Free/Libre and Open Source Software:

Policy Support

FLOSSPOLS

Deliverable D10 (cover page)

Skills Survey Interim Report

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Free/Libre and Open Source Software: Policy Support

FLOSSPOLS Deliverable D10: Skills Survey Interim Report

Executive Summary

Part of the FLOSSPOLS project is understanding the skills development and employment generation potential of participation in Free/Libre/Open Source Software (FLOSS) communities. To this end, two exploratory surveys have been conducted, using web-based forms. The survey of developers was conducted using a sample of respondents to the FLOSS survey of 2002, and got a total of 361 respondents. The survey of employers has been conducted in English, French, Spanish and German, receiving 128 responses from 14 countries.

The analysis of the results of the FLOSSPOLS Developer and Employer Surveys at this stage is not sufficient to allow final conclusions on the potential of FLOSS developer communities as a skills development environment. However, interim results and conclusions appropriate to this interim report are presented.

Our hypothesis that the range of skills learnt through participation in the FLOSS community is not limited to pure technological skills is clearly confirmed. Furthermore, it appears that advanced technical skills are learnt in the FLOSS community even by participants *with* prior technical knowledge. A broad range of skills are perceived to be better learnt in the FLOSS community than in formal surroundings, which applies especially to the re-usage of code in the technical dimension and software and license issues in the legal dimension. A surprisingly large share of those who have experienced formal courses rate it poorly as a form of learning, in comparison with the more interactive forms of learning in the FLOSS community, such as “fixing bugs”. Employers agree with developers that for most technical skills, active FLOSS community participation is a better way of learning than formal courses.

Finally, FLOSS community participants – most of whom have experience in the job market – appear to believe that proven participation in development projects compensates for the lack of formal qualifications. The Employer survey indicates a widespread recognition of the value of FLOSS as a training environment across countries, industrial sectors (within the high IT-use sectors surveyed) and firm sizes. The value attached to FLOSS experience among prospective and current employees is closely related to the firms' awareness of FLOSS, and in particular, the degree of importance FLOSS has within the firms' businesses. This indicates that the trend of increasing awareness among firms of FLOSS is likely to result in increasing appreciation among employers of skills learnt by FLOSS community participants, as well as increasing recognition that these skills can compensate for the lack of formal degrees.

(signed, August 31, 2005)

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Free/Libre and Open Source Software: Policy Support

FLOSSPOLS

Skills Survey Interim Report

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Maastricht, August 2005

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Background: New forms of learning for the "knowledge society"

The growing potentials of information and communication technologies and new forms of firm and work organization are characteristics of the unfolding "knowledge society". This process is aligned with an acceleration of innovation and product cycles, which determines new requirements from people and institutions with regard to their capacities in education and knowledge creation. (Livingstone, 1999; David, 1998; Voß & Pongratz, 1998; Kirchhöfer, 2000, 12-39; Faust & Holm, 2001) The buzzword of "lifelong learning" (OECD, 1977; Livingstone, 1999) stresses the necessity of new leaning arrangements that consists more and more of informal, self-organized, and incidental (i.e. driven rather by situational personal interests and needs than by pre-defined curriculae of educational institutions or firms) forms of learning. (Keeton et al., 1976; Houle, 1976; Chickering, 1976; Coleman, 1976, 1995; Lave & Wenger, 1991; Watkins & Marsick, 1992; Cseh et al., 2000; Council of Europe, 2000; Dohmen, 2001; Overwien, 1999)

David & Foray (2002) describe this change as an overall shift from "learning to do" to "learning to learn". Given the potentials provided by the Internet, "communities of practice" (Brown & Duguid, 1991) especially Internet communities, are considered to be extremely successful in developing and deploying such new learning forms. The community of open source software developers often serves as the prime example when the capacities of such volatile network organizations are demonstrated. (Faust & Holm, 2001; Demil & Lecocq, 2003; Hemetsberger. & Reinhardt, 2004; von Hippel, 2002; David & Foray, 2002; von Krogh et al., 2003)

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In fact, the FLOSS developer survey in 2002 has revealed that this community is mainly driven by its members' individual wish to learn about the development of open source software and the co-operation within the community. (Ghosh et al., 2002; Ghosh et al., 2004) Thus, the open source community provides a suitable object for research on the mechanisms and structures that characterise the new forms of learning. Special attention must thereby be paid to the question which purposes the community's learning activities serve. The discussion on informal learning usually concentrates on its usability for employment opportunities on internal and external labour markets, and political strategies in the EU addressing lifelong learning adopted this perspective, as they mainly deal with the problem how informally attained skills and knowledge can be evaluated, compared, and made visible to personnel officers. (Europäische Kommission 1995, 2000, 2001, 2002, 2003, 2004; Europäisches Parlament und Europäischer Rat, 1995)

Another important social aim of the EU's policy towards lifelong learning postulates that informal learning must be acknowledged in all societal and economic areas in order to create a general learning culture and to motivate especially those who have unlearned to learn. (Europäische Kommission, 2001, 14)

1 Objectives and research questions

The present "interim report describes the surveys being conducted for the study of skills development and employment generation in the FLOSS community. It details the research questions, hypotheses and objectives for this study, but does not aim to provide conclusive results or proofs of the hypotheses. It provides mainly descriptive results from the two surveys that have been conducted. The focus of this paper is on the survey of developers, referred to from here on as the "FLOSSPOLS developer survey", of which selected findings are compared to results of the

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survey of employers (persons responsible for hiring IT staff at employers across the EU – the "FLOSSPOLS employer survey").

The objective of the FLOSSPOLS developer survey is to reveal how learning in the open source community is organised, which mechanisms and patterns can be observed, for which purposes members of the community learn, on which preconditions this way of learning depends, and how these learning efforts are evaluated by employers. Answers to these questions are intended to help adjusting European policies towards lifelong learning to individuals' and firms' needs and to improve the capacities for knowledge creation and innovation in Europe. The results of the FLOSSPOLS developer survey shall furthermore provide a valuable source of information for policy-makers who want to improve the usage of open source and free software, for people and organisations in the field of software-related vocational training, and for employers. Policy-makers will benefit from the FLOSSPOLS developer survey as they will get deeper insights in the strengths and weaknesses of the community, which is a vital precondition for the definition of political activities that aim at an improvement of the use of and benefits from open source and free software. Software-related vocational training will benefit from the results of the FLOSSPOLS developer survey as insights in the informal processes of learning in the FLOSS community will help to elucidate trends and objectives that cannot be observed in formal vocational training. Thus, the FLOSSPOLS developer survey is intended to help firms and educational institutions to find a good mix of formalized vocational training and informal learning, which is often claimed to be necessary in the software industry (Faust & Holm, 2001, 95-98). Finally, the FLOSSPOLS developer survey shall help to raise employers' attention and awareness of capacities and skills that are developed and improved in and through the FLOSS community, which may help to reduce search costs for personnel and improve the efficiency of software production in companies.

