

Adoption of Open Source in the Software Industry

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Abstract. Is OSS undergoing a transformation to a more commercially viable form? We have performed a survey to investigate the adoption of OSS in the Norwegian software industry. The survey was based on an extensive screening of software companies, with more than 700 responses. Analysis shows that close to 50% of the software industry integrate OSS components into vertical solutions serving all major business sectors. In addition, more than 30% of the companies using OSS components have over 40% of their income from OSS related services or software. The adoption of OSS in the software industry may be a precursor of the OSS adoption in other business sectors.

1 Introduction

Open source software (OSS) is predicted to transform "into a more mainstream and commercially viable form" [4], where companies play an increasingly more important role. A premise for this transformation is increased commercial participation in the development of OSS products and increased use of OSS in vertical domains. However, only a few surveys provide empirical findings which support this assumed transformation, and most of these focus on the use of desktop tools and horizontal infrastructure like the LAMP stack. Is really OSS undergoing a transformation?

To answer this question we have performed a large scale survey in the Norwegian software industry. Our analysis shows that close to 50% of the software industry integrate OSS components into vertical solutions targeted at customers from all major business sectors. In addition, more than 30% of the companies using OSS components have over 40% of their income from OSS related services or software.

Our results show that the adoption of OSS in the Norwegian software industry is significant. The participation in the development of OSS is however limited. Nevertheless, it is reason to believe that OSS is actually undergoing a transformation into a more commercially viable form. The use of OSS in the software industry may eventually influence the rest of the market when software companies integrate OSS into their products. However, a lack of software companies adopting OSS may hamper the adoption of OSS in other sectors [15].

2 Related Work

Estimating the market share of OSS is a comprehensive task. Nevertheless, several attempts have been made e.g. [5, 6, 18]. Common to most of these is their focus on a few products like the LAMP stack and end-user applications like mail or office tools. One example is the Netcraft¹ survey of web servers on the Internet. While there have been made several attempt to estimate the adoption of OSS by consultant companies, we will rather focus on research published through academic channels.

Without providing any numbers, Glynn et al. conclude that OSS has had significant penetration in the software/consultancy and service/communication sector, but that it is more limited in the government/public sector [7]. Studies from the UK [17], Finland [15], and the USA [16] report only limited OSS adoption in the public sector with Linux as the only exception. Linux was used by more than 50% of the respondents in both the Finnish and the American study. Together with the other elements of the LAMP stack, Linux is quite frequently used in other sectors as well [6]. However, this adoption varies from country to country, on company size, and between sectors. For a mixed sample from industry and public sector, the *use or planned use* is reported to be as low as 17.7% in Sweden and as high as 43.7% in Germany [6]. Furthermore, numbers vary between about 10% and 75% for different strata [6]. A survey on Australia's top companies reports that 26% of the respondents used a varied specter of OSS products [8].

With the exception of Linux, Apache HTTP Server and perhaps a few others, most surveys report that less than 30% of the respondents have adopted OSS. Yet, little is said about the extent of this adoption. In studies focusing on the software sector, 50% of the companies in a Finnish sample use OSS in their internal development [13] and in a study on Off-the-Shelf development, 44 or 38.3% of the 115 projects use OSS components [11]. Without being able to provide any numbers representative for the whole population, an Italian study found that software companies using OSS commonly adapt or build on top of OSS products [2].

The transformation predicted by Fitzgerald involves company participation in the development of OSS products [4]. Companies are already known to be participating by allowing employees spend their time at work participating in OSS projects [10]. Companies are among others involved in 97 of the 300 most active SourceForge projects [1] and several companies in a Swedish survey actively contribute to OSS projects [12].

We see that companies and organizations have adopted OSS and that they are involved in the development of OSS. There are however only a limited number of empirical findings which show the extent of this adoption. This paper will provide results which quantifies the adoption of OSS in the software industry.

¹ <http://news.netcraft.com/>

3 Survey Method

The purpose of the study was to investigate *to what extent the Norwegian software industry approaches OSS development*. As an expansion of [9], we carried out a nationwide survey to investigate this matter.

3.1 Population: The Norwegian Software Industry

Legal entities in Norway are registered in The Norwegian Central Coordinating Register for Legal Entities² (CCRLE) with a *Nomenclature Generale des Activites Economiques dans L'Union Europee* (NACE) code. Based on 2005 data from CCRLE and other registers, Statistics Norway³ (SSB) reports that about 70 000 employees, or 4.7 % of all employees in Norway, are employed in the ICT sector [14]. In addition, the sector has a turnover of about €22 billion [14].

