FLOSS-US

THE FREE/LIBRE/OPEN SOURCE SOFTWARE SURVEY FOR 2003

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SEPTEMBER, 2003

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ACKNOWLEDGEMENTS

I. INTRODUCTION

Open Source and Free Software (OS/FS) has gained much notoriety in the last few years. Hundreds of thousands, perhaps millions, of programmers around the world have spent significant amounts of their time developing open source software. Why do so many individuals donate contribute their efforts toward building software that they give away for free? How do large numbers of contributors coordinate their efforts, if they never meet in person? Why is open source software often more robust, bug-free, secure, and yet cheaper, than its proprietary software counterpart?

A broad literature has grown to answer such questions.[1] However, only a few groups have studied the population of developers themselves to help understand who they are, how much they contribute, and why they do it. In 2002, our colleagues at the University of Maastricht in the Netherlands, led by Rishab Ghosh, conducted the largest survey of OS/FS developers to date, the Free/Libre/Open Source Software (FLOSS) survey.[2] A total of 2784 OS/FS developers completed the FLOSS survey's online questionnaire, which asked questions about developers' personal backgrounds, employment status, ties to proprietary software firms, motivations to program OS/FS, level of involvement in OS/FS, and monetary or non-monetary rewards.

We have conducted a second large-scale survey of 1588 developers of open source and free software, which we call the FLOSS-US survey for 2003. The first FLOSS survey targeted primarily European OS/FS developers, with 71% of respondents living in Europe or Russia, only 13% living in the United States, and roughly 17% living elsewhere in Europe or the world. The FLOSS-US survey sampled many more developers from countries outside of Europe, with 53% living in Western Europe, 27% living in North America, 8% in Russia and Eastern Europe, 5% in East Asia, 3% in Australia and New Zealand, 3% in Latin America, and 1% in the Middle East and Africa.

The FLOSS-US survey asked questions on some topics addressed by the first FLOSS survey, as well as questions about several new topics not previously addressed: developers' roles in OS/FS projects, the extent and intensity of their OS/FS contributions, support given to OS/FS projects by proprietary software firms, and relationships with commercial enterprises based on OS/FS. Altogether, the FLOSS-US survey provides an interesting perspective on the real contributions of the broad and diverse field of open source developers.

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[1] See http://opensource.mit.edu/ for an online repository of academic papers written on open source and free software.

[2] Ghosh, R.A., R. Glott, B. Krieger, and G. Robles. (June, 2002) "Free/Libre and Open Source Software: Survey and Study." International Institute for Infonomics, University of Maastricht, The Netherlands. Available at: http://www.infonomics.nl/FLOSS/report/.

II. DEMOGRAPHICS OF SAMPLE OF RESPONDENTS

The FLOSS-US survey was carried out through an online questionnaire posted on the web at http://www.stanford.edu/group/floss-us/. The questionnaire contained 45 questions, and took anywhere from 15 minutes to an hour to complete. Anyone who considered himself a developer of open source/free software was free to complete the online questionnaire. We monitored the remote host location on the internet of all incoming responses, allowing us to prevent anyone's responses from accidentally or intentionally being included more than once in the final data set.[3]

Rather than selecting out a small, well-controlled sample of respondents to be considered "developers," we allowed respondents to decide for themselves whether they should be considered "developers" of open source/free software. Our goal has been to analyze the *entire* open source/free software developer community. Allowing respondents to self-select themselves as part of the population of "developers" will create a more diverse sample of developers with different levels of commitment and types of projects than through being selective about what makes someone a true "developer." We sought out as large and diverse a sample of respondents as possible, and we succeeded in collecting a total of 1588 responses from developers living in 65 different countries.[4]

We solicited responses by publishing announcements of the survey at approximately 50 websites and mailing lists thought to be read frequently by developers of OS/FS.[5] The survey period lasted for exactly 20 weeks, opening on January 28, 2003 when an announcement was posted to Slashdot.org, and closing on June 17, 2003. We posted announcements of the survey on websites targeted to specific populations of developers – including open source websites for France, Germany, Italy, Russia, several South American countries, and Linux User Groups in India – always translating the announcement into the native language used by each website. We also sent several announcements to mailing lists for developers in particular open source projects, such as to the Linux Kernel, KDE, GNOME, xFree86, and OpenOffice developer mailing lists.

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[3] We automatically notified respondents whenever their submission originated from a remote host location from which we had previously received a response. We carefully compared all groups of responses coming from the same remote host location, weeding out responses that were clearly submitted by the same person. We kept in the data set those responses that originated from the same remote host location but appeared to be submitted by different people, such as when different people access the internet through the same proxy server. In addition, we removed from the data set a few bogus responses obviously submitted maliciously or in jest.

[4] All 45 questions, and the raw tabulations of answers to each question, can be found at: http://www.stanford.edu/group/floss-us/stats/.

[5] To find links to all known postings of the FLOSS-US announcement on the web and on developer mailing lists, see http://www.stanford.edu/group/floss-us/announcements/websites.html. At that site, you can also find translations of the announcement into English, Dutch, German, Italian, Russian, Spanish, Portugese, and Chinese.

The data set we collected is inevitably an imperfect representation of the whole population of open source/free software developers. The survey required a generous contribution of each respondent's time, and thus the respondents we sampled might have had a slightly skewed level of altruism or commitment to the OS/FS movement. Given the time commitment required to complete the survey, we trust that the large majority of responses were honest and sincere. We targeted primarily the most prominent developer websites, and the mailing lists for the largest open source projects, but the survey was announced on many websites for smaller groups of developers in different countries.[6] Thus our sample might be skewed toward more active contributors and fans of OS/FS, and toward developers who work on the most prominent projects like Linux.

Most responses were collected during only two fortnightly periods. (see Figure 1) The first influx of responses came February 11 – 24, when the survey was announced on Slashdot.org, LinuxToday.com, Debian Weekly News, and in an article on NewsForge.net published by Robin Miller. The second influx of responses came April 22 – May 5 mostly from OS/FS developers in Germany, after the survey was announced on Heise.de and MozillaZine.de by Claus Augusti. The rest of the responses came after the survey was announced on each of many websites less frequently visited.
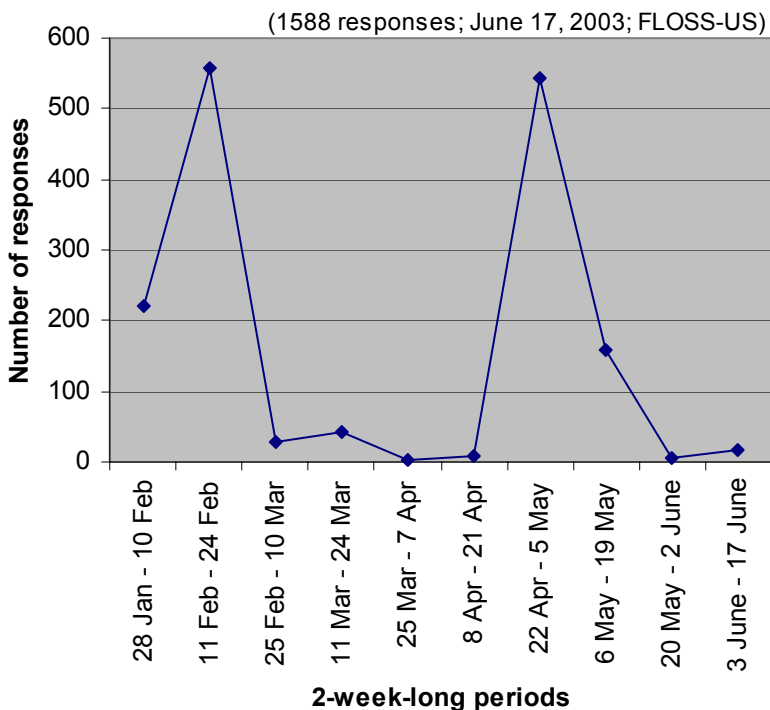

FIGURE 1: Number of responses to the FLOSS-US questionnaire received during each fortnightly period of the survey between January 28 and June 17, 2003

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[6] See http://www.stanford.edu/group/floss-us/announcements/websites.html for all the links we know to websites that have announced the FLOSS-US survey, as well as to translations of the announcement into eight languages.