2 Hypotheses

We start with some findings from the FLOSS survey (Ghosh et al 2002): 78% of developers join the free software community "to learn and develop new skills"; 67% continue their participation to "share knowledge and skills". These learnt skills have economic value to developers – 30% participate in the free software community to "improve … job

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opportunities"; 30% derive income directly from this participation and a further 18% derive indirect income – such as getting a job unrelated to free software thanks to their previous or current participation in free software developer communities. One hypothesis, therefore, is that being a developer in an open source software project (e.g. the Linux kernel) may be better proof of certain levels of skills better than having a computer science degree, and employers may benefit from such informally learnt skills. 36% of organisations polled in the FLOSS User Survey (Wichmann 2002) "totally" or "somewhat" agree that employees can work on free software projects on employer time. These are not necessarily IT companies – 16% of low IT-intensity companies (e.g. retail, automobiles, tourism, construction) "totally" agreed with this point.

We suppose that FLOSS communities function like informal apprenticeships – but the apprentice/students and master/teachers contribute their own time "for free", without any monetary compensation for the training process. There is certainly a social cost, but it is borne voluntarily by the participants themselves and not paid for directly by those who benefit (such as current or future employers, or society at large). Everyone can benefit equally from this training – any employer can hire someone informally "trained" through participation in the free software developer community. However, not everyone invests equally in it. As many "teachers" may have been formally trained at university or at work, which is explicitly paid for, explicit costs are being borne for some proportion of community participants who have been formally trained. Therefore, it has been argued that the FLOSS community's "training system" makes it a novel form of technology transfer, from large firms to SMEs, and rich countries to the developing world (Ghosh 2003).

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The main hypotheses of the FLOSSPOLS Developer Survey concern the contents and organization of and the scope of societal and economic benefits from learning in the open source community.

1 What skills are learnt

Regarding the contents, it appears clear that members of the open source community are not only technically interested in developing software. As the FLOSS Developer Survey and many other studies show, there is also a mindset that plays a significant role for the understanding of the community and that fits very well in the evolving knowledge society: many members of the community are convinced that software (or: information) should be widely accessible, a public (or at least a commons) good and should not be controlled by only few companies. We therefore assume that besides the technological aspects of the community the formation of political opinions and the coordinated mobilization of group members belong also to the elements of learning in the open source community.

Furthermore, formal computer science courses provide limited scope for learning several classes of skills, such as managerial and teamwork skills and knowledge of copyright, patent and other legal issues. We suppose that FLOSS communities provide a wide exposure to discussion of legal issues, and practical experience of teamwork and management, thereby providing a better platform for learning such skills, that are considered of importance in the job market.

2 How skills are learnt

Regarding the organization of learning we have three hypotheses:

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It is a matter of fact that learning is usually considered to be a top-down knowledge transfer from the experienced "master" to the less experienced "novice" (disregarding intermediate states of experience), which heavily relies on the provision of codified and explicit knowledge. (Overwien, 1999; Staudt & Kley, 2001). However, the open source community is a volatile network of freely interacting individuals. It is therefore not likely that we will find stable relationships between "experienced" and "non-experienced" community members. Rather, we assume that a person joining the community has to find his or her way through it by own means and in an un-coordinated manner of "trial & error". Uncodified and implicit (tacit) knowledge that is deployed in order to interpret communications, project architectures, and software code will therefore be more important than the transfer of explicit knowledge.

Finally, we expect that some degree of knowledge may be a necessary precondition for personal progress after joining the community. This initial knowledge must be attained elsewhere, for example in the University, on the job, or through interactions with friends and / or relatives. Whether this aim can be achieved or not is highly dependent on personal preconditions that are aligned with active self-organization of learning. A study of the German Federal Institute on Vocational Training (Bundesinstitut für Berufsbildung - BiBB) revealed that members of online learning communities are usually expert users of the Internet, are usually employed in or otherwise related to the IT sector, and are typically strong autodidacts. (Zinke & Fogolin, 2004) The open source community is obviously less strongly associated with employment and work place issues than those communities scrutinized by the BiBB, but if these findings are confirmed in the open source community it appears rather unlikely that persons who have difficulties in motivating themselves to learn would find

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support in online communities. In contrast, we would like to argue that participating in new forms of learning in online communities depends on preconditions that rather reinforce the comparative advantages of those who already provide strong capacities in "learning to learn" and puts off those who have difficulties in learning on their own.

It has been assumed that the typical socialization in the community starts with observation (of communications on email-lists or open source forums, of source code), goes on with the provision of first bug-reports, before a person finally becomes a bug-fixer (Lakhani & von Hippel, 2003). However, this assumption addresses only the progress of technical skills, whereas we know that social aspects of the community play also an important role (see above). Moreover, the FLOSS developer survey showed that a small but vital part of the community consists of consultants or executives, which differ strongly from software engineers, programmers, and students with regard to their high degree of activity in software development projects. Although we assume that the described professional maturation actually occurs in the community, we think that there is a manifold of "educational careers" and that not all members start in the community with a low degree of knowledge and experience. To find out if and how community members with different degrees of prior knowledge and experience interact in order to create and secure knowledge transfers is one of the most intriguing questions of the FLOSSPOLS developer survey.

As described above, the discussion on informal learning and lifelong learning mainly addresses the benefits of these learning arrangements for employment and innovation. Material motivations - improved career opportunities and monetary concerns (for instance: Lerner & Tirole, 2002) – have indeed long been considered as the main driving forces of the open source community, which would go well in line with these expectations. However, as many studies showed, such

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motivations play only a secondary role compared to the overwhelming interest in learning and the philosophy of open source. (Ghosh et al., 2002; Ghosh et al., 2004; Lakhani & von Hippel,2003, Bonaccorsi & Rossi, 2003) Thus, it seems that there is more to self-organized informal learning in Internet communities than pure work- and career-related interests and that therefore the scope of economic and societal benefits from informal learning in the open source community is much broader. With this background and developing on our first hypothesis we thus expect the open source community to play a vital role for democracy and social inclusion in the emerging knowledge society.

