

Appropriating Returns From Open Innovation Processes: A Multiple Case Study of Small Firms in Open Source Software

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Abstract:

This paper addresses a largely neglected area within the growing literature on open source software (OSS) – namely how firms generate returns and how that changes over time. Firms exist and sell a variety of products and services related to OSS, even though the OSS community has used legal and normative mechanisms to avoid property right claims and commercial transactions. The paper draws upon an explorative multiple case study of six small firms in Sweden and Finland that try to commercialize OSS, with rich empirical evidence from various data sources. The cases illustrate how firms try a variety of approaches to generate adequate returns and that selling services seem to be the dominant trend. By being adaptive and change ways of generating returns over time, the firms tackle the rapidly changing environment and uncertainty of what works. Firm also balance the relative inefficiency of traditional means of intellectual property right such as patents by putting greater emphasis on first mover advantages and creating network externalities.

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Key words:

Appropriability regimes, appropriating returns, uncertainty, resource-based view, open source software

1. Introduction

Open source software (OSS) has gained an increased interest over the past few years, attracting scholars from sociology, psychology, economics and management. Fundamental question can be addressed such as to whether OSS is an effective way of organizing innovative activities, the intrinsic and extrinsic sources of motivation to take part in the development of a public good as well as the extent to which OSS can create an economic impact in de novo entrants and incumbents.

Prior research has analyzed the motivation for skilled programmers to freely take part in a privately produced public good (Hertel et al. 2003; Hars and Ou 2002; Lakhani et al. 2002) and some of the mechanisms by which communities work (von Krogh et al. 2003; O'Mahony 2002, 2003). Thereby, we know more about OSS from the perspective of developers as well as from the perspective of users. This paper addresses a largely neglected issue in the literature, namely the role that firms play within OSS. Some firms are to varying degree involved in OSS by releasing code freely to the community, founding of projects in firm established communities, supporting existing projects, governing projects and sometimes in the extreme case steal the code from communities and use it in proprietary software (Dahlander and Magnusson 2004). The OSS community has consciously used legal and normative mechanisms to ensure that the code remains free and publicly available (O'Mahony 2003) and as a result firms from intervening. Nonetheless, some firms do try to generate rents on OSS despite the lack of intellectual property rights.

Much of the earlier studies of innovations focus on that firms invest money into research and development (R&D) and do innovations in isolation (Freeman 1991) and thereby gain sufficient resources and knowledge to create products or services. These are distributed and sold to customers, and the firm can to varying degree appropriate the returns from the investment. It is sometimes argued, however, that in times of fast changing and complex knowledge-bases, the sources of expertise and the locus of innovation will be found in networks, rather than in individual firms (Powell et al. 1996; Gulati et al. 2000). This is also the case in OSS, but rather than being inter-organizational relations, it is relations with external individuals that contribute with code, bug-reports and in other ways follow the evolution of different projects that are of relevance for the firm. In that respect, the users and developers which constitutes the OSS community, which is important for the firm, is located outside the boundaries of the firm. As shown in the brief overview of OSS outlined in the next section, efforts have been made to ensure that the code remains open and freely available and that firms enter the scene and use the code in proprietary software. Firms attempting to appropriate returns from open source, therefore have to rely on new ways of appropriating rents, as the traditional one with closed code for a fixed cost is obsolete. This leads us to consider the strategies firms in OSS pursue over time to appropriate returns as the knowledge, services and products keeps developing over time.

Much strategy literature suggests that the firm's primarily purpose is to generate rents through creating and sustaining sources of competitive advantage (Barney 1986). The resource-based view of the firms emphasize that firms consist of a bundle of resources (Penrose 1959) and that these are critical for creating such an advantage. Knowledge has in particular been emphasized as important (Kogut and Zander 1996) for firm survival as well as performance. The firms' incentive to induce investments in

strategic innovation depends on the degree to which it is possible to protect the knowledge and thereby appropriate future rent streams (Liebeskind 1996; Teece 1986). In that respect, appropriation is considered a crucial issue (Shane and Venkataraman 2000) because it is a prerequisite for the firm to generate revenues and thereby survive.

Therefore, this paper aims to analyze how small firms commercialize and generate returns in OSS and whether that has changed over time. The question of how firms create revenues in OSS is far from obvious as it is hard to intellectually protect knowledge and developments occur at a rapid pace where innovation partly take place outside the boundaries of the firms. More specifically, the paper analyzes;

- 1) how the firms generate returns, and
- 2) underlying mechanism for change way of generating returns over time, as well as
- 3) the means of protecting knowledge that the firms use,

These three sub-questions are used to structure the results. This explorative study can improve our theoretical understanding of a neglected phenomenon. To do so it builds upon case studies of six OSS firms in Sweden and Finland that in various ways try to build a sustainable and profitable firm.

Section 2 gives a brief overview and history of the OSS phenomenon. Thereafter, Section 3 draws out the theoretical background in respect to the appropriation issues. The research design and methodological choices are explained in Section 4, whereas Section 5 outlines the empirical results. Section 6 discusses the findings in relation to the aim of the study and concludes. Section 7 briefly summarizes.

2. A brief history of OSS

OSS implies that the source code for a piece of software is made open and available for anyone to screen. One can briefly say that programmers write software in a source code and document it with explanations and clarifications of how it works. These lines of source code are compiled into binary form (machine instructions consisting of ones and zeros), which get the software to work on the computer. Binary code is much harder for developers to read and interpret, compared to the source code. Herein, is the difference between ‘open’ and ‘closed’ software, as OSS allows you to screen the source code, interpret, make changes and thereafter compile if needed. This is different from the proprietary way within the software industry where the source code among commercial vendors is protected by against modification by property rights as well as by their own code (Lessig 1999). In addition to that OSS is open and made public, the definition includes statements of the right to use and redistribute and that the license must not restrict other software and no discrimination against fields of endeavor (The Open Source Definition 2003).