Developers living in 65 different countries answered the online questionnaire. The majority of developers (52.7%) live in Western Europe, while 27.1% live in North America, 7.6% live in Russia and Eastern Europe, and the rest live throughout East Asia (5.5%), Australia and New Zealand (3.1%), Latin America (2.6%), the Middle East (0.9%), and Africa (0.4%) (see Figures 2 and 3 for the distribution of responses by region and by country).
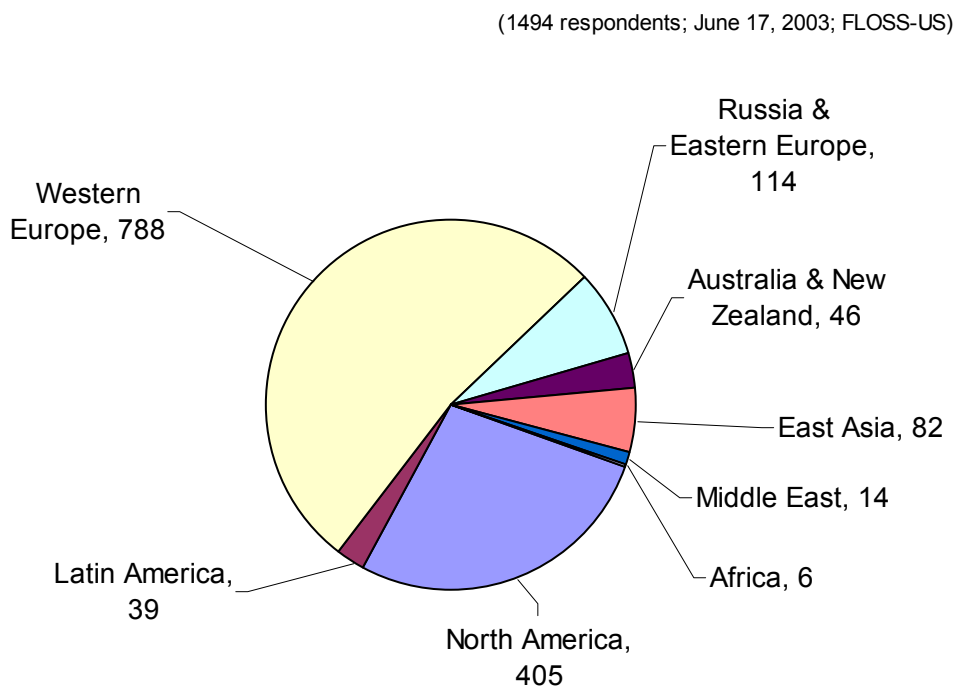
(1494 respondents; June 17, 2003; FLOSS-US)

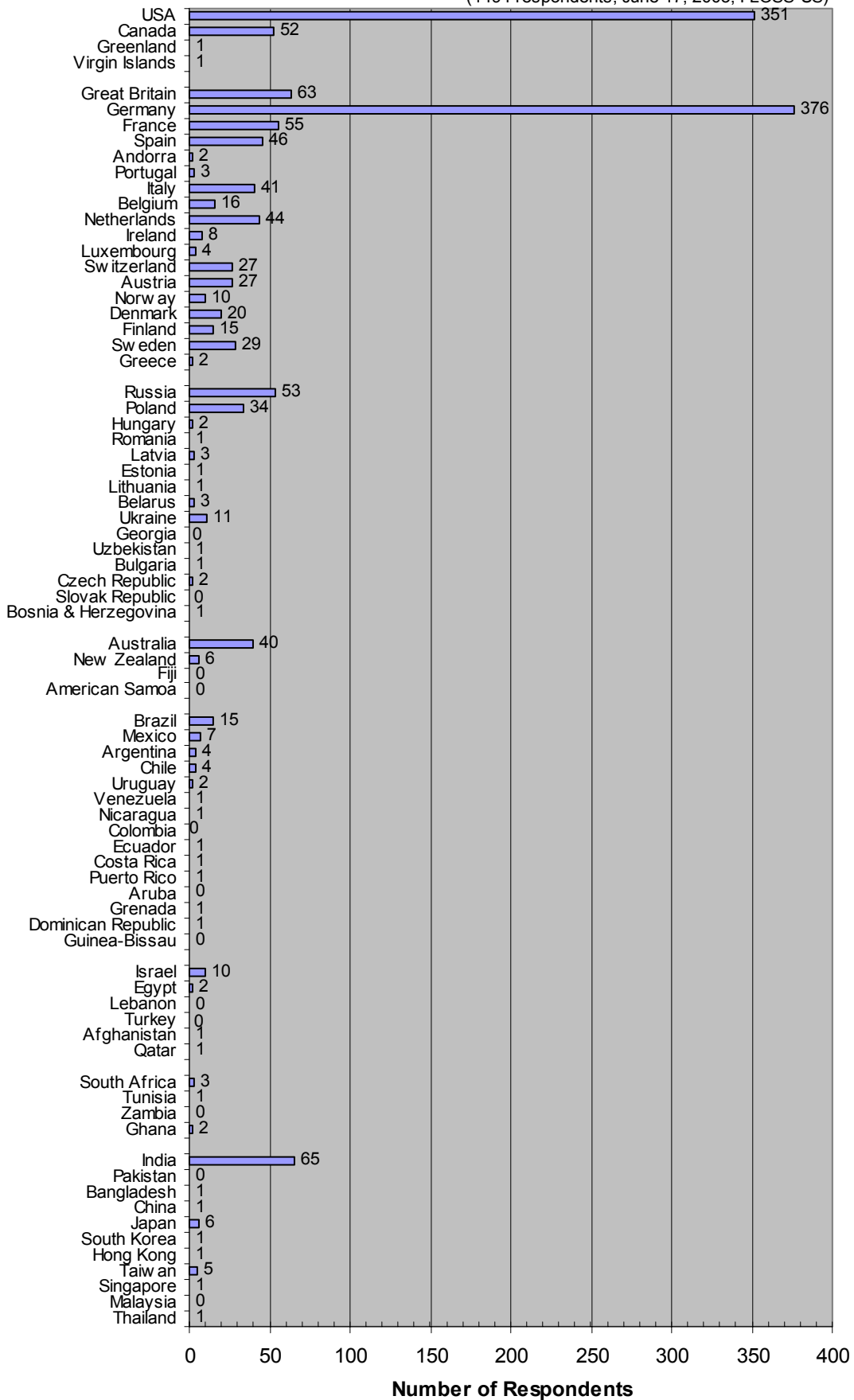**FIGURE 2: OS/FS developers' countries of residence, by region (Q43)**

FIGURE 3: OS/FS developers' countries of residence, by country (Q43)

As expected because the questionnaire was written in English, almost all respondents (95.0%) claimed to speak English "well enough to communicate with other OS/FS developers." The developers also speak German (35.3%), French (14.5%), Spanish (8.3%), Russian (6.6%), Italian (4.1%), and Swedish (4.0%) at this level of proficiency, in addition to many other languages (see Figure 4).[7]

(1486 respondents; June 17, 2003; FLOSS-US)

