linux server could handle 25-26 clients in comparison to 14-15 on Windows. Similarly, the CIO of St. Galler Tagblatt discovered that by implementing OSS, the batch jobs in their SAP environment were three to nine times faster than with Unix.

The Project Leader at Philips Medical Systems explained that presently, the company try to use as much commodity software as possible in their systems and concentrate their own resources on adding value. He pointed out that in this regard, they see OSS as a third option in leveraging the commodification effect. He further explained that pulling open source tools in the imaging systems environment would be useful because the company could use them to provide code for more platforms so that the risk of lock-in is reduced. The Head of R&D at Vodafone explained that the escape from vendor lock-in would be one of the reasons for embracing an open innovation strategy like OSS because he pointed out that, ‘every time we use a piece of software from another company, for every time that software is used, we have to pay them a certain amount of money. That’s killing our margin’. The Technical Director at Supertramp was also pleased with the sense of control in being able to change things as and when they wanted to without being forced to. As he explained, “one of the problems that you come across with a proprietary infrastructure is that your proprietary vendors tend to be putting their software and their systems on a release cycle and they tend to want to push you into continuing with updates and moving forward on a treadmill that suits them as the supplier”. The flexibility allowed by OS licences was viewed as quite significant in

creating value for the majority of the companies because it had a dramatic impact on reducing capital expenditure, in particular for the companies that had adopted OSS.

However, it became apparent that there are many characteristics of OSS that have the potential to impede value creation. For example, it was found that one of the biggest obstacles to value creation was the lack of ownership issue. One likes to know that if there is a problem, they can pick up the phone and this problem can be analysed and fixed. For example, the Project Leader at Philips Medical systems revealed that “if our developers cannot find the source of the problem, then it may take longer than they expected. The history of OSS tells differently but formally there is no one to go to...who is responsible for what is less unclear in an open source environment”. However, contrary to this, the Technical Director at Supertramp believed that “that’s a complete façade because if you look at any end user license agreement, the first thing that they do in an license agreement, proprietary or open source is waive all responsibility and warranty. So I think that that’s just the marketing spiel that we see in breeding fear, uncertainty and doubt”. The majority of the companies considered the lack of user support to be a real impediment to creating value. Some of the companies have teams of talented technicians that can cover the support risk internally. However, this is not always an option for many of the smaller organisations or very large organisations that have problems finding the right staff and competencies required to carry out this support. In addition, respondents in those companies that only have partial/non-adoption of OSS, i.e. Philips Medical Systems, Eurocontrol and Vodafone revealed that the lack of ownership and support issues surrounding OSS makes it difficult to convince others in the company to embrace OSS as they associate these drawbacks with increased risk and reduced organisational control. The Technical Manager at Eircom explained that to solve the ownership and support problem “we aligned ourselves with a third party support supplier...In other words we have shouldered the risk on to them. What that gives us though, in fairness, is expert support services from a competent supplier who is active in the open source community and familiar with those individual products and are in fact working with them on a daily basis in the context of their own product development”.

Other issues that had the potential to hinder value creation included compatibility issues and poor documentation. For example, the Technical Specialist at SCEE mentioned that compatibility of OSS with current tasks of developers was a concern as they sometimes were uncomfortable and unhappy with having to use OS based operating systems packages. The Technical Architecture Manager at Eircom also pointed out that there are often issues with the compatibility of OSS products with the current technology in the company. He pointed out that the company was like a brass clock and explained, “it has to run smoothly and it has to run in a predictable fashion. When you open up the brass clock, everything inside it must be compatible with one another...they must all be of an industrial strength. Also for a clock to be efficient, it needs to have the right number of parts in it...So when you look at the likes of open source, because you can acquire for free or very close to it...select a product and then download it and install it and so on, the issue that arises in here, for example, is that we end up with a lot of moving parts. More than we need and overlapping parts, competing parts, not the place to be”. In terms of poor documentation, the IT Specialist at SCEE explained that, “if you try and find a software package to access database or templating layer or whatever you are looking for, you’ll find a myriad of solutions that will claim to meet your needs and some of them will have died in development some time ago”.

## **4.2 Value Capture**

Various attributes of OSS also enabled the companies to capture value in different ways. For example, the Technical Manager in Supertramp explained that by migrating to OSS, in addition to dramatic cost savings, the company “didn’t have any data corruption and all of a sudden we had all of our data in one place, both financial and customer relationship management. It really transformed the way the business process was”. Because the migration to OSS was so successful,

the company decided to create a spinout company, i.e. the process of reaching external markets through external business ventures, with the explicit intention of providing reliable and effective IT solutions to other businesses. According to West (2007), firms have opportunities to release more value from their technologies by situating them outside the firm, but at the same time maintaining a corporate involvement. Focussing on an inside-out process by transferring ideas outside the company's boundaries had clear advantages for Supertramp in terms of both value creation and value capture as they were able to leverage their experience with OSS to meet a new customer requirement, thus opening up a whole new revenue stream. OSS had already proven itself in the company and many of its staff members were experienced technically with the software, thus reducing the risk of failure in this new venture.