The tensions between property right claims, the OSS community and firms can be seen in the history of OSS at universities and government laboratories in the US, where open code was the norm and as computers were expensive to buy. After a commercial firm changed the previously freely and openly available operative system UNIX to become proprietary software, Richard Stallman founded the GNU (recursive acronym for GNU’s Not UNIX) project in 1984. This was a reaction of the tension between the

advocates of open source and commercial firms that wanted to use the code in proprietary software. Stallman and others started the free software foundation (FSF) to ensure that the GNU-project remained publicly available and it was clearly stimulated by how the academia works with scientific research, peers that evaluate progress, and diffusion of ideas (Raymond CatB). The individuals within the free and open source movement have thus used legal and normative mechanisms to ensure that the code remained free and publicly available (O'Mahony 2003), and thereby hinder that firms make small changes in the software and sell it to a third party. It should be noted however, that the notion of "free" more refers to that the source should be accessible for everyone of liberty reasons and not to "gratis". These legal mechanisms include licenses which states how the software can be used and non-profit foundations that governs projects. The most commonly used license is the General Public License (GPL), but a multitude of different licenses exists that to a varying degree allows the user to fit the code after the purposes and commercialization of follow-on inventions (Lerner and Tirole 2002). The programmers of a new piece of software can decide which conditions that follower users and developers have to obey. Even though it is possible to create own licenses, the vast majority of the projects use of one the well established licenses. The GPL-license is very strict in terms of its requirement for asking developers to release the source code of derived work. Therefore there exist other licenses that are more designed to allow commercial interests. Many successful projects in OSS also have a non-profit foundation to which copyrights are assigned and govern the effort of the project with a more formal organization structure.

The software industry has evolved at a rapid pace to become one of the largest industries in the world economy (Campbell-Kelly 2003). After its birth at universities and government laboratories, the industry grew to attract a mass-market of consumers for business as well as recreational software. The software industry has been growing to be one of the largest industries in the world. This and the fact that OSS has diffused rapidly among users and developers in many niches has resulted in that many firms are interesting in how OSS evolves. Some well-known successful examples of OSS are in operating systems (GNU/Linux), web servers (Apache), programming languages (Perl), mail forwarding (Sendmail) and databases (MySQL).

3. Theoretical framework

The resource-based view argues that the firm consists of a bundle of resources (Penrose 1959; Wernerfelt 1984), such as assets, capabilities, information, knowledge etc (Barney 1991). Resources are commonly defined as the stock of available factors that the firm owns and controls (Amit and Schoemaker 1993). These resources take many forms; such as financial, human, technological, physical and organizational; and these resources are used to combine final products and services. To create a competitive advantage which can be fruitful for the company in order to create revenues, a number of important characteristics have been stressed as important. Grant (1991), among others, points out durability, transparency, transferability, replicability as the determinants of this advantage. Durability refers to the pace at which the firm's underlying resources depreciates or becomes obsolete, whereas transparency implies how fast other firm can imitate its strategy. Transferability is the degree to which imitation is possible ones a firm created an attractive position due to transfer of resources across its boundaries. Imperfect

transferability, avoids the threat of competitors buying resources to imitate the success. Replicability, on the other hand, refers to the process by which a firm can acquire resources by internal investments. Given these characteristics of when resources can gain a superior position, knowledge plays a critical role as it is hard to transfer, replicate and durable. Knowledge, therefore, is argued to be key for innovativeness and survival (Teece et al. 1997), and even as a foundation for the very existence of firms (Grant 1996; Spender 1996).

3.1. Appropriation and generating returns

In the resource-based literature, the primary objective for firms is to maximize the rents from the resources a firm possess over time (Barney 1991) and that possible ways of knowledge protection and thereby appropriate future rent streams, influence the firms' incentive to induce investments in strategic innovation (Liebeskind 1996). Appropriation therefore plays a crucial role in innovation studies as it creates economic value from innovations and new ideas (Levin et al. 1987). In fact, the term *invention* is sometimes used when an opportunity is discovered and *innovation* when it is commercialized and the returns are appropriated.

Firms can rely on different ways of going to the market and generate returns – by selling products or services. In both cases, firms have to heavily invest in building a market presence and reputation and in many industries with rapidly changing knowledge-bases, there is a great uncertainty of what works. Product companies also have to build up manufacturing plants, or cooperate with actors that have that resource.

This suggests that appropriation is a crucial issue that deserves attention among researchers.

3.2. Appropriability and means of protection

Appropriability is defined as the possibility the owner of a resource is to capture a return equal or more to the value created by that resource. The appropriability regime governs an innovator's ability capture the profits generated by an innovation (Teece 1986) and therefore influences the incentive for knowledge creation and innovation. Appropriability regime is related to the features of the core knowledge in the innovation and the possibilities of institutional protection. The appropriability regime is said to be 'weak' when the asset is hard to protect and 'tight' or 'strong' where it is relatively easy. These are not two extremes cases but rather the possibility to generate future rent streams range from 0 to 1. One can say that the closer to 0, the harder to generate revenues and vice versa. With weak appropriability regimes, profit margin will be driven to zero (Katz and Shapiro 1985; 1986) and in the absence of appropriability, firms have to rely on speed to market, timing and luck (Teece 1986).