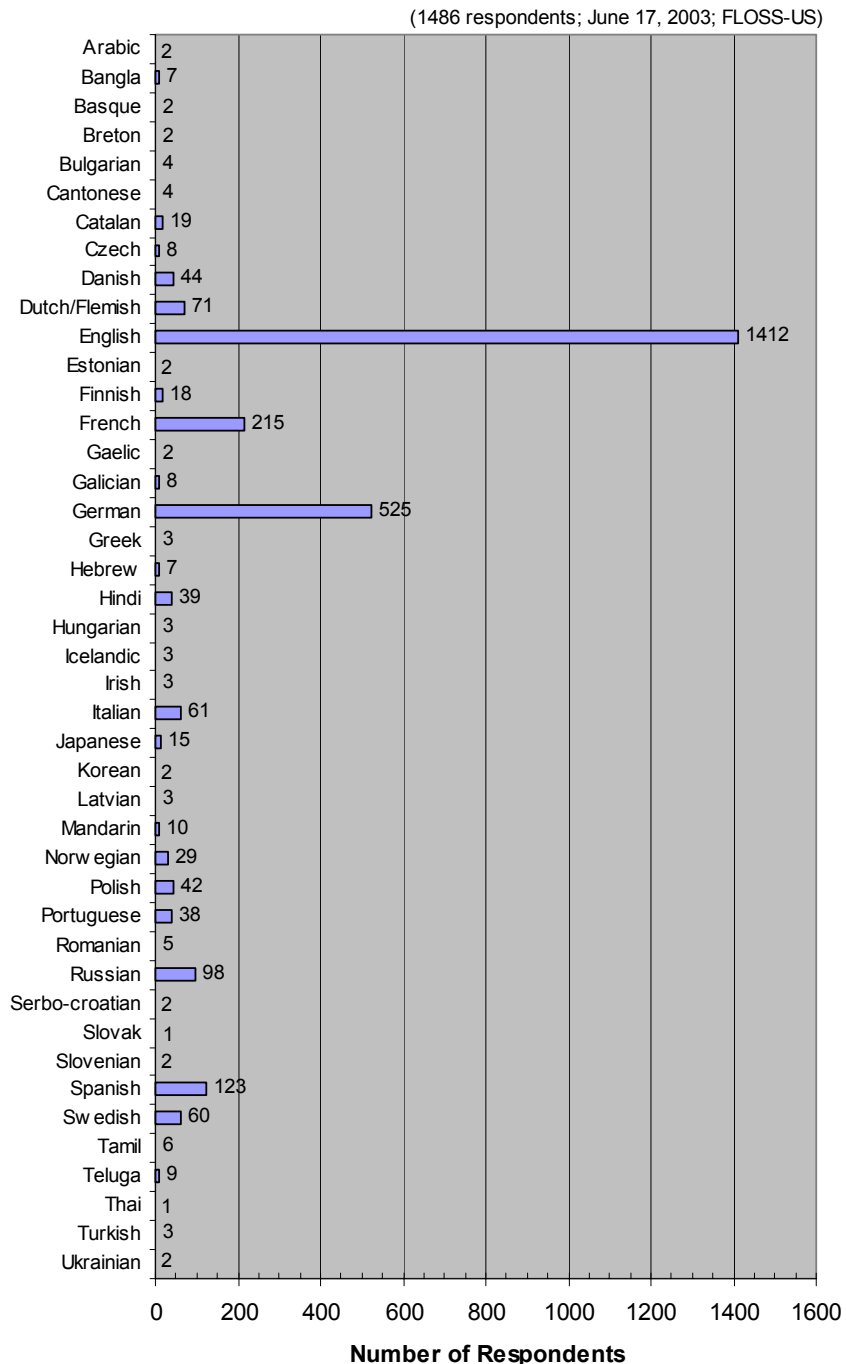| Language	Number of Respondents
Arabic	2
Bangla	7
Basque	2
Breton	2
Bulgarian	4
Cantonese	4
Catalan	19
Czech	8
Danish	44
Dutch/Flemish	71
English	1412
Estonian	2
Finnish	18
French	215
Gaelic	2
Galician	8
German	525
Greek	3
Hebrew	7
Hindi	39
Hungarian	3
Icelandic	3
Irish	3
Italian	61
Japanese	15
Korean	2
Latvian	3
Mandarin	10
Norwegian	29
Polish	42
Portuguese	38
Romanian	5
Russian	98
Serbo-croatian	2
Slovak	1
Slovenian	2
Spanish	123
Swedish	60
Tamil	6
Teluga	9
Thai	1
Turkish	3
Ukrainian	2

FIGURE 4: Languages spoken well enough to communicate with other OS/FS developers (Q41)

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[7] I included in Figure 4 a few languages (Thai, Arabic, Slovak, and Ukrainian) that respondents noted in the comments they left at the end of the questionnaire, although these languages were not available as answers in Q41.

Fitting the stereotype of computer programmers, nearly *all* OS/FS developers were male. (see Figure 5) Many respondents are single (39.6%), but many have a partner (30.5%) or are married (28.0%). (see Figure 6) The large majority of respondents (81.0%) do not have children. (see Figure 7)
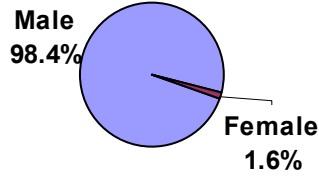
(1493 respondents; June 17, 2003; FLOSS-US)

**Male
98.4%**

**Female
1.6%**

FIGURE 5: Developers' genders (Q38)

(1113 respondents; June 17, 2003; FLOSS-US)

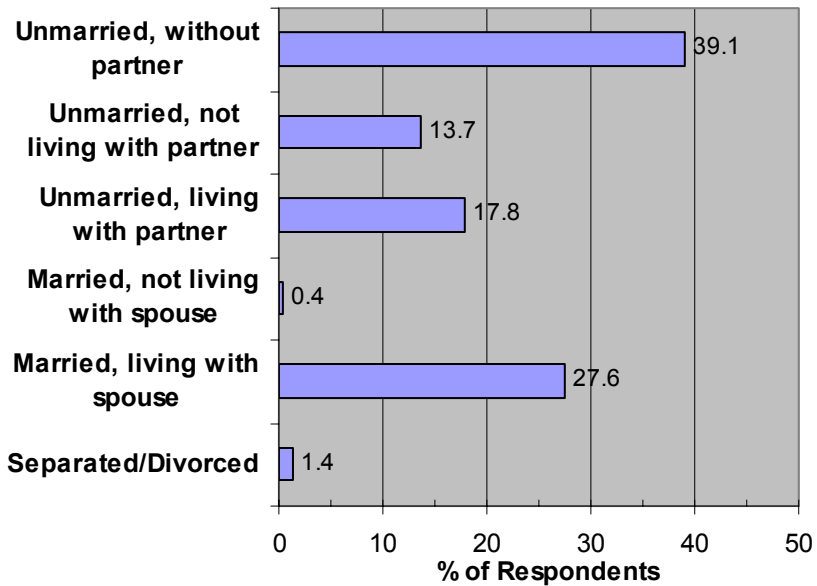|	
Unmarried, without partner	39.1
Unmarried, not living with partner	13.7
Unmarried, living with partner	17.8
Married, not living with spouse	0.4
Married, living with spouse	27.6
Separated/Divorced	1.4

% of Respondents

FIGURE 6: Respondents' current marital status or domestic situation (Q40)

(1491 respondents; June 17, 2003; FLOSS-US)

**Children
(age<6)
9.9%**

**Children
(age>6)
6.8%**

**Children
(age<6
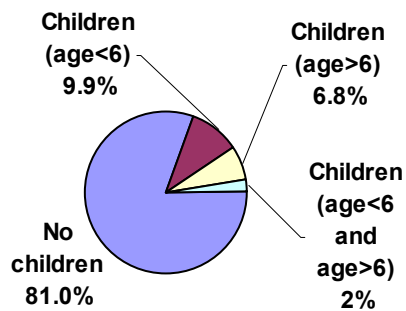and
age>6)
2%**

**No
children
81.0%**

FIGURE 7: Developers with or without children (Q39)