For SCEE, the value capture in utilising OSS was 'the fact that we can do some of the research using existing OSS tools, create some of the products based on OSS systems and run out support sites using OSS is an extra saving that we would lose otherwise' (Technical Specialist, SCEE). By using OSS, the company could better afford an in-house team of website developers who were able to create the custom development that the company needed to increase the value of their services to developers. Therefore the quality of the product was better and produced in less time and with fewer resources that it would otherwise need. For this company, using OSS had a direct affect on their ability to acquire and retain a new customer segment, in addition to managing ongoing relationships with them. This Technical Manager also explained that the company captures superior technical knowledge and pointed out that "we have been able to find staff to bring on to the team who have had experience in some of the packages that we are using which is a great benefit". She further explained that the open platform created by the company for its PS3 product may lead to some interesting opportunities as well as aiding the technical development of people who join their industry in the future. For Nokia, the Head of Software and Technology explained that the company captures value as the use of OSS in their products saves time and increases the profits of sale through money saved on software components. Working as part of a community also provides the company with access to code and engineers outside of their own development team. It is evident that both SCEE and Nokia captured value by focussing on an outside-in process where external knowledge gained from customers and the OSS community was integrated in their product development etc.

The escape from vendor lock-in was also seen as an important trait of OSS that enables value capture. The Head of R&D at Vodafone explained that this would be one of the reasons for embracing an open innovation strategy like OSS because he pointed out that, 'every time we use a piece of software from another company, for every time that software is used, we have to pay them a certain amount of money. That's killing our margin'. The Technical Director at Supertramp was also pleased with the sense of control in being able to change things as and when they wanted to without being forced to. As he explained, "one of the problems that you come across with a proprietary infrastructure is that your proprietary vendors tend to be putting their software and their systems on a release cycle and they tend to want to push you into continuing with updates and moving forward on a treadmill that suits them as the supplier". The flexibility allowed by OS licences was viewed as quite significant in capturing value for the majority of the companies because it had a dramatic impact on reducing capital expenditure, in particular for the companies that had adopted OSS. The fact that OSS encourages innovation was also viewed as advantageous in capturing value as access to the source code produces more ideas and creates opportunities for more innovation and creativity. As the Technical Director of Supertramp explained 'it's very straightforward to be innovative when you have access to all the code..the ability to be able to think about what can be done in the business system.. now I can actually go deep into the core of my systems and I can make the systems do that because I can write into it. And that means we do innovate'. Again, all of the companies found the flexibility of use associated with OSS extremely beneficial in terms of value capture it facilitates changes and customization, allows for mixing and



matching of components used, facilitates experimentation and permits freedom of choice in new server hardware.

Yet again there were also some characteristics of OSS that were viewed as impediments to value capture. For example, three of the companies mentioned that the idea of giving away the source code might be perceived by others in their respective companies as a hurdle to capturing value. As the Head of R&D at Vodafone pointed out “you know if we were to share - it’s one asset for killing an idea... Somebody will have that great idea what that new thing is...that somebody could be inside Vodafone. Basically we should protect that and we cannot give that away”. According to the Project Leader at Philips Medical Systems, there are still many people in the company nervous about this issue but added that there are certain parts that can be given away without any problem. Difficulties in finding the right staff and developing the competencies to work with OSS was also seen as potential obstacle to capturing value. For example, the Head of Software & Technology at Nokia revealed that the company finds it difficult to locate top quality staff and competencies to work with OSS, particularly where the company is attempting to embed OSS into their products and technologies. He added that that for application development, there is no problem finding staff but for the type of work that the Nokia Research Centre is carrying out, the staff need to be well versed in OSS. Likewise, the Head of R&D at Vodafone explained that the ability to create and develop new competencies requires a different way of thinking because OSS will be new to them. Another impediment to capturing value was the lack of roadmaps associated with an OSS product and its lifecycle. For example, the Technical Infrastructure Manager at Eircom believed that it was difficult to see any strategic direction for the vast majority of the products that are available in OSS. He also added that most OSS products were built to either displace an existing product or to solve a particular problem and therefore, most of them had no strategic intent. This, he pointed out, could cause problems because as a team moves on to greater and more challenging technical projects, the product itself may not move one iota from where it currently is.