Appropriating value from knowledge is more difficult than other resources because knowledge, unlike land and labor, is non-rivalrous in its usage and can be used by many people, without diminishing its productivity for any user. Expropriation, or illegal imitation, is therefore hard to detect (Liebeskind 1996) as knowledge is a social entity that resides in the head of humans. Societies have realized that technological progress is the primary engine of growth, and to encourage investments in private R&D intellectual property protection (IPR) have been created (Granstrand 1999). The legal system, however, can be ineffective depending on the type of innovation and the knowledge

involved. Patents and copyrights, do not always apply as good protection on intellectual property as they are costly and time-consuming to enforce. Empirical work in the US (Levin et al. 1987, Cohen et al. 1998) and Europe (Arundel et al. 1995) has shown that the effectiveness of patents as protection of knowledge differ across and even within industries. Innovation, however, takes place despite the weak institutional protection. Some firms rely on secrecy (Arundel 2001) or other means of generating returns from innovations. Following Teece (1986), an outstanding innovation is not a guarantee to successfully commercialization, but that this process requires complementary assets i.e. those assets that need to be used in conjunction with the knowledge about the innovation, such as distribution, service, manufacturing etc. By having access to these assets, the probability of successfully commercializing increases.

In some cases, network effects can be an advantage in those products and services where the benefit a user derives increases with number of other people using it (Katz and Shapiro 1985). New users are therefore influenced of what previous users have chosen, which causes a path-dependency (Arthur 1989; David 1985). Firms in such industries can therefore appropriate returns by building a large user base and create a lock-in. Related to this is the discussion about lead time and first-mover advantages. Lieberman and Montgomery (1988, 1998) argue that pioneering firms can gain a first-mover advantage by acquire superior resources and capabilities, by entering the market in an early phase. These firms gain access to distribution channels, gain reputation, linkages to other firms, which can create an advantage compared to later entrants.

This leads us to a deeper understanding of the complexity in terms of different ways of protecting knowledge. Firms can rely on several means of protection and that differs depending on the industry in which the firm is active in, as well as the specific situation of the firm.

4. Methodology

4.1. A multiple case study approach

Appropriation in OSS has rarely been analyzed previously in the literature and there is too little empirical work to understand the process, context, and specific phenomena. Under these circumstances, multiple case studies are fruitful (Eisenhardt 1989; Miles and Huberman 1984) to discover novel constructs and achieve theoretical advances.

Therefore the paper builds upon a multiple case study of six firms in Sweden and Finland that attempt to commercialize OSS and generate revenues. The firms are obviously operating in different contexts, which may affect the study in various ways. Based on a maximum variation logic to identify common patterns across the cases as well as differences (Miles and Huberman 1984), the cases were picked based on that they represent different ways of working with OSS, geographical location, history and background. There are currently no complete database existing on the number of firms in OSS in Sweden and Finland, so much effort was made in picking relevant firms through screening as many firms as possible. Given the magnitude of data collected of each firm, a reasonable number of cases had to be chosen to see patterns across the cases as well as differences.

4.2. Data collection and analysis

The study uses both quantitative as well as qualitative data sources in order to create a valid study (Eisenhardt 1989; Uzzi 1997) and allowing for triangulation of evidence. Therefore, several data collection approaches were used (Maxwell 1996) in two major steps. In the first step, secondary resources were gathered on all firms from annual reports, company directories, business and specialist press and homepages. Information about the firms was stored in separate directories. All information was used to get an idea of the competitive environment and the perception of outsiders. Moreover, a comprehensive study of mailing-lists, newsgroups and forums were used to analyze the firms' relations with developers and users in the OSS community. In the second step, semi-structured face-to-face interviews were carried out at the firms. Two pilot interviews were carried out with to learn how to use the interview manual and test the relevance of the questions and how to introduce the study. The interviews in the case studies lasted between 0,5-3 hours and included questions about from where the company get revenues and the rationale for changing that strategy over time and the underlying mechanisms. Because of the small size of the firm and the informal organization, it is impossible to mention one title that the respondent had. It was discussed with the firm who was most suitable to answer the questions. In most cases it was the founder and the CEO. After asked for permission, the interviews were recorded and transcribed within two days. In three cases, the respondent was reluctant to having the interviews taped and these interviews were instead documented through extensive and careful note-taking. A draft of the empirical results was sent to the respondents for them to comment upon and ensure that the technical details were interpreted correctly, which ensures construct validity (Yin 1984). This procedure was complemented with telephone conversations and correspondence via email if needed. Table 1 outlines a summary of the interviews and the general characteristics of the cases.

Table 1: Summary of the interviews

Name of firm	Geographical location	Number of employees 2003	Number of interviews
Firm A	Uppsala, Sweden	55	2
Firm B	Linköping, Sweden	12	4
Firm C	Linköping, Sweden	10	2
Firm D	Helsinki, Finland	30	3
Firm E	Gothenburg, Sweden	6	2
Firm F	Stockholm, Sweden	3	1

Table 1 shows that five of six firms in the sample are based in different locations in Sweden, whereas one firm is based in Helsinki, Finland.

The data was analyzed by first building individual case studies from the material focusing on relevant aspects such as the history of the firm, decisions making in relation to appropriation etc. Thereafter, the cases were compared and contrasted and the most important points in respect to the research question were analyzed in detail.

4.3. The firms in the sample

The firms studied here all serve different markets such as web-servers, thin-clients etc. using different approaches to appropriate returns. They are all relatively young and were

founded in the 1980: ies or later. The age therefore span between 1 to 16 years. The firms are small and the number of employees ranges from 4 to 58. The firms are owned by entrepreneurs and sometimes in combination with venture capitalists (VC). The firms act in a fast changing market so the financial situation changed in some cases after the end of the financial year 2002 reported in the annual reports. Firm D, for example, made a major change during the first 3 quarters of 2003 and became profitable.