8

Many developers have received an education at the graduate level (36.7%), professional level (6.2%), or undergraduate level (36.3%). Only 19.4% of OS/FS developers have not had more formal education than high school. (see Figure 8)
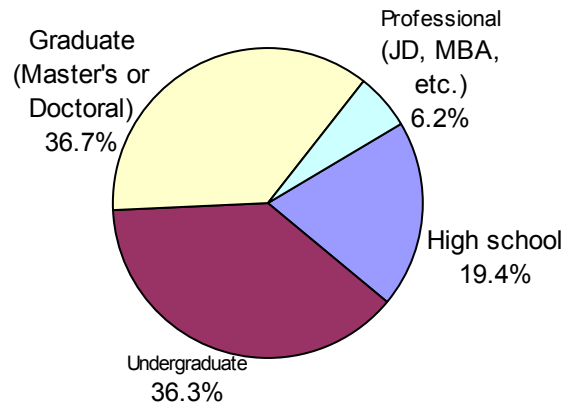
FIGURE 8: Developers' highest formal education level (Q45)

III. EMPLOYMENT OF DEVELOPERS

In contrast to the perception of OS/FS developers as a group of young students without jobs, in fact the large majority (67.8%) of OS/FS developers surveyed are employed, 15.9% of whom are self-employed. Only 28.8% of the developers are currently students, and only 3.6% are currently unemployed. (see Figure 9)

(1488 respondents; June 17, 2003; FLOSS-US)

FIGURE 9: Respondents' present occupational status (Q28)

Open source developers are sometimes portrayed as anti-capitalists who are trying to supplant proprietary software development with a new form of free, open communal software development. However, a large majority of respondents to the FLOSS-US survey (69.4%) have bee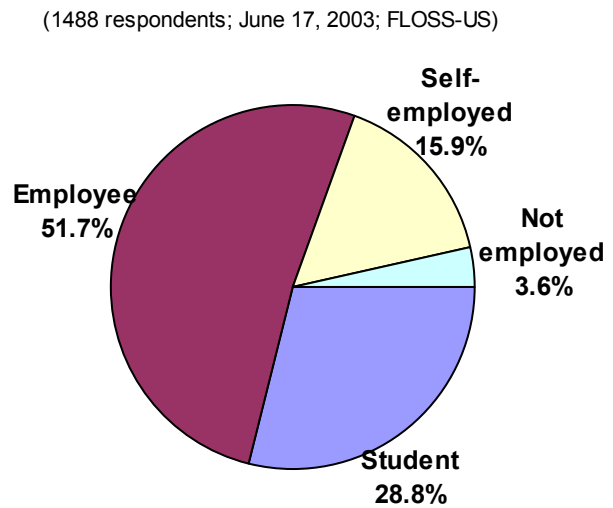n employed by a private firm or organization that produces proprietary software. Almost half (49.1%) of all respondents have worked for such organizations in the past 2 years. (see Figure 10) 65.3% have earned income from business firms working on software or IT, an increase from the 49.7% of respondents who earned income in software and IT more than 2 years ago. Relatively few respondents have earned income from business firms in computer hardware (12.5% in the past 2 years), banking and finance (6.2%), accounting (2.6%), and other occupations in universities, education, the government, scientific research, healthcare, consulting, and elsewhere (10.6%).[8] (see Figure 11)

(1498 respondents; June 17, 2003; FLOSS-US)

Category	%
Within the past 2 years	49.1
3-5 years ago	19.7
6-10 years ago	9.1
Over 10 years ago	5.9
Never	30.6
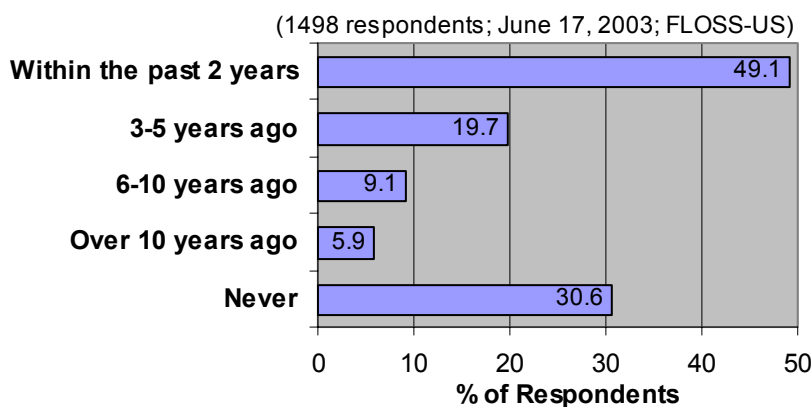
% of Respondents

Figure 10: Employment by organizations producing proprietary software (Q30)

(1494 respondents; June 17, 2003; FLOSS-US)

Category	During the past 2 years	More than 2 years ago
Software/IT	65.3	49.7
Computer Hardware	12.5	13.7
Banking and Finance	6.2	6.6
Accounting	2.6	3.3
Other	10.6	9.8

% of Respondents

■ During the past 2 years
□ More than 2 years ago
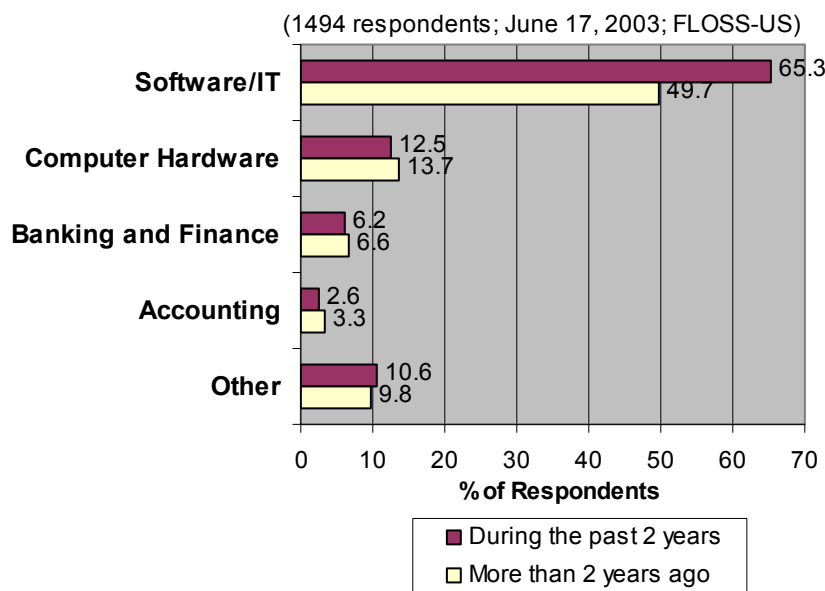
Figure 11: Income earned from business firms (Q34)

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[8] See http://www.stanford.edu/group/floss-us/stats/q34.html for a complete list of types of firms from which respondents have earned incomes.

For the most part, developers' employers or schools are well aware of their work on OS/FS (59.2% of all respondents, or 71.1% of employed respondents). Many respondents (27.4%) even work on OS/FS as part of their employment. Some employers (21.2%) are unaware of the respondent's work on OS/FS, but very few (2.6%) do not want them to contribute to OS/FS development. (see Figure 12)
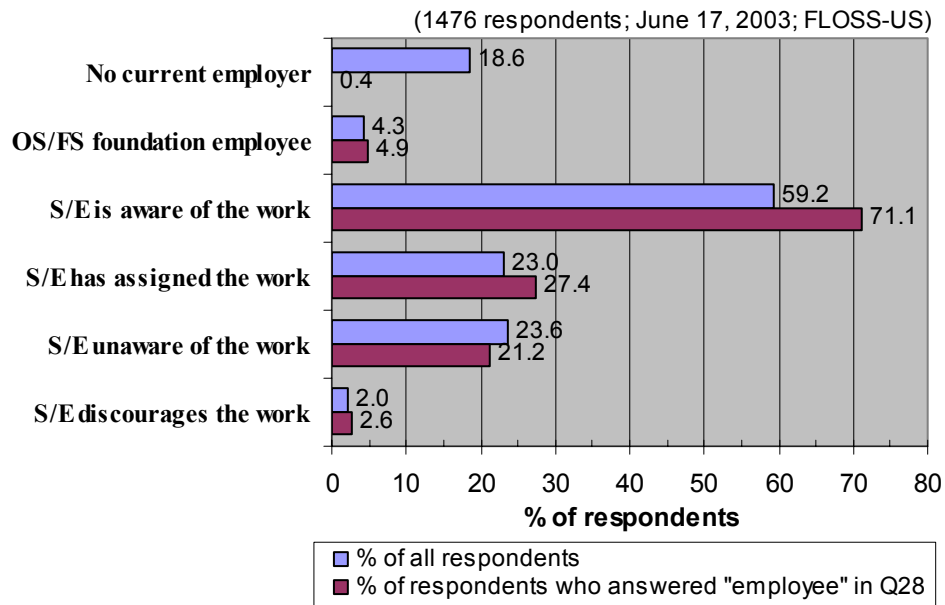