While the economic benefits from the community have already attracted some scientific attention with regard to participants' motivation (Bonaccorsi & Rossi, 2001; Wichmann, 2002a, b; Lerner & Tirole, 2002b; Ghosh et al., 2004), most important questions concerning the actual impact of free software community participation on careers, labour markets, and organisations' employment policy remain open. For instance, we do not know how companies value this experience as compared to other (formal) qualifications, to what degree they actually look for people with this experience, and how they pay for such experience. We also do not know how and for which purposes people with experience in free software are employed. And on the level of the developers themselves, there is a distinction between developers who see themselves as free software professionals, directly earning a living based on their community participation, and those for whom free software is a skills developing environment that helps them get jobs, but does not contribute directly to their income, i.e. they do not work with free software in their jobs.

The hypotheses of the FLOSSPOLS employer survey relate to the scope to which free software developers are employed in firms in IT-intensive industries in Europe[1], how employers value open source and free software skills in comparison to formal skills, including differing employment conditions, if any. A further hypothesis would be that firms for whose business free software plays an important role are more likely to value skills learnt from developer community

[1] Principles of the sample selection are explained in the fourth section of this paper ("methodology").

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participation. More generally, we hypothesize that a greater awareness of free software technologies and development methods would lead to a greater appreciation by employers of skills learnt through developer community participation, regardless of the degree of importance of free software to the firms' own businesses.

We assume that while employers with a business interest in open source may prefer employees with open source experience, other employers do not pay much attention on whether a person is experienced in open source / free software. Rather, open source / free software experience may, at best, be seen as compensating for the lack of formal degrees.
However, if a firm follows a personnel policy that deliberately selects employees with experience in open source / free software, we expect that these employees are more valued than those who have no experience in open source/ free software. Thus, we expect experience in open source / free software to play a greater, determining role mainly in firms with an explicit personnel policy towards open source / free software.

3 Survey Methodology

The FLOSSPOLS developer survey takes up the results of the FLOSS developer survey in 2002, which has been replied by more than 2800 persons. It addresses 70% of the FLOSS survey respondents who have provided their email address in order to be contacted for further research projects, including those verified as participants in the developer community (Ghosh et al 2002b). These persons are asked to fill in a detailed online questionnaire on learning activities and context conditions of their involvement in the community, which will be suitable to answer our research questions and to test our

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hypotheses. The advantage of re-approaching the FLOSS-respondents is that the FLOSS survey provides already a large amount of socio-demographic characteristics and of experiences in and attitudes towards the community.

The methodology includes a pre-test of the questionnaire with about 25 community members in order to test our questions for comprehensibility and appropriateness and to test reliability and validity of our results. There were 361 responses to the FLOSSPOLS Developer Survey. The rest of this paper is based on these responses.

The FLOSSPOLS Employer Survey is targeted at HR managers and CEOs of companies drawn from databases of companies in EU countries.[2] It includes questions that mirror those from the developer survey, to identify the employer perspective of the skills learnt by participants in the developer community. The FLOSSPOLS employer survey was sent by e-mail (with a link to an online questionnaire) to 1722 firms in Belgium, France, Germany, Spain and the UK in French, German, Spanish, English and Dutch[3], drawn from contact databases. They received up to 3 reminders. It was also distributed through industry organisations and SME associations in other countries (including CEAPME, a Europe-wide SME association). A total of 128 responses were received from 14 countries, reflecting a 7.4% share of the total contacts made. As there was no pre-selection made to identify a sample of firms willing to respond, this figure cannot be compared to typical response rates of surveys of firms (10-15% of a pre-selected sample). As around a third of firms randomly

[2] The selection of firms for the employer survey sample was determined by their participation in IT-intensive industries, as identified by the share of IT-spending as a percentage of revenue (META Group and Rubin 2001, and Wichmann 2002a. In addition, we attempted to ensure that we survey large companies as well as SMEs and that we cover open source/free software-related firms as well as firms outside this community. As an exploratory survey, we did not attempt country representation; nevertheless, the translation of the questionnaire into German, French and Spanish, in addition to English, resulted in broad EU-wide coverage with a concentration in high IT-spend countries (France, Germany, UK).

[3] Only the explanatory letter was sent in Dutch to Flemish contacts; they were provided the questionnaire in French or English

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contacted are willing to respond to any survey, the share of respondents to all contacts made is typically well below 10%, in line with our results. The data of the employer survey are not described in detail in this paper,[4] we will refer to them mainly where a direct comparison to the perceptions of the developers appears to be useful.

4 Findings from the FLOSSPOLS Surveys

4.1 Characteristics of FLOSS developers in the FLOSSPOLS sample

Since the approach to contact the respondents of the FLOSS developer survey 2002 (see Ghosh et al., 2002) again for the FLOSSOLS survey intended to cover a group of well-experienced developers which belong to the community for a long time it is evident that the average period of time the 361 respondents belong to the FLOSS community is quite long, with a mean of 8.7 years (and a standard deviation of 4 years). The average age (mean) is 31 years, with a standard deviation of 7 years. Except for one person all 361 respondents earn either directly or indirectly monetary rewards from their FLOSS activities. The vast majority of the respondents (68 per cent) is employed, 4 per cent are unemployed, 13 per cent are students, and 15 per cent are self-employed. The FLOSSPOLS developer sample provides thus a good representation of different economic status levels. Software engineers provide by far the largest professional group of the respondents (43 per cent), followed by system administrators (13 per cent) and executives (managers, department heads, 10 per cent). Besides these groups only programmers (9 per cent), researchers (8 per cent) and the residual category of other professions (7%) reach appreciable shares of respondents, whereas the shares of network and database administrators as well as creative professions (designers, illustrators, graphic

[4] As this deliverable is an interim report; the final report will contain further details.

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artists) remain below 3 per cent. Three quarters of the respondents provide a university degree, another 13 per cent a high-school degree. The share of female respondents is only 1.7 per cent.

4.2 Characteristics of employers in the FLOSSPOLS sample

Overall the responding firms are located in fourteen different countries, but the sample is concentrated in five countries, which we assume to be due to the different levels of support provided by industrial or SME-associations to the survey. The strongest response came from Germany (36% of the sample), and France (26%), followed by the UK (16%), Spain (8%), and Belgium (6%). The shares of responses from the other countries (Denmark, Finland, Iceland, Latvia, Poland, Portugal, Switzerland and the USA[5]) do not exceed 2% individually and add up to a total share of roughly 9%.