Table 2: Overview of the firms

	Firm A	Firm B	Firm C	Firm D	Firm E	Firm F
Founded	1995	1992	1994	1991	2002	1987
Owners	Private, VC	Private, VC	Private, VC	Private, VC	Private	Private
Revenues 2002	5257	857	1217	946	N/A	171
Revenues 2001	514	2433	3301	N/A	N/A	371
Employees 2002	32	19	58	N/A	N/A	3
Employees 2001	12	39	58	N/A	N/A	3
Profits 2002	-1610	-106	-4715	-506	N/A	-30
Profits2001	-884	-372	-3385	N/A	N/A	5

Data from annual report and other secondary data. All numbers in 1000 €

The OSS firms are in their infancy and it is hard to do generalization about firms within OSS at large. As common in multiple case studies, generalization is made to theory, rather than to the population at large, and just as quantitative studies cannot explain all variance, qualitative studies have difficulties in reporting all the richness of the data. Nonetheless, they provide useful insight about how firms attempt to appropriate returns in OSS over time, and the underlying mechanisms for changing way of appropriating returns. This can be used as insights for further research and to develop more accurate hypothesis about the OSS phenomenon.

5. Results

The question of how firms generate returns in OSS despite all the mechanisms to keep them away is addressed in this part. More specifically, the following sub-questions were outlined as important to answer in the introduction;

- 1) how the firms generate returns, and
- 2) underlying mechanism for change way of generating returns over time, as well as
- 3) the means of protecting knowledge that the firms use,

Each of these questions will be analyzed in turn by highlighting the variety across the cases and summarize these into tables.

5.1. Generating returns

The case studies showed that different approaches can be used to create revenues within OSS, namely through - 1) consultancy, 2) education, 3) support, 4) licensing, and 5) black-box. Table 3 outlines the taxonomy used to categorize the companies in the study.

Table 3: Sources of generating revenues in OSS

Type	Explanation
Consultancy	Consultancy work based on an area of expertise, be it a product that the firm release or a community established project.
Education	Education based on an area of expertise, be it a product that the firm release or a community established project.
Support	Support based on an area of expertise, be it a product that the firm release or a community established project.
Licensing	Licensing the right to use the software i.e. adding a proprietary part to the open code or by allowing the customer to use the source code how they wish
Black-box	Bunching several pieces of OSS in a hardware solution

The firms can rely on one or more approaches to generate adequate returns to survive. Table 3 also illustrates current situation with respect to how the firms try to appropriate returns divided into the five possible ways of creating revenues. In the present situation, all firms sell consultancy hours to their customers. Education services are sold by three out of six firms. Licensing own products is used by two of the firms, whereas selling black-boxes (combining OSS with hardware) is used in one case. Interestingly, even within each category outline in Table 3, there is great variety in the approaches to appropriate returns. Each case will therefore be discussed in more detail, which is summarized in Table 5.

Firm A develops a database which is known world-wide for its technical features and usability. Even though a number of competitors exist, it has become world-wide known. It locates its head quarter in Uppsala Sweden and has several offices in other countries. The mission is to make superior data management available and affordable for all. Compared to its competitors it drastically cuts cost. According to a manager at the firm, it is a so called “second generation” open source company with a dual licensing strategy. The product is licensed under the GPL-license and a firm specific license that enables that customers are not forced to reveal its code as stated under the GPL-license. It is perceived as supporting open source values and methodology in a profitable, sustainable business. The database is downloaded approximately 35000 times a day, which makes it one of the most popular used databases. The company get its revenues from several sources. Online support and subscription services are sold at the website to all users of the product. Given the vast size of users and developers that use the product, that generates revenues among those that need on-going support and service. The support is divided to different niches, depending on the type of support you need and how frequently. Moreover, the firm also uses a franchising model, in which partners can use the brand and sell the product to others. The product has so many potential users, that the firm benefit from having an external sales organization that sells the product. Training programs and other means of education in relation to the product also generates revenues. In addition, the firm can help with customizing the product after the customers need i.e. sell consultancy hours. The firm organize fairs and meeting at many different places so education is sold all over the world.

Firm B was one of the earliest OSS firms in Sweden and is therefore well-known within the software industry in Sweden. Firm B develops products and services based on OSS. Most effort is being made on a thin-client product, but the company also offers different kinds of courses on OSS. The product is used to centralize applications through the use of server based computing and thin clients and the company also sells services to customize the product. One individual explained the current concept with “*We’re*

building a framework that makes different OSS modules work together. In that way we don't have to pay expensive licenses and have to increase the price of the product. The code is usually very good and has a long history that ensures stability. In the end, the price/performance ratio is crucial for us". The product is based on several different OSS modules from different OSS projects, which are bundled together in a closed proprietary framework. The modules are not closed, but the framework that makes them connect is proprietary. A person at the firm claims that this is the "*heart, brain and backbone of the system*" and is licensed to customers. The OSS modules have different licenses, which are described in the license agreement and are supported by Firm B as a part of the product. The firm therefore has to deal with the strategic issue of what is allowed according to the licenses in these modules. An additional security service that runs on the product for accessing files over a network is also merchandised.

Firm C set up one of the first company web pages ever in 1994. The company is famous for its web server, which is a full-featured open-source solution distributed under the GPL license. The web server has therefore a relatively long history, but has got fierce competition from other servers such as Apache, Microsoft and Netscape. The firm attempts to be unique towards its competitors by offering a web-based interface for configuration and administration that makes it simple to use. The web server however, does not generate revenues to the firm so they use a hybrid strategy in combining OSS with a more traditional way of making money. The rationale for giving away the product for free is the stiff competition from Apache that makes it hard to charge money for and extending the user base. The current focus is to make money on a Content Management System (CMS) that runs on the web server, which according to the company is easy to use and configure. So even though the web server is distributed under the GPL license, the CMS is proprietary software and sold with licenses. Thereby, the company tries to generate returns in combination with specialized services such as consulting with installing the software as well as education.