The ICT sector in Norway includes telecommunication (64.20), ICT manufacture industry (32.xx), ICT wholesale and retail trade (51.8x), and the soft- and hardware sector (72.xx). Based on CCRLE data from 2007, we found that approximately 26 000 legal entities and 38 500 employees constitute this sector, see Table 1. According to SSB only about 13 000 of these legal entities are active companies and about 1300 have five or more employees [14]. We will in this paper focus on the software sector (72.2x).

Table 1. The Norwegian 72.xx sector based on data from CCRLE 2007

Sub sector	NACE Entities	
Computer and related activities	72.00	26105
Hardware consultancy	72.10	251
Software consultancy and supply	72.20	21559
- Publishing of software (software houses)	72.21	1295
- Other software consultancy and supply (consultancy)	72.22	20264
Data processing	72.30	489
Database activities	72.40	2916
Maintenance & repair of office, accounting and comp. machinery	72.50	733
Other computer related activities	72.60	163

3.2 The Sampling Process

Data from CCRLE helped us constructing a close-to representative sample of software companies [3], with a focus on software (72.21) and consultancy (72.22) companies with more than five employees. However, the sample also included

² <http://www.brreg.no/>

³ <http://www.ssb.no/>

companies from the other 72.xx sub-sectors and companies with fewer than five employees. The purpose of the sampling process illustrated in Figure 1 was twofold. First, estimate the share of companies integrating OSS components into their products. Second, create a sample for our survey consisting of companies using OSS components.

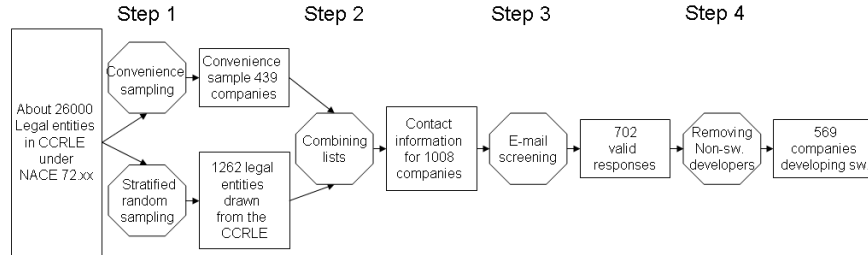


Fig. 1. The sampling process

Step 1: The sample was constructed based on a convenience sample, from earlier studies, of 439 companies and a stratified random sample of 1262 legal entities from CCRLE. The strata were defined according to the number of employees, the business organization form, and the 72.xx sub-sectors.

Step 2: Then, the two lists were merged. 300 duplicate entries were removed during this merger. Several companies occurred in both samples and some companies were registered with more than one legal entity, typically larger companies. We used data from CCRLE and Internet to find web-sites and email addresses for the companies. Another 395 or 31.3 % of the 1262 randomly selected legal entities were removed from the list because no contact information could be found. Knowing that only about 50% of the companies in the sector were active, this was not a surprise. The vast majority of these companies were small and most likely inactive companies. The final list contained contact information for 1008 companies from the Norwegian software industry.

Step 3: The screening process was carried out by sending the companies a brief request on email containing the questions below. About 200 of the companies from the convenience sample were contacted in March 2007 and the rest in June/July. One reminder was sent by email in September. The 200 companies contacted in March were only asked the first three questions while the remaining companies were asked all four questions.

1. How many employees do you have in Norway?
2. Are you doing software development in Norway?
3. Do you use open source components in your products or services (other than Linux, Apache HTTP Server, Eclipse, PHP/Perl, MySQL etc.)?
4. Do you participate in or run any open source projects?

38 of the 1008 email addresses did not work. However, we got 739 responses which is a response rate of 73.3%. 32 companies responded that their company was inactive or about to be dissolved, one company did not want to participate, and another four duplicate legal entities were found, leaving 702 or 69.6% valid responses. The response rates were similar across most of the different strata (size and sector). The names of the respondents and their email addresses were stored together with the other contact information.

Step 4: 569 or 81.1% of the 702 companies in our screening process confirmed that they perform software development. These companies make the basis for further analysis. The percentage of companies involved in software development is similar across different size and business types. However, when looking at sectors, the percentage varies from 73.6% (72.40 Database activities) to 90.2% (72.20 Publishing of software).

3.3 The Survey Process

Close to 50% of the 569 companies constituting our sample integrate OSS components into their products. 204 of these companies were invited to participate in a web survey. The survey contained three parts focusing on (1) development of commercial OSS products, (2) integration of OSS components into software products, and (3) demographic information.