The large majority of the respondents (55%) belong to the software industry. 19% to business services (i.e. Including consultancies), 5% belong to the educational sector, 3% to the communication industry, and 18% belong to other industries. The size structure of the companies in the sample is dominated by SMEs. Almost one quarter employs only one to five employees, another 16% employ six to ten employees, and 18% employ 11 to 30 employees. Another 11% employ 31 to 100 employees, 13% employ 101-250 employees, and 18% employ more than 250 employees (of which 12% employ more than 1000 employees). The sample provides thus good profiles for different industries and size classes of companies.

Due to the topic of the FLOSSPOLS survey the sample is dominated by companies that use FLOSS, which applies to 80% of the respondents. More than two thirds of the companies that participated in the survey say that FLOSS plays a very important (33%) or important role (38%) for them, 18% said FLOSS is hardly important and another 9% said that FLOSS is not important at all for them. 3% did not know how to assess the role of FLOSS in their company. 84% of the respondents were aware

[5] This refers to one case of the sample. Though we did not contact US companies, it turned out that in this specific case our request to a UK-company was obviously forwarded to the US parent company. Since the answers of this company to the questions in the questionnaire do not differ significantly from the answers given by the European companies, we decided to keep this case in the sample.

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whether they have employees with FLOSS experiences in their company. 69% of the respondents reported that there are positions in their company that require FLOSS experiences, of which 41% qualified these positions as leadership positions. The likely overrepresentation of FLOSS users among respondent firms was expected and does not negatively affect the analysis of the responses for the purposes of the FLOSSPOLS study, which examines differences between users and non-users rather than shares of the total population.

4.3 Activities of FLOSS developers in the community

The FLOSS community is often described and perceived as a community of software developers. However, it is evident that the activities within the community are not only limited to software development, i.e. to actually coding software. There are people required to translate software and texts, to organise events, and there are a lot of political activities that are clearly not covered by the term software development. Thus, one intention of the the FLOSSPOLS developer survey was to find out which role these activities play and how they are related to each other.

As shown in Figure 1, activities that are most often performed within the FLOSS community are only indirectly related to coding software: convincing people to migrate towards FLOSS; reading questions and answers, and raising public awareness for FLOSS. However, directly software-related activities (writing code / fixing bugs / providing patches; testing software; reading bug-reports / release reports) provide the second most important group in terms of frequency. Beyond that, a good part of the activities in the community consists of passive observation. Translating texts, providing creative elements, organising workshops etc., documenting software, providing ideas for projects, translating software or documentation, participating in technical workshops etc., providing tutorials and HOWTOs and answering questions in forums are less frequently performed activities.

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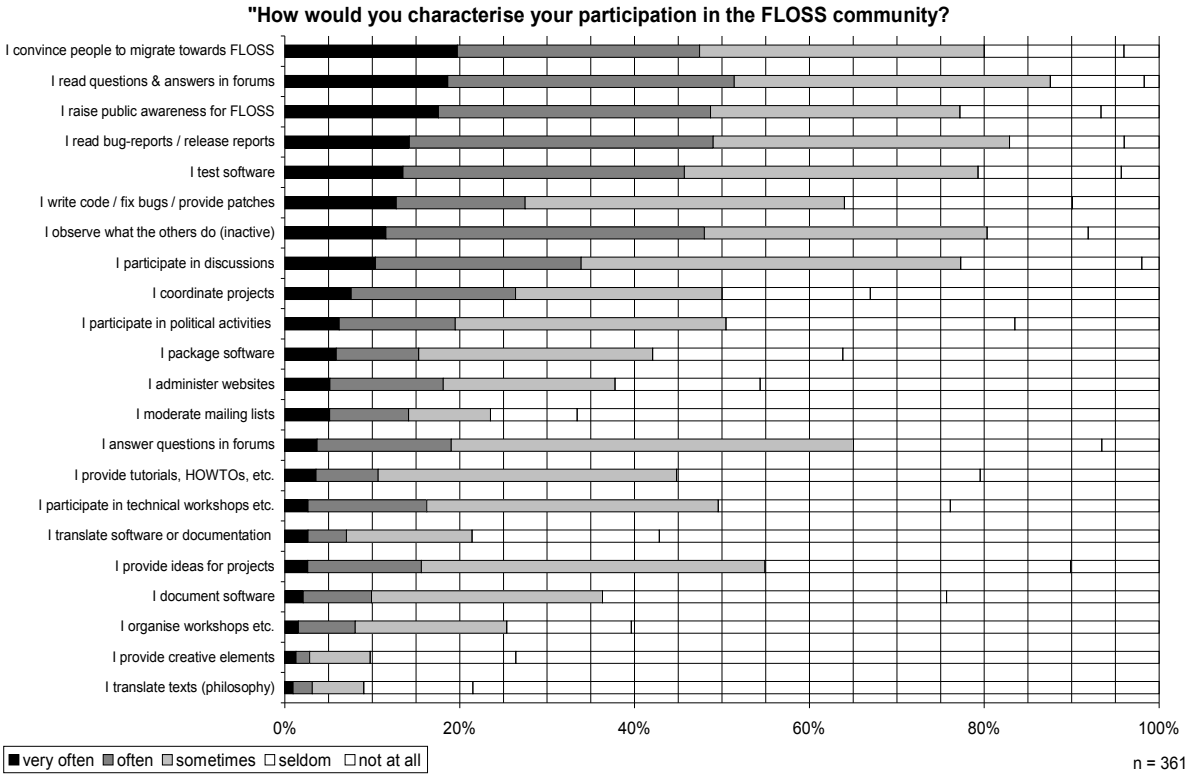
Figure 1: Activities in the FLOSS community



A principal component analysis of the 22 different activities that could be chosen by the respondents revealed six groups (components) of closely inter-related activities. Together, the six components account for 60 per cent of the variation of answers to the question for the activities of FLOSS developers. As depicted in table 1, the first component consists of organising activities and comprises the moderation of mailing lists for FLOSS activities, participation in technical workshops, congresses, and other meetings, administration of websites for FLOSS activities, help in the organisation of workshops, congresses, and other meetings, and coordinating functions for a development project. The second component consists of bugfixing and related activities, such as reading bug-reports / release reports, testing software, packaging software, writing code / fixing bugs / providing patches, and the provision of ideas for new features for software projects. The third component is clearly determined by political activities. It contains raising public awareness for

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FLOSS, convincing people to migrate towards FLOSS, and participation in political activities. The fourth component is defined by translating activities, disregarding whether it is translation of software or texts. The fifth component is provided by communicative activities that are performed via questions & answers and in discussions. Finally, the sixths component consists of supportive activities, such as the provision of creative elements for a project or Website, the documentation of software, or the provision of tutorials or HOWTOs.