Firm D is a Finnish firm with offices in Estonia and Russia. It was founded in 1991 and is one of the most famous OSS firm in Finland. Firm D has experience working on projects of all sizes and of varying complexity. The company releases a Linux desktop, Linux server and office suit under the GPL-license, which can be downloaded from the community established by the firm. By giving away the product for free, Firm D attempts to build up recognition as knowledgeable and trustworthy partner and sell services to customers. The firm helps customers integrate OSS after their needs and building different types of solutions. The company is expert in the support and maintenance of GNU/Linux servers and desktop environments. The company also has the facilities to provide professional level training, technical support, remote services and complete data solutions". The company is thus relying totally on selling services.

Firm E is recently founded and combines "*hardware, software and services to deliver Linux based solutions for heavy calculations*". It is based in Gothenburg, next to a university and has a close connection with the academia and combines expertise in Linux with numerical calculations. By doing so, the company develops Linux clusters and sells computer power through internet by selling CPU hours. The project combines different OSS modules which are built together in a framework in order to build a Linux based solution for heavy calculations. The typical customer, is "*demanding high performing grid solution for technical and scientific computing*" claims a person at the company. The

system is built on open components and the firm develops a framework to make these components work together. Another kind of revenue source is selling hardware when they install Linux clusters. The managers at the company argue that even though the profit margin is low, it is a valuable as a complement to other revenue streams from selling services.

Firm F, is a firm based in Stockholm that was founded in 1987. Because it has focused on open system for a long period of time, it is well-known by people within the field despite its small size. The idea is to sell services and expertise in software engineering within OSS. To do so, the firm follows the evolution of different project and keeps up to date in their expertise, in order to be able to sell services. Moreover, the firm offers courses in a wide range of areas within OSS.

These cases reveal the details of how firms generate returns in OSS. Appropriation take place by developing businesses on packaging, support, service, by using complementary proprietary software to varying degrees, embedding it into hardware products etc. It has been shown how the cases in the present situation think about appropriation. It shows that a variety of approaches are used in the current situation and that most firms use more than one source of appropriation outlined in Table 4. Consultancy and other means of services seem to be the dominant trend.

5.2. Generating returns – changes over time

Table 5 illustrates that many of the firms have used a variety of methods of generating returns. The present situation differs from the historical how the firms have been doing previously in four of the six firms – namely Firm A, B, C and D. Firm E, however, is recently founded and has therefore a short history. That implies that only one firm has kept the same appropriation strategy over time. While the table illustrates how the appropriation has changed over time, the cases also show the mechanisms underlying that change.

Firm A has made a number of major changes in their ways to generate returns. The firm was founded by two persons that were influenced by the free software foundation. It was founded at a time where web servers increased rapidly and databases were expensive to buy, so the company's database rapidly became a large player competing with established database solutions such as Oracle and DB2 (IBM). In the web server segment, the database is probably the most common database used, whereas in other segments the larger competitors are stronger. Until two years ago, the company had one firm specific license that regulated whether a customer had to pay for using the database or not. After that Firm A decided to use a dual licensing strategy – the GPL license and a firm specific license. In that way, users are allowed to use the product under the ordinary GPL license, but if the customer does not want to make their own code available as stated in the GPL license, they can buy the other license. A person claimed that *“it was previously hard to tell whether you had to paid for our product or not. We felt that some were misusing our license and used it in ways we did not intend. They closed the code or packaged the database with other software so we had to change that”*. In that way the firm gets revenues from the specific license and can use the good part of OSS. Still, much of the revenues stems from other means of making business such as selling services and education around its product. A person claimed that *“Selling licenses stands for approximately 50% of our turnover. The rest originates from services related to*

customization of our product after the customers need as well as education around our database". Using multiple revenue sources is a strategy that has been used throughout the firm history. Another major shift has however taken place when the firm received a considerable amount of venture capital. The firm recruited a new external CEO and prioritized growth over profits. The parallel usage of two licenses is however perceived as being a viable way of appropriate adequate returns for the firm in the long run.

Firm B has tried a number of different ways of generating incomes throughout the years. One of the founder claimed that *"When I come to think about it, we have tried a number of different things without finding out what the demand really is. We have developed solutions without conscious planning earlier, but today our focus is much more customer oriented"*. The company had sold a firewall black box, but that was spun out to a separate firm after a joint venture with another firm. Selling services has also been a major revenue source throughout the history. In the beginning of 2003, the firm made a major change and started to focus on selling a product based on OSS. The company was near bankrupt and was forced to do a major change in order to get access to new capital. Forced by this fact, the leading persons within the group sat down and had a discussion about the future and possible ways of creating a new way of appropriating returns and ensure the survival of the firm. Different ideas were tested and evaluate, but after a seminar about a thin client solution in the beginning of 2002, Firm B decided to focus on that. The other ideas were put aside as they did not have enough of money to commercialize all ideas, and it took five months before the product was launched and the other ways of getting revenues have continuously decreased since then.