(1476 respondents; June 17, 2003; FLOSS-US)

	% of all respondents	% of respondents who answered "employee" in Q28
No current employer	18.6	0.4
OS/FS foundation employee	4.3	4.9
S/E is aware of the work	59.2	71.1
S/E has assigned the work	23.0	27.4
S/E unaware of the work	23.6	21.2
S/E discourages the work	2.0	2.6

% of respondents

□ % of all respondents
■ % of respondents who answered "employee" in Q28

Figure 12: Occupational (employment and school) context of involvement in OS/FS work (Q29)
"S/E" = School/Employer. The answers in the questionnaire were worded as follows (from top to bottom):
"I do not currently have an employer"
"I work for an OS/FS foundation and get paid for my participation in OS/FS development"
"My school/employer knows that I work on open source/free software"
"My school/employer has assigned me to work on OS/FS on the job"
"My school/employer is unaware of my involvement in OS/FS"
"My school/employer does not want me to collaborate in OS/FS development"

OS/FS developers on the whole have high ambitions of being leaders of business enterprises in the future that are based on OS/FS. Many more respondents expect to be a consultant, owner, company director, or company officer of a private firm in the future than those who have had these roles in the past. (see Figure 13) Developers' ambitions for these positions grow with age too: the number of respondents who expect to earn these jobs in the future rises with age until 33, after which fewer people expect to rise so high. (see Figure 14) However, *fewer* respondents expect to be relegated to the position of "employee" in the future, especially the young (ages 11-23) and the old (ages 33-69).
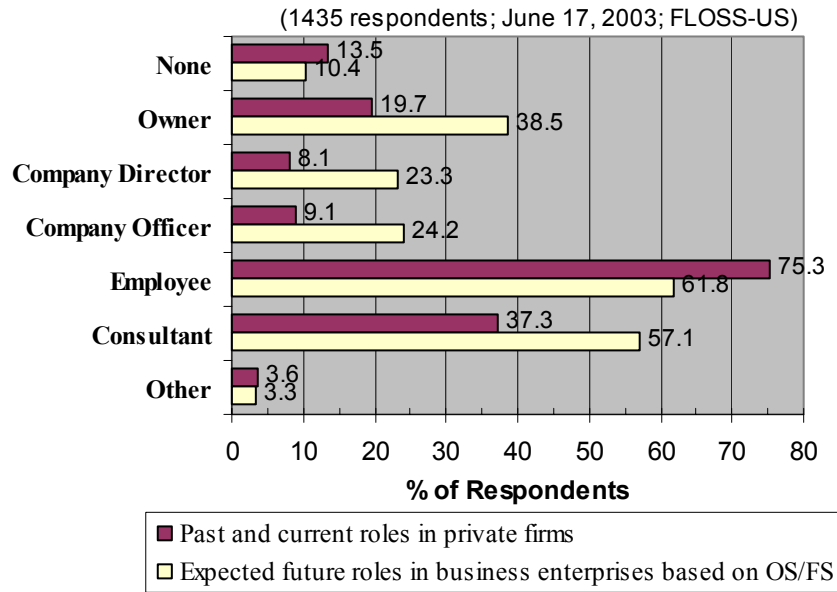

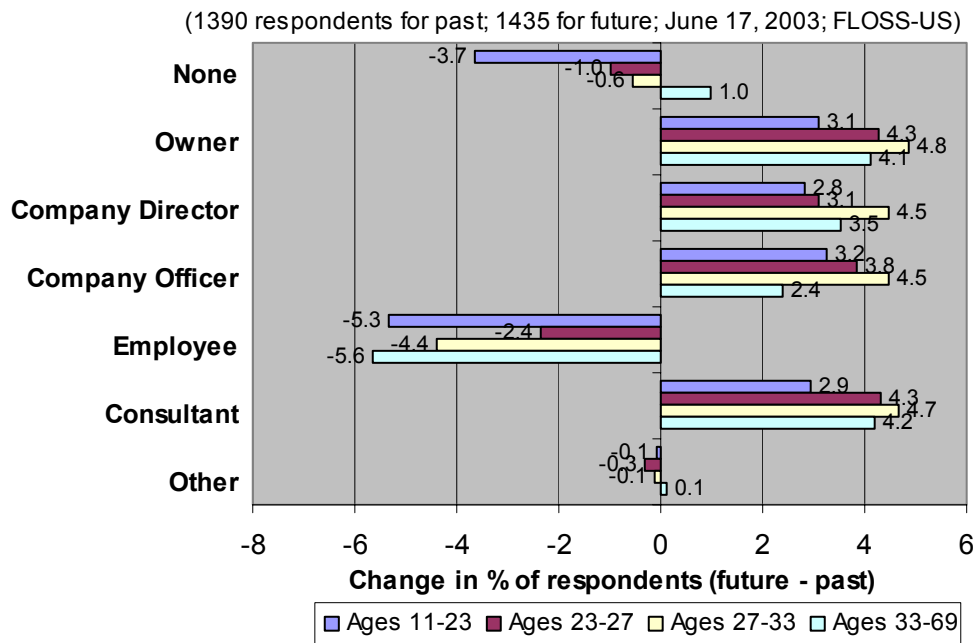**Figure 13: Roles in private firms and business enterprises (Q35 & Q36)**

Figure 14: Expectations for positions in business enterprises based on OS/FS, compared to respondents who previously held those positions in private firms (Q35 & Q36)

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The FLOSS-US questionnaire asked whether developers have worked in a country other than their current country of residence during the past year. A significant number of respondents (3.56%) have worked in the United States, while a fair number have worked in Great Britain (1.55%) and Germany (1.28%). A few developers have worked in a collection of other countries as well. (see Figure 15)
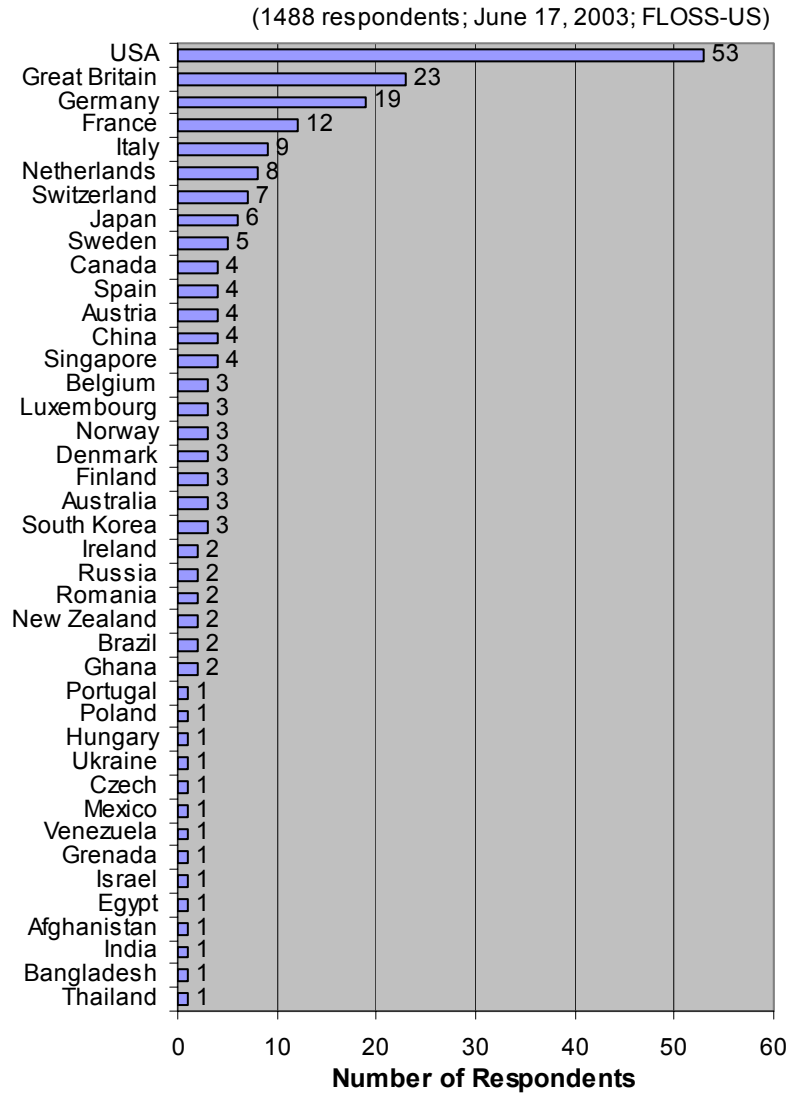
(1488 respondents; June 17, 2003; FLOSS-US)