Table 1: Activity components in the FLOSS community

	Component					
	Organising activities	Bugfixing activities	Political activities	Translation activities	Communicative activities	Supportive activities
I moderate mailing lists for FLOSS activities	0,718					
I participate in technical workshops, congresses, and other meetings	0,629					
I administer websites for FLOSS activities	0,594					
I help organising workshops, congresses, and other meetings	0,592					
I have a coordinating function for a project (development)	0,576					
I observe what the others do, but do not actively participate						
I read bug-reports / release reports		0,746				
I test software		0,714				
I package software		0,615				
I write code / fix bugs / provide patches		0,611				
I provide ideas for new features for a software project		0,517				
I try to raise public awareness for FLOSS			0,863			
I try to convince people to migrate towards FLOSS			0,830			
I participate in political activities (e.g. against software patents)			0,537			
I translate software or documentation (internationalisation / localisation)				0,801		
I translate texts about the idea / philosophy of FLOSS				0,756		
I answer questions in forums					0,828	
I participate in discussions					0,617	
I read questions & answers in forums					0,599	
I provide graphics, sounds, or other creative elements for a project or Website						0,704
I document software						0,653
I provide documents to help people with their FLOSS problems (e.g. tutorials, HOWTOs)						0,512

Extraction Method: Principal Component Analysis.
Rotation Method: Varimax with Kaiser Normalization.

Rotation converged in 9 iterations.

4.4

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4.5 Improvement of skills in the FLOSS community

The respondents of the FLOSSPOLS developer survey were asked to specify from a list of 30 different skills which of them were improved through participation in the FLOSS community – and to what degree. The strongest improvement was observed with regard to legal skills, such as "to understand patent law issues", "to understand copyright law issues", "to understand licences", and "to understand the differences between copyrights, patents, and licences". 42 to 58 per cent of the respondents stated that these skills have improved a lot (Table 2).

A second important group of skills that obviously improves considerably through participating in FLOSS is of course provided by many software-related skills. "To write code in a way that it can be re-used", "to become familiar with different programming languages", "to look for and fix bugs", "basic / introductory programming skills", "to run and maintain complex software systems", and "to re-use code written by others" are items of which 42 to 50 per cent of the respondents claimed that each of them has improved a lot. Only two items of the general skills, "to get an overview of developments in software technology" and "to better understand English, especially technical discussion", attained similar shares of respondents who said they improved a lot.

In contrast to these skills, managerial skills such as "to coordinate own work with the work of others", "to accept and to respond to criticism from others", "to express personal opinions", and "to clearly articulate an argument" were considered to have improved a lot by 23 to 28 per cent of the respondents.

A crucial question with regard to the value of the skills that are learned in the FLOSS community is how these skills compare with skills that are attained in formal software-related courses. As shown in Figure 2, FLOSS community members are not convinced that all skills are better be learned in their community, they differentiate very much between the various items.

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Table 2: Skills improvement in the FLOSS community

	I learned ...			
	a lot	some	little	nothing
Technical skills				
To re-use code written by others	50,0	34,5	12,6	2,9
To run and maintain complex software systems	49,3	29,5	14,0	7,2
Basic / introductory programming skills	46,6	24,9	14,7	13,8
To look for and fix bugs	43,6	33,4	18,6	4,4
To become familiar with different programming languages	43,0	33,2	20,3	3,4
To write code in a way that it can be re-used	42,4	36,0	12,7	8,9
To design modular code	32,7	35,6	21,6	10,2
To document code	18,2	42,8	29,3	9,7
To create new algorithms	11,7	28,2	38,1	21,9
Managerial skills				
To clearly articulate an argument	27,9	38,1	24,0	10,0
To express personal opinions	24,9	39,9	25,5	9,7
To accept and to respond to criticism from others	24,9	47,3	20,7	7,2
To coordinate own work with the work of others	22,8	43,7	20,1	13,5
To evaluate the work of others	17,4	46,0	25,4	11,2
To lead a project or a group of people	16,9	27,1	28,9	27,1
To keep a community going	15,9	30,0	33,0	21,1
To clearly define and achieve targets	12,8	34,6	29,9	22,7
To settle conflicts within a group	12,6	36,3	29,8	21,2
To motivate people	11,9	27,7	37,5	22,9
To plan work and stick to a work schedule	5,4	24,7	33,4	36,4
Lega skills				
To understand the differences between copyrights, patents, and licences	57,7	27,4	12,9	2,0
To understand licences	52,0	37,1	8,3	2,6
To understand copyright law issues	49,6	33,6	14,0	2,8
To understand patent law issues	42,2	35,0	18,8	4,0
To improve my understanding of liability issues	24,6	39,2	28,9	7,3
General skills				
To better understand English, especially technical discussion	42,3	28,9	12,2	16,7
To get an overview of developments in software technology	40,4	41,0	17,8	0,9
To get an overview of the skills you need in the software professions	28,9	42,4	22,8	5,8
To understand and work with people from different cultures	23,0	43,1	24,8	9,1
To interact with other people	20,2	45,7	26,1	7,9