Firm C has also tried several means of appropriation throughout the history. Up until 1999, the company was influenced by technological spirit, rather than making a sustainable business. The people at Firm C developed a programming language called Pike, which a web server is built on. The people developed technological advances in product development which was the core of the company's focus. During 1999, the company focused on establishing itself in the international market and supplying the technological developments they had been working with in the form of completed products. External expertise in the areas of product development and international establishment was brought in and the old internet pioneers within the company got a less central role. An initiated person claimed that *"We have constantly moved away from the OSS concept towards a more traditional approach of selling proprietary software. We felt that something had to be done in order to survive"*. The initial idea of giving away the web server and get it further developed by the community and then being able to make money was perceived as having more disadvantages than advantages. Therefore a major shift took place, where the web server remained free and publicly available, whereas the firm tried to sell licenses of its content management system for the web server. Selling services was important before, but as the demand decreased as the focus was changed to the current strategy of selling licenses of its CMS.

Firm D has done several things after it was founded. Selling OSS services and solutions became the only business in the mid 90ies. In the first quarter 2000 the firm got an investment from an American venture capitalist. At that time, Linux distributions were considered to be a desirable way to grow and Firm D changed to that after discussions with the venture capitalist. The CEO explains that *"at that time the business models that venture capitalist was looking after publishing business. Printing carton boxes with Linux*

inside and selling them. We tried that in quite large scale and then discovered it's actually not a business. It would be a good business if you didn't have any R&D costs, but when you have R&D costs and you're doing a book publishing business then that is something that can't work. In general product development in open source base is something that is pretty hard to make it work. If you invest a lot and make some research and develop some nice new features – the day when you release the product everybody will have that also, freely in use. Then you can't compete and it's not sustainable". Selling distribution was harder than they thought. For every box they sold, they made a considerable loss. The CEO explained that *"We were doing the same thing what RedHat is doing now 1,5 years ago. Giving up the commercial development of their Linux distribution in exactly the same steps. Eventually, you have no other options because making pure open source products is not sustainable. Absolutely, not sustainable. Then mixing it with some close source will eat up good things because of bad will from community if stop closing some part of the product"*. So the firm changed the focus once again to selling services and solutions for customers primarily in Finland. After making considerable losses for years that they sold distributions, the firm is once again profitable. The Linux distribution remains within the company, but only as a marketing tool to spread the Firm D brand. The CEO argued that the key in OSS is that *"you have to be very good in what you do, and you have to maintain that position. That's the thing that matters. You can't be good in everything you have to somehow focus. For example, we are doing platforms. We are doing platforms for various applications and appliances systems. The operating system layer and integrating it to the customer's solutions. If you have some kind of network router and you want to have the full package and sell it as box, there is an operating system. We could be making an operating system layer there and then integrating it into the applications and making the hardware compatibility layer and then make some tools for configuring it. Maybe some update related mechanisms and maybe even installation if you sell it also as separate software, that's what we do. It's very focused"*. The CEO perceived it as extremely hard to create a sustainable business model by producing a Linux distribution and therefore drastically changed. The more focused strategy with selling services has so far been more successful. He argued that *"You can't create a sustainable competitive advantage by making new features or anything. The only advantage you can gain is by making services in a scalable way. The R&D must concentrate on developing processes, quality insurance, software engineering, methodology that fits to open source development models. In general you have to have a good process so that you can guarantee that the products will fit the need of customers. Perhaps know how to make it fast you have to have people who not what they're doing and are experts. That is basically what counts. Developing own open source products is simply crazy. That's why we have a community. The open source community is making the products, the suppliers and vendors, they take the products from the open source community and make them fit for the customers and also guarantee for support, maintenance and everything like that. I don't think that open source companies should deal with open source product development or R&D at all"*. Today, therefore, they focus the strategy on selling services.

The cases highlight how firm attempt to solve the problems of appropriation in OSS, and how the firms have been forced to change as one mode of appropriation did not work. It also illustrates the tendency of selling services, rather than products as they were

argued to be more profitable.

5.3. Means of protection in OSS

Table 4 shows the means by which firms can protect their knowledge. These factors were highlighted in the literature review and a brief explanation of how it can be used in OSS is drawn out in Table 5.

Table 4: Means of protection in OSS

Type	Explanation
Patents	Institutional protection in terms of temporary monopoly granted to novel, useful and non-obvious innovations
Copyrights	Institutional protection that grant creators exclusive right to reproduce, prepare derivative works, distribute, perform and display the work publicly
Secrecy	Keeping secrets within the firm, primarily by closing the code
First-mover advantages	Early entry to the market which can create advantages by acquire superior resources and capabilities
Network externalities	Getting a large user base that can contribute with code, bug-reports etc.

Firm A attempts to build up a large user base of its database product. By doing so it hopes to benefit from network externalities in the way that new users chose the product due to the possibility of extensive feedback from other users and rapid bug-reporting. Database competitors had very expensive products when the firm released its database, so it rapidly attracted users.

Firm B bundles OSS modules in a framework that make them connect. By closing parts of the software, they use a secrecy strategy. Attracting users to the product is therefore not used, as it is hard when the software is closed.

Firm C combines a secrecy and network externality approach. By giving away their web server for free they have throughout the history hoped to attract users and developers that can contribute with code and bug-reports. That strategy was less effective for the firm, as the competition in the web server segment was stiff. The main strategy today is to rely on secrecy by closing the software.

Firm D solely relies on benefiting from network externalities. By giving away the product for free, they attempt to get users and developers that can improve the product further. This in turn can build up their recognition among customers that are interested in buying services from them.

Firm E bundles OSS modules in a framework and package that in hardware. The framework is closed, so in that way a secrecy strategy is used.

Firm F does not have a product that they merchandise, but rather rely on keeping expertise within the company. As it is small and mainly consists of a founder and two skilled colleagues, expropriation is not a big problem.