### **4.3 Importance of a Value Network**

The majority of the companies have established quite successful value networks that has enabled both value creation and value capture. These networks have been extremely beneficial in terms of the high levels of knowledge and know-how being communicated and the open, transparent process in which the interaction takes place. It can be further suggested that companies like Nokia Research Centre, SCEE and Supertramp have integrated elements of the coupling process, i.e. combination of an outside-in and inside-out process, which has been a key success factor for them. For example, the Head of Software and Technology at Nokia acknowledged the value in creating OSS in collaboration with others. As he explained “me and other companies have done quite a lot in trying to make joint ventures or joint exercises around open source....we made a joint effort to enhance Linux with some features that are important for the telecom infrastructure”. The company also works with communities to enhance components and develop them further. One such example is the Eclipse Foundation, an open source community whose members include IBM, Hewlett Packard, Intel etc. This consortium is focused on creating an ecosystem that enhances, promotes and cultivates an extensible development platform with complementary products, services and capabilities. Nokia plans to use the Eclipse tools platform widely in its tools portfolio and is comfortable cooperating with some of their competitors to further develop and drive adoption of this shared technology.

SCEE has built up quite a significant customer base of its Linux for Playstation products and in this way benefit from extensive suggestions and feedback that increases the value of their product. As the Technical Specialist explained “we get lots of feature requests that come in and a lot of quite significant add-ons that they want us to provide”. This Technical Specialist also explained that they had successfully collaborated with another company to produce their Linux for PS3 product. The Technical Manager at Supertramp also outlined how its spinout company has collaborated with

other companies to deliver state of the art technology systems. Similarly, Philips Medical Systems described how they have a number of collaborative projects with other firms and academic institutions. Presently the company is one of 19 partners, including Nokia and Siemens, in the Eureka ITEA programme that deals with OSS in a distributed development setting and is looking at business processes as well as technical processes. The R&D Engineer at Vodafone also felt that “OSS is a new way of collaboration between people”. The company has successfully collaborated with the Spanish Government who has funded them in their effort to develop a Linux mobile platform with other companies that include Motorola and Samsung.

## 5. SUMMARY

Section two of this deliverable examined the circumstances that have motivated companies to adopt OSS as part of an open innovation strategy in nine European firms, see Table 8. This examination used a business model framework as it represents the architectural / logical design that connects a firm’s strategy with its operational activities. Consequently, it can be considered a useful lens to examine how decision makers reconcile strategic directions on open innovation with the operational aspects of adopting a particular open innovation strategy such as OSS. Consistent with findings from West and Gallagher (2006), it was obvious from the study that the use of open source by several of the firms began in a way that would not disrupt their core business model, e.g. Sony Computer Entertainment Europe, or came at a time when their existing business model was under threat, they were forced to make radical changes, e.g. Supertramp. However, it was apparent that the decision to embrace open source software proved very beneficial for the companies that have implemented it.

<b>Factor</b>	<b>Description</b>
Low Cost	Attracted by cost saving potential of OSS in relation to licensing and hardware/software upgrades
Scalability/Quality	Embraced OSS because of scalability and reliability issues with proprietary based IT systems
Staff Development	Could invest more resources in staff training and development
Consumer Demand	Customers wanted OSS products running on their machines
Harmonisation	Improved harmonisation in interoperability and practices/operations
Desire of Top Management	Top management wanted to learn more about software, i.e. where it could be used and how
OSS Components	Preference for components developed by active communities
Reduced Risk of Lock-in	Could use open source tools to provide code for more platforms, thus reducing the risk of lock-in
New way of collaboration	OSS is viewed as a new way of collaboration with other companies, OSS community, government etc.

*Table 8 Circumstances that motivated firms to embrace an OSS strategy*

Interestingly, only half of the companies, particularly the smaller ones, viewed the low cost of OSS as an attractive option in adopting OSS. Rather, all of the companies felt that the technical benefits associated with OSS, i.e. quality of the software, were motivating factors in their decision to embrace OSS. In addition, the increased collaboration allowed by OSS also make it an attractive option for companies. Additionally, it was also found that there are many characteristics of OSS that enable a firm to create and capture value (see Table 9). For example, some defining characteristics that help achieve value creation include low cost, escape from vendor lock-in, quality, performance etc. while attributes such as access to code and human resources outside the firm, increased innovation and the flexibility of use allowed by OSS enable companies to capture value. It was also found that firms adopt or take interest in open innovation strategies like OSS in

order to facilitate and enhance their capacity to create and capture value to the customer. For example, Supertramp utilised the software to improve their business processes, thus creating value in the form of improved customer support. This finding also contributes to previous studies on OSS in the context of open innovation that generally tend to be predisposed towards product innovations and ignore innovations to improve processes or business efficiencies.