Country	Number of Respondents
USA	53
Great Britain	23
Germany	19
France	12
Italy	9
Netherlands	8
Switzerland	7
Japan	6
Sweden	5
Canada	4
Spain	4
Austria	4
China	4
Singapore	4
Belgium	3
Luxembourg	3
Norway	3
Denmark	3
Finland	3
Australia	3
South Korea	3
Ireland	2
Russia	2
Romania	2
New Zealand	2
Brazil	2
Ghana	2
Portugal	1
Poland	1
Hungary	1
Ukraine	1
Czech	1
Mexico	1
Venezuela	1
Grenada	1
Israel	1
Egypt	1
Afghanistan	1
India	1
Bangladesh	1
Thailand	1

Number of Respondents

Figure 15: Foreign countries where developers have worked during the past year
(other than their current country of residence)

We were able to compare respondents' places of birth with their current countries of residence to calculate how many developers have tended to move into or out of each country. The net movement to or from a country roughly indicates the country's economic situation, its normal flow of immigration, and how welcoming the country is to OS/FS developers. By far the most OS/FS developers have moved to the United States, with 1.94% of developers currently living in the US being born outside the US. Other countries with a high influx of OS/FS developers are Australia (.67%), Canada (.54%), Germany (.33%), and Spain (.33%). The countries from which the most developers have *exited* are the Ukraine (-.60%), South Africa (-.40%), Poland (-.40%), Belgium (-.33%), and India (-.27%). (see Figure 16)
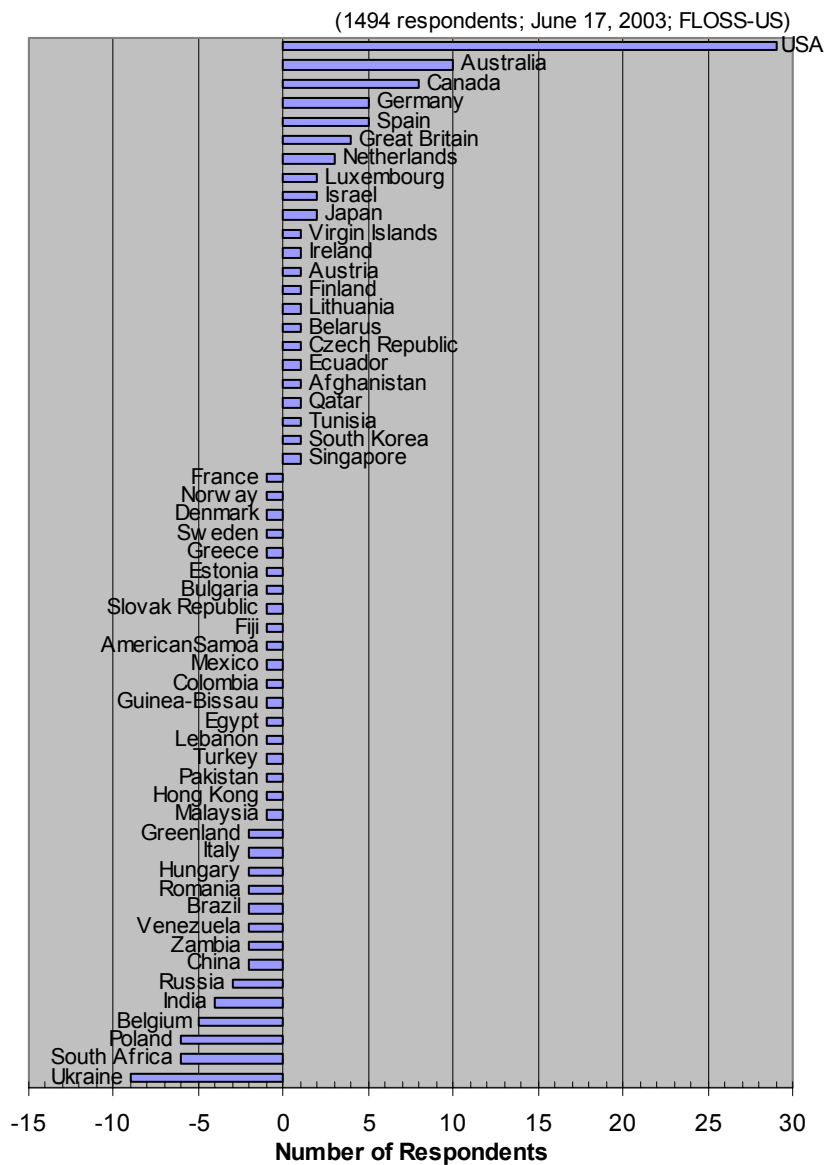

Figure 16: Country-based mobility balances (Q42 & Q43)
(net movement of developers from their place of birth to their current country of residence,
i.e. positive values indicate that more developers live in the country than were born there)

IV. ENTRY INTO OS/FS DEVELOPMENT

Open source and free software development has gained popularity, for the most part, only during the last few years. Half of respondents began developing OS/FS during or after 1999, and only 31.6% of respondents began developing OS/FS in 1997 or earlier. (see Figure 17) OS/FS developers are predominately in their 20s. The median age of those beginning OS/FS development was 22, and their median age now is 27. 50% of developers are currently between 23 and 33 years old, although they come as young as 11 and as old as 69. (see Figure 18)
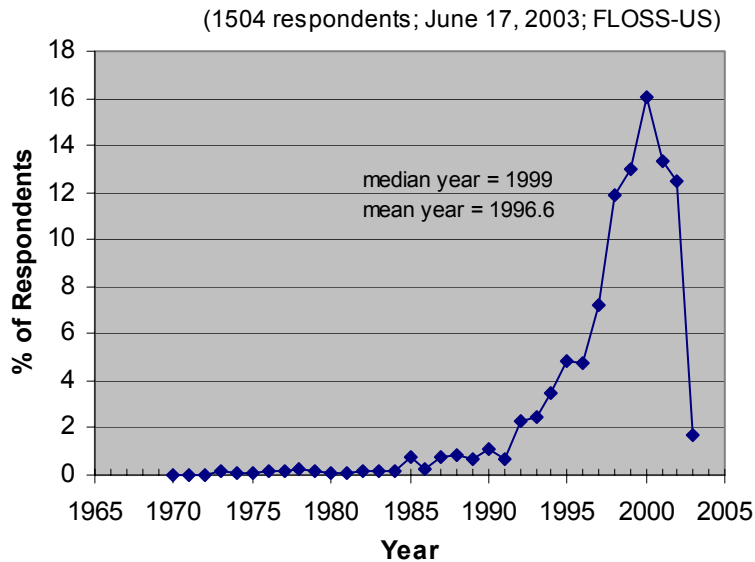
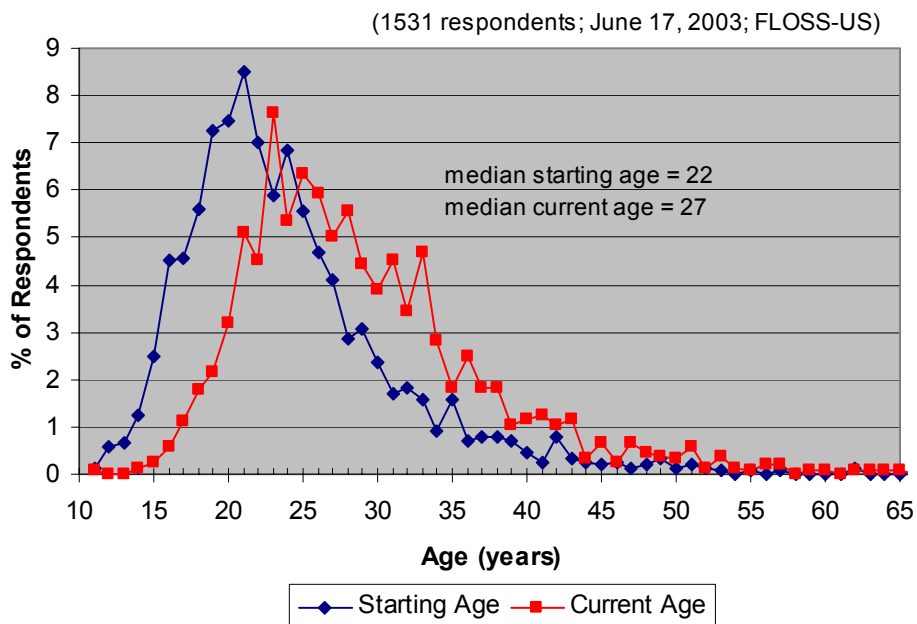**FIGURE 17: Starting year in OS/FS development (Q1)**