The cases show that despite the weak institutional protection in OSS, there are other means of protection that the firms can rely on. The firms are not using patents and that is something that they are negative towards. Instead some of the firms rely on secrecy i.e. keeping valuable information and knowledge within the company to the degree possible or by closing parts of the software or keeping expertise within the boundary of the firm. Copyright is also frequently used among the firms that develop products, but it does not inhibit other users from screening the code, modifying and redistribute. Most importantly, therefore, is to create first-mover advantages and network externalities by attracting a

large user base and move down the learning curve.

Table 5: Summary of the cases

	Firm A	Firm B	Firm C	Firm D	Firm E	Firm F	
Current strategy:	A dual licensing strategy. One free under the GPL-license and one commercial non-GPL license. It sells services and training.	Bundles OSS modules under different licenses and build a system that makes them connect.	Releases a free web server and sell a content management system that runs on the server.	Use a free Linux distribution with an Office suite to build reputation and thereafter sell services.	Bundles OSS modules together with own code and sells installations as well as services.	Sell services and education in areas of expertise	
Means of protection:							Frequency:
Patents							(0/6)
Copyrights		X	X		X		(3/6)
Secrecy		X	X		X		(3/6)
First mover advantages	X			X			(2/6)
Network externalities	X (2/5)		X (3/5)	X (2/5)			(3/6)
		(2/5)			(2/5)	(0/5)	
Appropriating returns - Current situation:							
Consultancy	X	X	X	X	X	X	(6/6)
Education	X	X				X	(3/6)
Support	X						(1/6)
Licensing	X	X	X				(3/6)
Black-box					X (2/5)		(1/6)
	(4/5)	(3/5)	(2/5)	(1/5)		(2/5)	
Appropriating returns - Historically:							
Consultancy	X	X	X	X	X	X	(6/6)
Education	X	X		X		X	(4/6)
Support	X						
Licensing	X	X	X	X			(4/6)
Black-box		X (4/5)			X (3/5)		(2/6)
	(4/5)		(2/5)	(4/5)		(2/5)	

6. Discussion and conclusions

OSS is often compared with the phenomenon of open science with its peer review, critical examination and with recognition as an important source of motivation (Bezroukov 1999; Kogut and Meitu 2002). By focusing on this aspect of OSS, the discussion in the academia has paid less attention to the fact that firms are in fact trying to make a business out of OSS. Thereby, it fills in a gap in the literature by providing a case study of six small firms in Finland and Sweden countries that has been working with OSS, which can increase our understanding of the role of firms in OSS and what strategies they pursue to generate returns. The results are interesting in its own right, as the empirical data is novel, but a number of more abstract theoretical observations can be made on how to appropriate returns in innovation processes that are open in the sense that the firm boundaries are blurring.

6.1. Protecting knowledge in OSS

Despite the mechanisms to keep firms away and the problems of generating returns, relatively many de novo entrants have tried the possibilities to generate money on OSS. The paper has shown that the firms in this study are not successful in creating profits and that they all make considerable losses. Even though this can be partly explained by that entrepreneurs typically are overly optimistic of the new opportunity they attempt to exploit (Shane and Venkataraman 2000), appropriating returns in OSS is complicated. Knowledge is difficult to protect as expropriation and imitation is hard to detect. Even though patents are inefficient in some industries and under some circumstances, innovation is much larger than that which can be protected by patents (Mansfield 1986). In the software industry at large, patents has increased rapidly in both absolute as well as in relative numbers (Bessen and Hunt 2003) and advocates of software patents have argued that software patents increase research and development intensity and in turn innovativeness. Recent empirical work, however, shows that software patents are negatively correlated with R&D (Bessen and Hunt 2003), suggesting that patents in software decreases innovativeness. Possible explanations have been that primarily large firms at a modest cost can build patent portfolios of ‘cheap’ patents. The small firms which constitute the cases in this paper do not use software patents and are negative towards this trend. The rationale for that is that they utilize existing projects or rely on getting their product adopted among a large number of users. Moreover, in all firms except Firm C which moved away from the OSS concept, the founders and other key persons in the cases share the beliefs with the OSS community at large – namely that information wants to be free.

Traditional means of intellectual property rights such as patents are inefficient in OSS and the reason for that is two-fold. First, developers and users within the OSS community have interests over their work and thereby protect it by various legal mechanisms (O’Mahony 2003), and these pieces of software are regulated by licenses that do not allow the software to be closed by proprietary software. The firms have to cope with the conditions under which different licenses can be used. Second, many firms in OSS have interest in getting their products adopted among a large number of users and thereby benefit from having the product as open as possible to attract these users.

Following López and Roberts (2002), this probably depends on that firms use combinations of means of protection and thereby balance the relative inefficiency of one method by putting greater emphasis on alternative methods. This can explain why there exist firms in OSS despite the little institutional protection of knowledge since they rely on other means of ensure returns. Rather than using patents, firms in OSS that develops products rely on creating first-mover advantages and network externalities. By getting early into the market, the firms hopes to achieve an attractive position by attracting a OSS community around its product or finding a new way of benefiting from what the community has developed.

It is worth noting that with weak institutional protection diffusion might occur at a more rapid pace than with strong. As pointed out by Levin et al. (1987:788) "*unimpeded diffusion of existing technology is immediately beneficial not only for consumers but also for those who would improve that technology. Because technological advance is often an interactive, cumulative process, strong protection of individual achievements may slow the general advance*". So even though firms get less incentive to invest because of weak protection, the technology can advance rapidly which benefits users, but not individual firms. This seems to be applicable to OSS, where users benefit from diffusion, but where firms have difficulties in generating adequate returns.