<b>Value Creation Processes</b>	<b><u>For Firm</u></b> <ul style="list-style-type: none"> <li>• Enhanced efficiency of business processes leading to improved quality and productivity</li> <li>• Commodification of software</li> <li>• Reduced susceptibility to viruses etc.</li> <li>• Ability to acquire new customer segments/meet customer requirements</li> <li>• Allows more investment in staff development/training</li> <li>• Saves time, reduces capital expenditure and increases profits</li> <li>• Escape from vendor lock-in</li> <li>• Lower TCO</li> <li>• Enables knowledge sharing/collaboration with communities, customers etc.</li> <li>• Facilitates joint ventures with other companies</li> </ul>	<b><u>For Customer/Community</u></b> <ul style="list-style-type: none"> <li>• Improved customer service/satisfaction</li> <li>• Enhanced software, upgraded features and improved performance for customer</li> <li>• Provision of complementary services to customer, e.g. support infrastructure, third-party system</li> <li>• Release of code to community increases participation/collaboration with company</li> </ul>
<b>Value Capture Processes</b>	Creation of spin-out company Captures superior technical knowledge Access to code and engineers creates more opportunities for innovation/creativity Flexibility of use permits freedom of choice, customisation, experimentation etc. Releasing code fuels adoption/innovation	
<b>Value Network</b>	Cooperation/collaboration with communities e.g. Eclipse Joint ventures with companies Collaboration with customers, government, academic institutions and other companies	

*Table 9 How Companies Create and Capture Value*

For several of the companies OSS was also a way of entering markets and acquiring new customers. Incorporating OSS into their products created value to the customers who believed the software could make a distinctive contribution. The value creation included commodification of products, delivery of enhanced products and improved performance, in addition to providing complementary assets to customers, e.g. support infrastructure. Deciding on an outside-in process has proved successful for companies like SCEE and Nokia Research Centre in terms of value capture. As well as saving time and money, non-monetary gains such as the technical knowledge captured was viewed as extremely beneficial for these companies. In addition, companies like Supertramp that choose an inside-out process as part of their open innovation strategy captured value through the creation of a spinout company. It was also quite obvious in the study that OSS is a compelling example of how companies can manage a value network to create and combine internal and external innovations. In this case, many of the companies have integrated elements of a coupled process. For example, companies like Nokia Research Centre and SCEE acknowledged the value in collaborating with other companies and OSS communities and felt there were many opportunities to be gained from a value network in terms of value creation and capture. Working as part of a value

network enabled several of the companies to capture value in the form of competencies and tacit knowledge that in turn created superior value to the customer. However, impediments such as those summarised in Table 10 have the potential to hinder both value creation and capture.

<b>Impediments to Value Creation</b>	<b>Description</b>
Lack of ownership	Inability to hold someone responsible or accountable for problems
Lack of support	No safety net as there is no support or company to back it up.
Poor documentation	Documentation outdated or may have died in development
Compatibility Issues	Compatibility problems with current technology, skills and tasks
<b>Impediments to Value Capture</b>	
Finding staff/competencies	Often difficult to find top quality staff and competencies to work with OSS
Lack of roadmaps with OSS products	Makes it difficult for companies to see any strategic direction with OSS
Access to source code	Some discomfort with releasing source code for products

*Table 10 Impediments to Value Creation and Value Capture*

## **6. LESSONS LEARNED, RELEVANCE TO OPAALS COMMUNITY AND FUTURE RESEARCH**

This deliverable has focused on applying the theoretical ideas of open innovation to better comprehend the value component of open source business models, which in turn has real implications for understanding digital ecosystems. Open innovation is a new phenomenon, thus this deliverable has been beneficial for the OPAALS community and the wider research community as the empirical findings revealed lead to a better understanding OSS business models, in particular how firms create and capture value. For example, it is evident that the decision to embrace an open innovation strategy such as OSS is most highly influenced by the potential to create and capture value within the firm. It is also apparent that the issue of external collaboration with value network members is critical to creating and capturing value with an open innovation strategy. Nevertheless, it appears that value network collaboration centres on collaborative design rather than collaborative decision-making on open innovation initiatives. This suggests that while firms seek to embrace open innovation strategies, they remain strongly influenced by the desire to remain self reliant; a characteristic of the closed innovation paradigm. Finally, this study has contributed to understanding the decision making process on the adoption of open innovation strategies by 1) examining the circumstances that motivate decision-makers to embrace an OSS strategy, 2) investigating the characteristics of OSS that enable or hinder value creation and value capture and 3) revealing the various ways in which value is created and captured. However, one important finding of this deliverable and something that has real implications for digital ecosystems, is the need for network-based activities for successful acceleration and exploitation of innovations. It is therefore timely for research that examines the appropriateness of extant approaches to adoption in light of (i) the differences in risk and control associated with open and closed innovation, and (ii) the role of an external network (e.g. partners, peer-production communities, IP intermediaries) in the adoption decision, something that will also be addressed in Phase III of the OPAALS project.

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