To learn more about the companies and to increase the response rates, every second company ordered by size was contacted by phone. The companies were asked if they could participate and sent an email with instructions if they accepted our invitation. The other half was invited to participate through an email. One reminder was sent by email about a month later. 12 or 5.9% of the 204 companies could or did not want to participate. Six contact persons did not have time, three said their company's main focus was not software development or OSS development, one did not want to participate, one experienced a browser crash, and one respondent's company had not yet released its product as OSS. Nevertheless, 95 of the 204 companies or 46.6% completed the survey. Of these 95, 21 were only involved in software development without directly developing *software products*, for instance consultancy companies providing developers to external customers. This left 74 or 36.3% valid responses for the two main parts.

4 Results

Here, we present results from both the screening process and from the survey.

4.1 Selection and Integration of OSS Components

Out of the 569 companies constituting our sample, 266 or 46.9% integrate OSS components into their software solutions. This use goes beyond merely using

OSS operating systems, databases, infrastructure, development tools, and programming languages. The companies actually find, evaluate, and integrate OSS components into their software solutions. The integration of OSS components happens less frequently in software houses. Only 34.1% of the companies registered in sector 72.21 "Publishing of software" use OSS components in their software, see Figure 2.

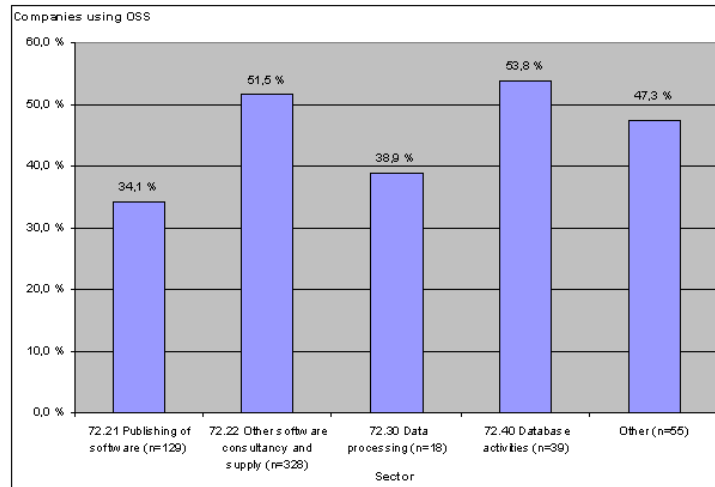


Fig. 2. The use of OSS components distributed over sectors

From Figure 3 we see large companies integrate OSS components into their products more often than smaller companies. 56.9% of the companies with more than 100 employees use OSS and 50.0% of the companies with 25 to 99 employees integrate OSS components into their products compared to around 43% of the companies with between 2 and 24 employees. Companies with one or less than one full time employee, use OSS components somewhat more frequently.

66 companies completed the second part of the survey about integration of OSS components. The products delivered by these companies *serve all main business sectors* with a small emphasis on the public and health sector. The functionality of these products was directed mainly towards web/portals and enterprise solutions. 40.9% of the products were classified as domain specific and 36.4% as differentiating end-user products. The effort spent developing these products during the last year, range from less than one (1) person-month to between 101 and 500 person-months.

4.2 Participation in OSS Projects

In total 368 of the 569 companies developing software responded to the fourth screening question. 60 or 16.3% of the respondents said that employees in their

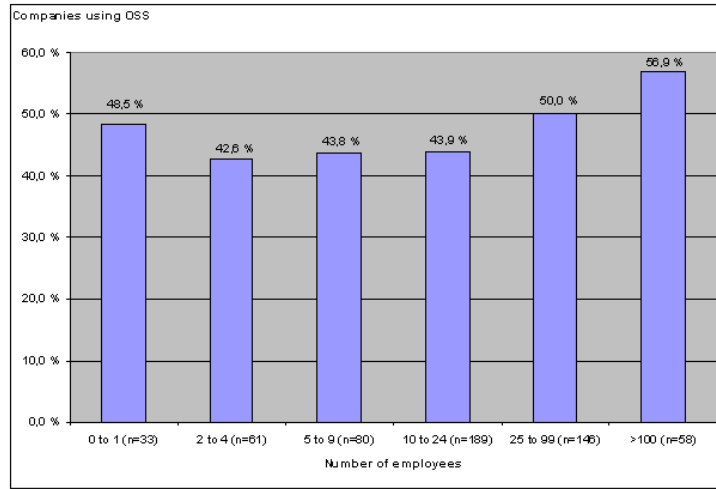


Fig. 3. The use of OSS components distributed over the number of employees

company participated in OSS projects. This participation was in some cases part of their job and in other more a hobby. Another 18 or 4.9% of the 368 companies said they have their own OSS project. However, through the researchers' previous experience with some of these companies we would say that the OSS projects are only an important part of the business for a few of them.