FIGURE 18: Ages of OS/FS developers (Q1)

Before they began developing open source and free software, the majority of respondents used OS/FS regularly or occasionally for recreation (75.4%) or in their coursework (60.9%). Respondents used OS/FS in their professional work less frequently, although still significantly – 48.2% used OS/Fs as employees in a company, and 39.3% used OS/FS in their own business. (see Figure 19) The average developer used OS/FS for 2 to 3 years before participating in its development, although they used OS/FS for shorter or longer duration with almost the same frequency. (see Figure 20)
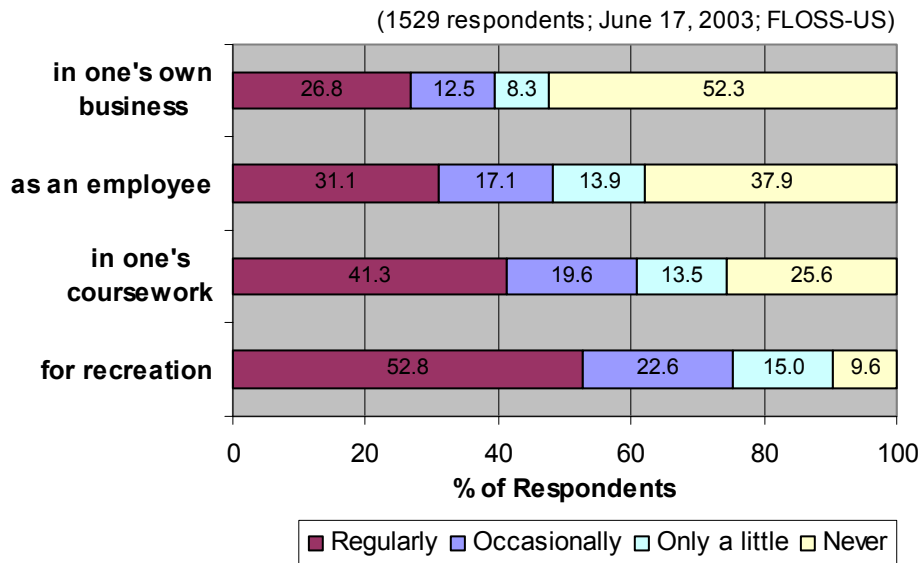
(1529 respondents; June 17, 2003; FLOSS-US)

	Regularly	Occasionally	Only a little	Never
in one's own business	26.8	12.5	8.3	52.3
as an employee	31.1	17.1	13.9	37.9
in one's coursework	41.3	19.6	13.5	25.6
for recreation	52.8	22.6	15.0	9.6

% of Respondents

■ Regularly ■ Occasionally □ Only a little □ Never

FIGURE 19: Usage of OS/FS before respondents started participating in OS/FS development

(1543 respondents; June 17, 2003; FLOSS-US)

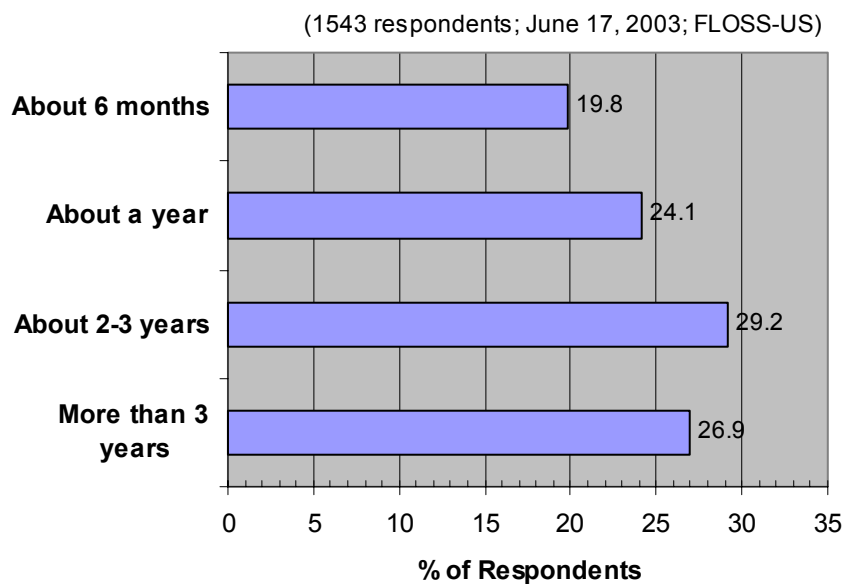|	% of Respondents
About 6 months	19.8
About a year	24.1
About 2-3 years	29.2
More than 3 years	26.9

% of Respondents

FIGURE 20: Length of time using OS/FS before participating in OS/FS development (Q3)

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Many theories have been proposed to explain why programmers choose to develop software as open source or free software, even though developing software this way rarely brings any direct monetary rewards. Boosting one's ego, having fun, being part of a community, demonstrating one's skills as a programmer, improving software for one's own use, and simply defeating Microsoft are all potential reasons why a programmer would choose to start developing OS/FS.

The FLOSS-US survey confirms the theory that many programmers start developing OS/FS to be part of the community: 77.8% respondents considered it "important" or "very important" to give back to the community after using free software themselves, and 57.2% were motivated to interact with like-minded programmers. A large majority of respondents were also significantly motivated to promote the OS/FS mode of development (68.6%) and the ideal of freely modifiable software (78.6%), or to provide an alternative to proprietary software (61.9%). (see Figure 21)

Only about half of respondents started to develop OS/FS to modify their software to perform certain tasks (56.3%), to fix bugs in the software (53.1%), or to learn how a program works (54.7%). Many respondents wanted to become a better programmer (68.7%), but fewer sought the challenge of fixing bugs and problems in existing software (40.2%). Very few respondents joined OS/FS development because their employers wanted them to do so (7.2%).

Most respondents listed "other reasons" as significant motivations to start developing OS/FS (68.5%). The reasons they listed were varied, including gaining a reputation, having fun, hobbyism, the influence of friends, wanting to distribute their code for free, political or moral considerations, fighting against proprietary software firms, affordability of the software, and taking control over their own software.[9] Further surveying of OS/FS developers would be necessary to discern how commonly each of these motivations individually pushed developers to join the OS/FS movement.