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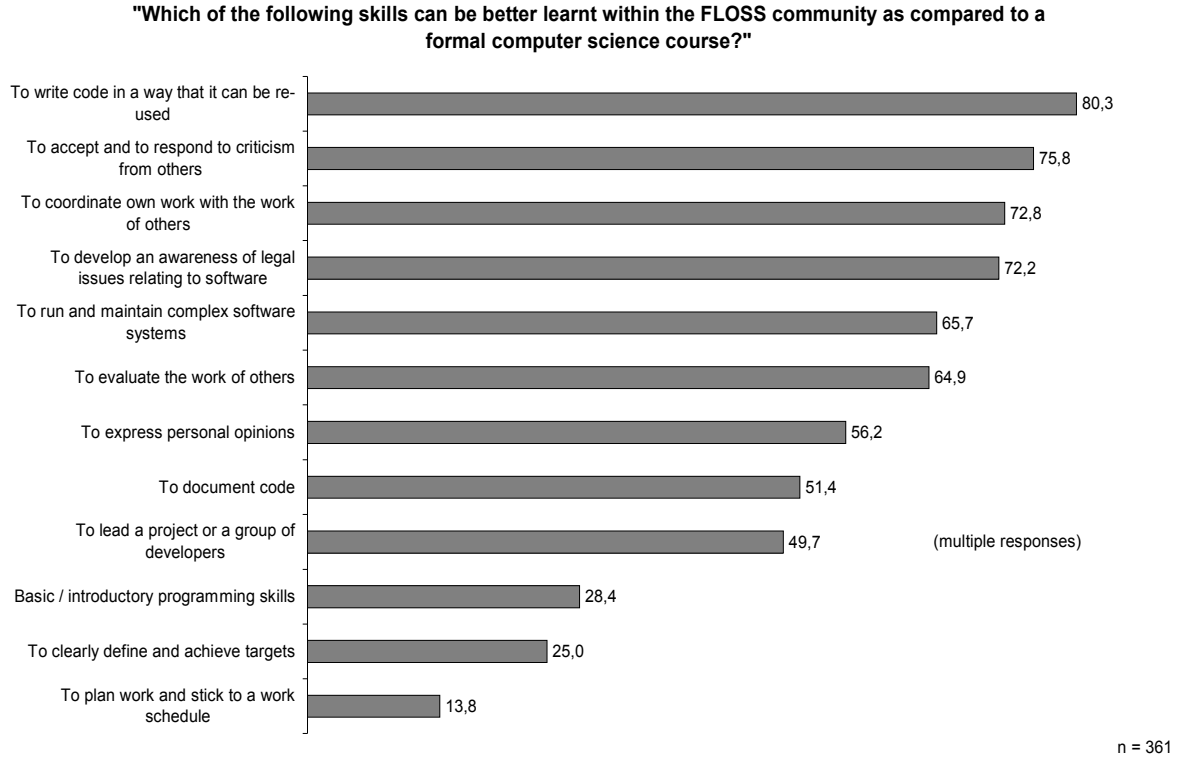
Figure 2: Skills learnt better through FLOSS



Writing source code in a way that it can be re-used is in this context an outstanding item: 80 per cent of the respondents claim that this skill can better be learnt in the FLOSS community than in proprietary environments (figure 2). To accept and respond to criticism from others and to coordinate own work with the work of others are two managerial skills that are also considered to better be learnt in the FLOSS community by a large majority of the respondents. Finally, legal issues relating to software provide another item that is considered to be learnt better in the FLOSS community. Managerial skills regarding the organisation of work and tasks and basic programming skills appear to be considered to be better or equally well learnt in more formal environments.

There is no clear picture that technical, legal, or managerial skills as categories are better learnt in the FLOSS community or in formal learning contexts. Rather, respondents differentiate in their comparison on the basis of individual skills at some level of detail.

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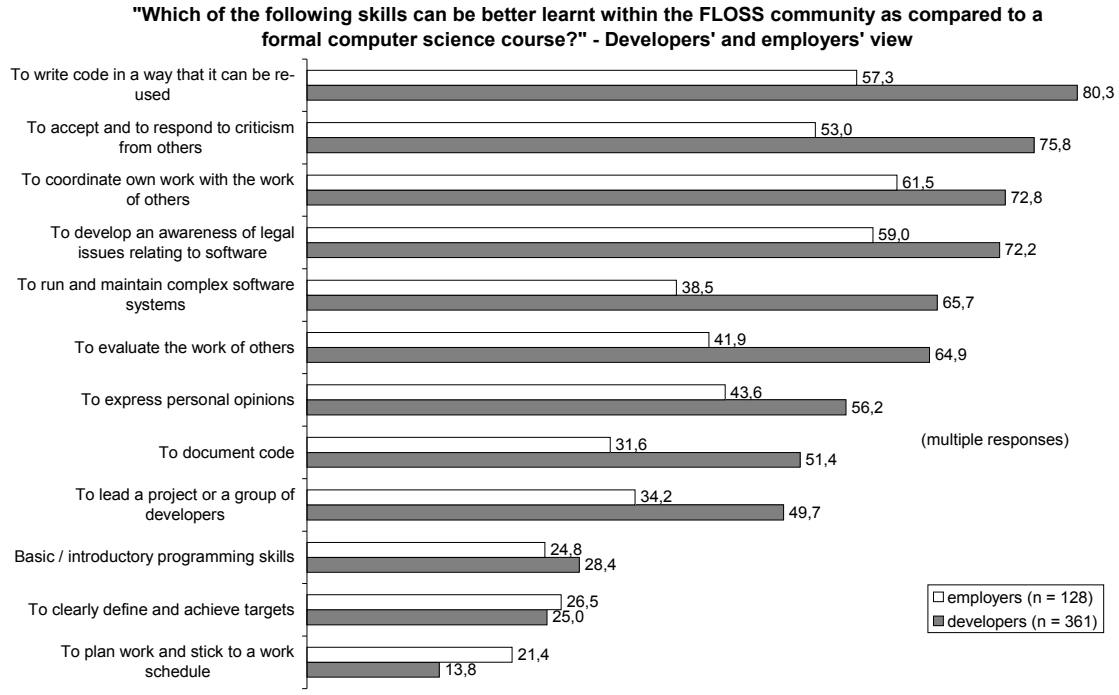
The comparison of the developers' view to the employers' view on these skills (see figure 3) turns out some significant differences. Most employers consider skills to coordinate the own work with the work of others and to develop an awareness of legal issues related to software as the ones that can better be learnt in the FLOSS community than in formal courses, whereas these skills come only on third and fourth position among the developers. Moreover, the shares of employers who consider skills like "to run and maintain complex software systems", "to evaluate the work of others", "to document code", and "to lead a project" as skills that can better be learnt within the FLOSS community are significantly lower than the respective shares of the developers. Thus, the attainment of fundamental and important technical and managerial skills in the FLOSS community compared to their attainment in formal courses are perceived quite differently by employers and developers.