4.3 Income for OSS Related Activities

One question in Part 3 requested the respondent to estimate how much of the company's income comes from OSS related services or software development. Even though most of the 95 respondents answered less than 20% or "don't know", almost one third answered that more than 40% of their income comes from OSS related services or software, see Figure 4.

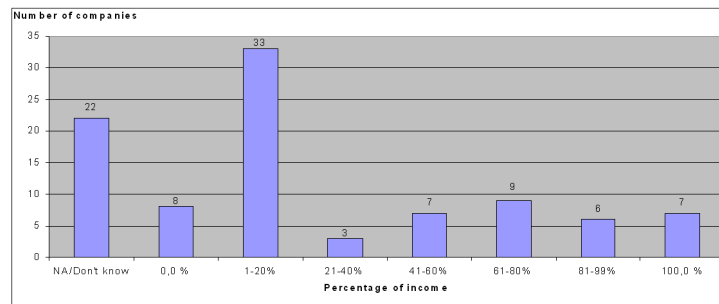


Fig. 4. Percentage of income generated by OSS related products and services

5 Discussion

5.1 Findings

The use of OSS in Norwegian software industry is significant. Close to 50% of the companies developing software have integrated OSS components into one or more of their products and more than 30% of the respondents get over 40% of their income from OSS related services or software. The use of OSS in software houses (72.21) living of the sales of software licenses is somewhat lower than in other software sectors. This could be caused by reciprocal OSS licenses (e.g. GPL) which requires derivate products to be released under the same license, thus removing the software houses profits from sales of licenses.

The products developed by the respondents served all major business sectors and 77.3% of them were classified as domain specific or differentiating end-user products. Thus, we can conclude that OSS is used in vertical products targeted at all business sectors.

We observed increasing OSS use in relation to increasing company size. However, Lundell et al. observed that companies with more than 250 employees seemed more conservative towards OSS adoption [12], Bonaccorsi et al. found that size does not favor OSS adoption [2], and Ghosh et al. found variations in the adoption of OSS over size, countries, and sectors [6].

Industrial participation in OSS projects seems limited with only 16% of the software developing companies confirming that they do participate in the development of one or more external OSS product.

5.2 Validity and Reliability

Generalization to other countries is made somewhat more difficult because of the variations found in other studies [6].

The participation in OSS projects is related to some uncertainty. First, 200 of the companies in the screening process were not asked whether they participated in any OSS projects. Second, there is some confusion about what participation is. Some companies answered "we do not participate but we report bug's and share occasional bug-fixes" while others answered "we do participate with some bug reports and bug fixes". We interpreted both these statements as participation.

The sampling process has an intentional bias towards companies with more than five employees. This bias was reinforced by the fact that we were unable to find contact information for several small and probably inactive companies. Having a web site is very common for active companies in Norway, especially for software companies. The majority of these companies without a web site are therefore most likely inactive. To aid the sampling we benefitted from CCRLE and the NACE sector codes. While this classification was of great help, the software industry is an industry with rapid and frequent changes. As

a consequence of these changes, central registers such as CCREL are not up-to-date at all times. For example, only about 90% of the companies under 72.20 "Publishing of software" actually develop software.

Response rates of 73.3% for the screening process and 36.3% valid responses in the main survey is decent compared to many other studies but low response rates is one of the challenges with survey research. Even though there is some room for improvement, we have been able to get responses from a large and close to representative sample of the Norwegian software industry. The research design is well documented and replicating the survey in another setting should be easy, though labor-intensive.

6 Conclusion

Results from our study show limited company involvement in the development of OSS products but widespread use of OSS components. By integrating OSS into vertical product serving all major business sectors, the software industry will contribute to wider adoption of OSS. Software companies have clearly started to adopt OSS products but the transformation of OSS into a commercially viable form is far from completed.

Future research should involve looking closer at the companies' actual involvement in OSS development. This involves investigating companies' integration of OSS components, their contributions to the development OSS projects, and how companies develop their own OSS software. We will also continue working with the data from the survey. However, due to variations observed in other studies, it is also important to verify our results with studies from other countries.

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