6.2. Generating returns in OSS

Appropriating returns in OSS is different compared to many other industries since the OSS movement has used legal and normative mechanisms to ensure that the source remains free and publicly available. O'Mahony (2002; 2003) argues that contributors to community managed projects have interests and rights over their work, and that they are interested in protecting their intellectual property from proprietary appropriation. From the firm's perspective, this implies that they have to balance the possibility of generating returns, while still maintain a good relation to the community and obey to their rules and codex. The fact that it is harder to intellectually protect knowledge and other resources in OSS causes firms to rely on alternative ways of appropriating returns than solely selling ordinary products. Selling complements to free software may include proprietary software, services, systems, and packaged collections of software (Lerner and Tirole 2000). Selling proprietary software for a fixed cost is obsolete.

One of the main strengths with OSS is that it allows customization which can satisfy heterogeneity of demand (Franke and von Hippel 2003) which is a potential source of distinctive capabilities (Teece et al. 1997). Rather than buying a standard product which only can be modified to a certain extent, you buy a solution that can be modified after the customers' needs. This is the essence in OSS, and by customizing after the special requirements a firm can extract greater value from their customers (Arora et al. 2001). Given that, the firms in OSS attempts to commercialize part of that value and generate adequate returns by finding new ways of making money.

The simple taxonomy of possible ways to generate returns; namely consultancy, education, support, licensing, black-box; drawn out in the paper was used to illustrate the diversity of ways to appropriate returns that the firms use. The paper has shown that many firms rely on selling services around its product or another area of expertise. An important point here is that not all firms aim to benefit from a community around a project that the firm has developed. When using a more traditional service approach and

sell consultancy services, the firm rather chooses to acquire knowledge in some areas and sell their expertise to their customers. In that respect, choosing the projects that have the potential of being a standard is the crucial part. Other firms have products that they have developed and released to the community, in order to pace the technological development. These too, however, heavily rely on selling services. In one extreme, Firm D, the product is merely used to attract users and built up recognition and all revenues come from services. A firm can either choose to release the code developed inside the firm or attract a community that can pace the development with bug reports etc. or build up internal competences in existing projects that they thereafter can sell. Firms that have access to gatekeepers in important projects and access to communities have an advantage over its competitors. The knowledge and access to important gatekeepers do not necessarily have to be in firm established communities, but can emerge from experiences in other projects. The firms' intentions on capitalizing on the volunteer work of developers and the interests of the community might collide, resulting in conflicts and changed conditions. While improvements in the OSS are not appropriable, firms can indirectly benefit in a complementary proprietary segment. In the resource-based view, resources are often defined by the factors that the firm owns and controls (Amit and Schoemaker 1993), but in the OSS the knowledge the developers and users in the OSS community possess and develop is located outside the boundaries of the firms. The communities that develop OSS are important for several reasons. They can report bugs, develop code on the firms' products and they can develop community managed software without the interference of firms that are important for all firms in OSS.

The cases indicate that the firms balance the inefficiency of making money from ordinary products, by finding new innovative ways of appropriating returns. OSS firms can gain a firm gains a first-mover advantage versus its future competitors. In that respect, the firms can create a niche in which they believe that they can make money in the future. Given that the market allows the firms to capture *some* of the investments in research and development, this may be a valuable strategy in OSS. Other firms minimize investments in R&D but rather develop processes and routines to capitalize of what the OSS community develops.

6.3. Mechanisms for changing ways of generating returns over time in OSS

The problems of appropriate returns have caused the firms to change over time in four out of five firms with a history. One of the firms is recently founded, and has yet not made any major changes. An explanation for that is the great uncertainty of what a fruitful strategy of appropriating returns in OSS consists of. A common way of doing business does not exist within OSS today, so the firm seems to try different way by rapidly adapting when they realize that a strategy does not work. Early entrants can gain first-mover advantages by gaining capabilities of what works. Far from all early entrants succeed, but have the advantage of gaining experiences and knowledge and possibly get the firm to be adaptive and change. The uncertainty of how to appropriate adequate returns in OSS causes firms to change appropriation strategy over time as they get new knowledge and experiences. The cases indicate that uncertainty is a major factor influencing that the firm changes way of appropriating returns. As the firm gains new knowledge and experiences of what works, the strategy can change. Technological uncertainty is not a major factor influencing OSS, as its long history from governmental

labs and extensive user base ensures the stability. The open innovation process with testing across a wide number of users and developers pace the development and stability compared to traditional software development within the boundaries of the firm (Raymond 1999). However, the market uncertainty is great in terms of how to appropriate returns and what the customer is prepared to pay for. Uncertainty makes it difficult to estimate the future demand. Interviews at all firms have highlighted the mental lock-ins among potential customers as they are used to proprietary software.

The firms do not possess financial, physical or other valuable tangible assets that can be argued to be valuable in terms of the Grant's (1991) framework with durability, transparency, transferability, replicability. Compared to incumbents in the software industry, the relative position of the cases studies are weak. One can, however, question as to whether the resource-based view captures the blurring boundaries between firms and the OSS community. As mentioned previously, firms are in various ways depending on the community and a number of interactions take place (Dahlander and Magnusson 2004). Given that the firm can ensure access to projects by building a firm established community or build competences in critical projects, the firms can benefit from innovative activity that take place outside the firm.

7. Summary

This paper has analyzed how firms in OSS appropriate returns and how that evolves over time by providing a multiple case study of six firms that attempt to commercialize OSS in various ways. Many de novo entrants as well as incumbents have tried the possibility to generate returns with varying results. The firms try a variety of approaches to generate returns and forced by the appropriability issues and changing environment they change drastically over time. These firms face the challenge important resources to provide competitive products and services are located outside the boundary of the firm. It is therefore need for more research on how firms ensure access to projects in the community or create firm established communities. This, I would argue, is an important area for future research.

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