Figure 3: Skills learnt better through FLOSS: employers' view



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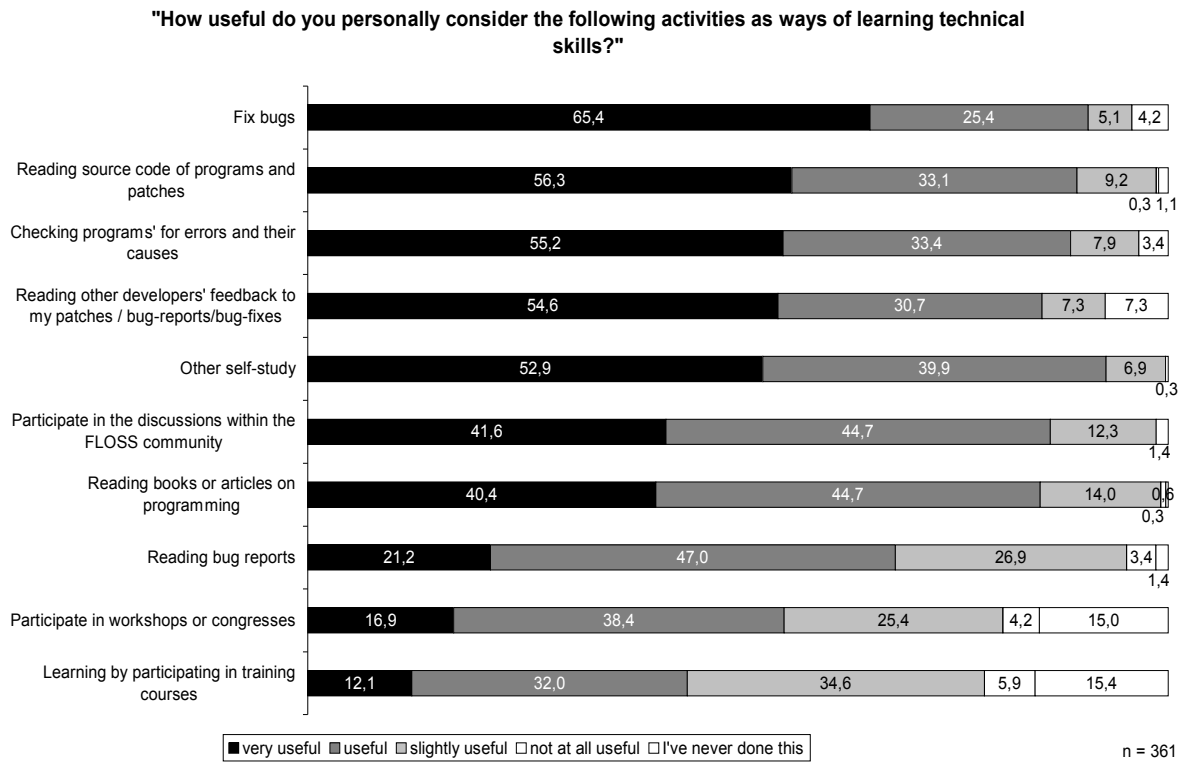
4.6 Learning activities in the FLOSS community

Fixing bugs is clearly considered to be the most useful way of learning, as indicated by two thirds finding this kind of learning very useful and another quarter of the respondents finding it useful (see Figure 4). Reading source code, testing programs, checking other developers feedback to own contributions and other forms of self-study play also an important role (53 to 56 per cent consider these activities to be very useful). While participating in discussions within the FLOSS community and reading books and articles are still considered to be quite useful – each item attracted shares of 42 per cent of the respondents who find these learning activities very useful -, reading bug reports (21 per cent), participating in workshops (17 per cent), and formal training courses (12 per cent) are considered least useful. It is notable that only 15% of respondents to the question did *not* have any experience of formal training courses, and even after excluding these respondents the share who find formal courses useful or very useful is surprisingly low in relation to the other methods of learning.

Figure 4: Methods of learning



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The FLOSS developer survey in 2002 showed that employment opportunities do not play a strong role in the motivations of people to participate in the FLOSS community, although participants do nevertheless find employment through their FLOSS participation. An open question however remained as to what degree the overwhelming wish to learn that was revealed as the major motive of FLOSS developers to join and to stay in the community is related to career perspectives. The FLOSSPOLS developer survey now shows that almost two thirds (64 per cent) of the respondents consider the skills they develop in the FLOSS community as core skills for their professional career, whereas 26 per cent claim that these skills provide only a supplement to their core skills. Only ten per cent state that the skills they attain in the FLOSS community are an end in itself and have no relevance to their professional career.

The questions what people learn in the FLOSS community and how they value what they learn must be compared with the degree of prior knowledge participants had before they joined the community. Given the strong professional character of the community one might suppose that only people with a good initial knowledge of technical and legal aspects of software, or of the way how FLOSS is developed, or of the philosophy of free software feel themselves encouraged to join this community. However, it turned appears that this assumption is wrong. As shown in figure 5, under ten percent claim to have known really a lot about any of the aspects of FLOSS. In particular few people have knowledge of the organisation of work in FLOSS communities prior to joining. Also noteworthy is the finding that over ten percent had no prior knowledge of technical aspects.

Taken together, our findings on the relatively low value of formal training and the perceived usability of the skills attained in the FLOSS community for professional purposes raise the question as to how FLOSS developers can compete on the labour market with software developers who have a formal degree. More precisely, the question is whether experience in the FLOSS community can compensate for the lack of formal degrees that could be attained in formal courses or at university. According to the respondents of the FLOSSPOLS developer survey there cannot be any doubt about the compensational capacity of FLOSS experience, as 70 per cent claim that FLOSS experience can

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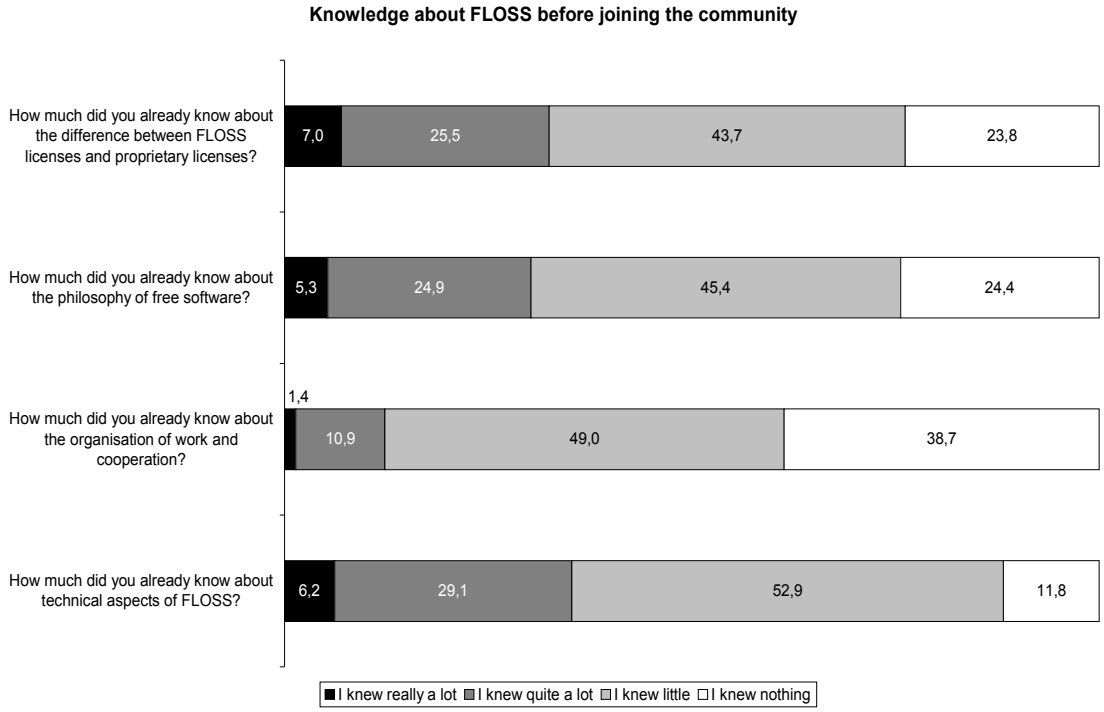
compensate for the lack of formal degrees and only 16 per cent state it cannot. The remaining 14 per cent do not know.

Figure 5: Prior knowledge



Employers show a somewhat different attitude towards the value of FLOSS-skills compared to formal degrees. A strong majority of 93 per cent of firms where FLOSS is plays an important role, and 68% of firms where FLOSS is not important, report that practical experience in the FLOSS community adds value to formal qualifications. However, when it comes to FLOSS experience compensating for a lack of formal degrees, employers are less appreciative of practical experience than developers. The largest share of respondents (39 per cent) says that there is no difference between formal qualification and practical experience in FLOSS, and a further 17 per cent claim that the formal qualification is worse, adding up to 56 per cent of employers who think FLOSS experience can compensate for the

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lack of a formal degree. This represents 65 percent of firms for whom FLOSS important, but only 35 per cent of firms for whom FLOSS is not important.

Accordingly, a majority of the developers responding are convinced that FLOSS-experienced people have an advantage over people who have only experience in proprietary software. We asked the respondents to imagine two people with exactly the same level of formal qualifications but different experiences: Person A has proven experience developing an important component of a proprietary software product. Person B has proven experience developing an important component of an open source software product of equivalent complexity. The respondents should then decide which of the two persons they think is in a better position to get a job? Only ten per cent answered that person A, with proprietary credentials, is advantaged, whereas 44 per cent were convinced that person B, with FLOSS development credentials, is advantaged. 35 per cent think that both persons are equally likely to get a job (11 per cent answered "I don't know"). Clearly, responses to this question are strongly influenced by their own experience and beliefs, and need to be compared with responses to similar questions asked in the FLOSSPOLS Employer Survey.

Among employers, a strong majority of firms for whom FLOSS plays an important role in their business said they would prefer to hire person B with FLOSS experience (60 per cent) while a majority of firms for whom FLOSS does *not* play an important role said whether it was FLOSS or proprietary experience would not influence their hiring decision (51%). In comparison to someone with proprietary software development credentials, someone with FLOSS credentials is equally likely (in firms for whom FLOSS is not important) or more likely (in firms for whom FLOSS is important) to get employed.

With regards to terms of employment, asking whether people like person A, with proprietary development credentials, are paid the same by employers as people like person B, with FLOSS development credentials, revealed a fairly different picture, at least among developers. While 30 per cent of respondents believe that both persons are paid the same, 28 per cent believe that person A with proprietary software experience is better paid and only 9 per cent feel person B, with FLOSS

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experience would be paid more. The large share of 33 per cent who did not know what to respond illustrates a strong degree of uncertainty among potential employees about the value of FLOSS skills on the labour market compared to proprietary software experiences. Employers were not asked this question, but were asked a related one – would they pay those with FLOSS experience more than those with a formal degree? 53% responded that they would pay persons with FLOSS experience same. However, the share of employers who would pay FLOSS-skilled employees more is double the share of employers who would pay those with only a formal degree more: 13 vs. 6 per cent. This is partly a reflection of the higher share of firms interested in FLOSS among our sample, but perhaps reflects that while a lack of degrees may not be compensated by experience while hiring new employees, those who do get hired are paid more on the basis of their experience than on whether they have a degree.

On the current level of analysis these contradiction must remain unclear. We assume that the questions targeting a comparison of formal degrees to practical experience is perceived by the respondents in a more abstract way, so that their answer is influenced by the impression that *in general* it is always better to have a proven degree than a questionable practicable experience. The questions targeting at a concrete hiring situation, we assume, seem however to be perceived in the context of the actual experience or perception of the practical skills that are typically provided by FLOSS members: capacities to coordinate the own work with the work of others, awareness of legal issues relating to software, writing code that it can be re-used, and the ability to accept and respond to criticism from others are considered to be better developed in the FLOSS community than in formal courses and which obviously make FLOSS community members more valuable for employers than people who performed "only" formal courses.

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5 Conclusions

The analysis of the results of the FLOSSPOLS Developer and Employer Surveys at this stage is not advanced enough to allow final conclusions on the potential of FLOSS developer communities as a skills development environment. However, some basic observations and conclusions with regard to our hypotheses can be noted.

The hypothesis that the range of skills learnt through participation in the FLOSS community is not limited pure technological skills is clearly confirmed. Furthermore, it appears that advanced technical skills are learnt in the FLOSS community even by participants with prior technical knowledge. A broad range of skills are perceived to be better learnt in the FLOSS community than in formal surroundings, which applies especially to the re-usage of code in the technical dimension and software and license issues in the legal dimension. The existence of different learning strategies indicates that there is not only one way of learning in the FLOSS community, however a surprisingly large share of those who have experienced formal courses rate it poorly as a form of learning, in comparison with the more interactive forms of learning in the FLOSS community, such as “fixing bugs”.

Finally, FLOSS community participants – most of whom have experience in the job market – appear to believe that proven participation in development projects compensates for the lack of formal qualifications. The Employer survey indicates a widespread recognition of the value of FLOSS as a training environment across countries, industrial sectors (within the high IT-use sectors surveyed) and firm sizes. The value attached to FLOSS experience among prospective and current employees is closely related to the firms' awareness of FLOSS, and in particular, the degree of importance FLOSS has within the firms' businesses. This indicates that the trend of increasing awareness among firms of FLOSS is likely to result in increasing appreciation among employers of skills learnt by FLOSS community participants, as well as increasing recognition that these skills can compensate for the lack of formal degrees.

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