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[9] To see a complete list of other reasons for starting to develop OS/FS that respondents typed in, go to: http://www.stanford.edu/group/floss-us/stats/q4.html.
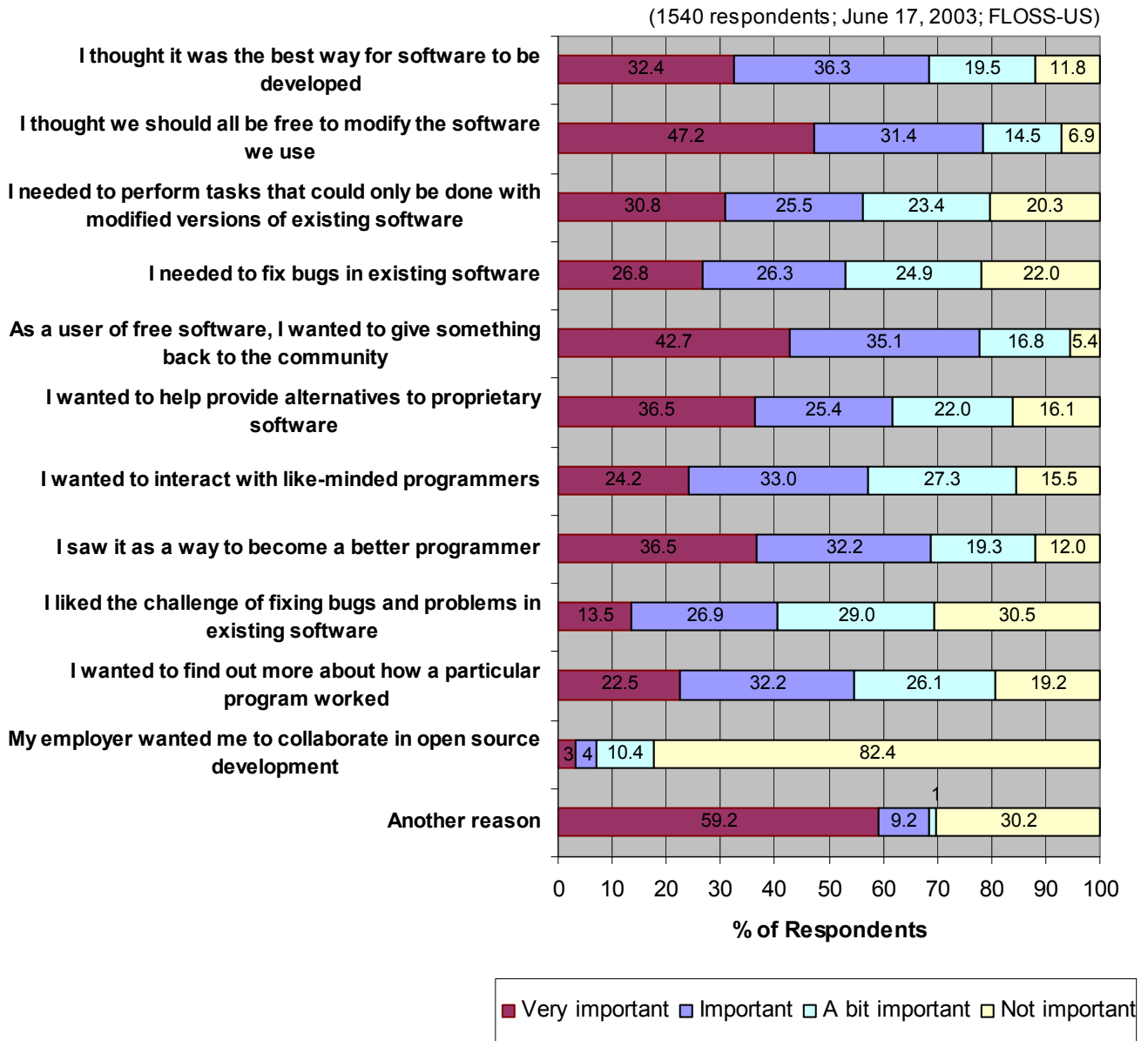
FIGURE 21: Motivations to start developing OS/FS (Q4)

Developers as a whole supported the OS/FS movement ideologically. Four out of five developers agree that software users should have the right to see software's source code (78.3%, 53.1% of whom "strongly agree"), and 68.8% think that ideally all software would be developed as open source or free software. Most developers also agree that OS/FS software is superior in quality to proprietary software (63.2%), and that OS/FS development is more efficient than proprietary development (58.5%). Many admit that proprietary software can sometimes be useful and developed more efficiently than OS/FS (54.8%), although very few strongly believe this possibility (8.9%). (see Figure 22)
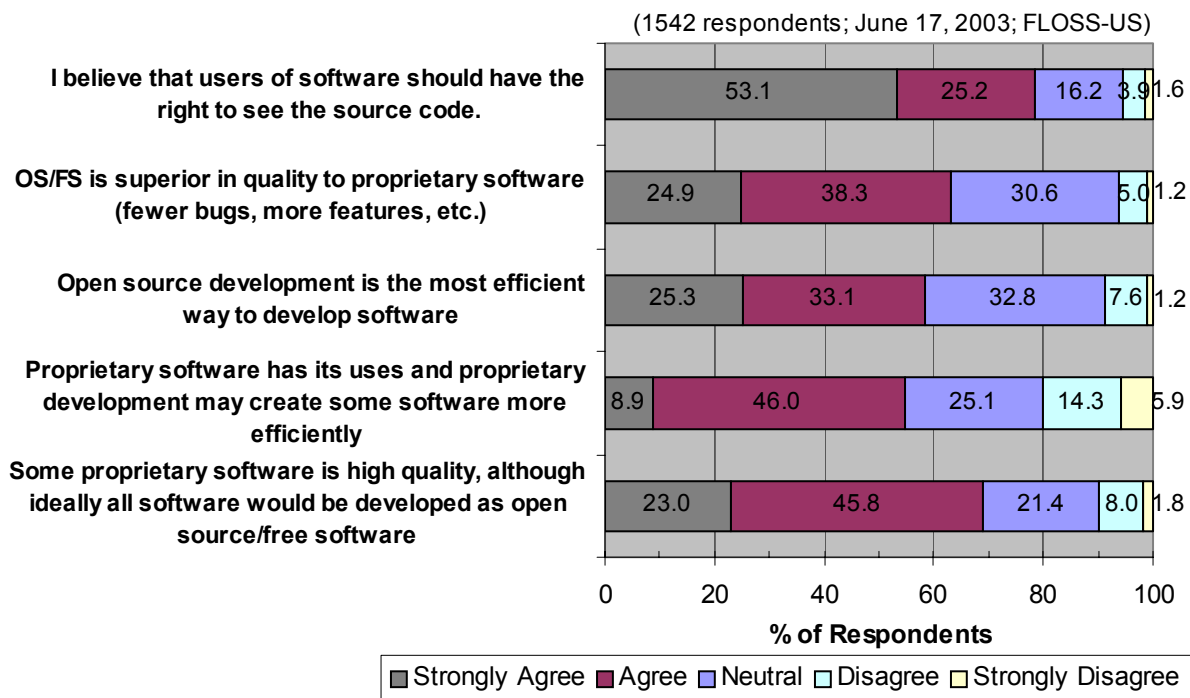

Figure 22: Agreement with statements about OS/FS and proprietary software (Q5)

Throughout the questionnaire, we refer to both "Open Source software" – software whose source code is openly and modifiable – and "Free Software" – software that is given away for free – together as "open source/free software" (OS/FS). However, to many involved in the development of OS/FS, the communities of programmers who develop each type of software are separate and distinct. We found that about ⅔ of developers consider themselves a part of one community more than the other: 31.4% identify more with the "Free Software" community, and 31.5% identify more with the "Open Source Software" community. The other ⅓ of respondents identify equally with both communities or do not see a difference between them (22.2%), or they do not care (14.9%). (see Figure 23)
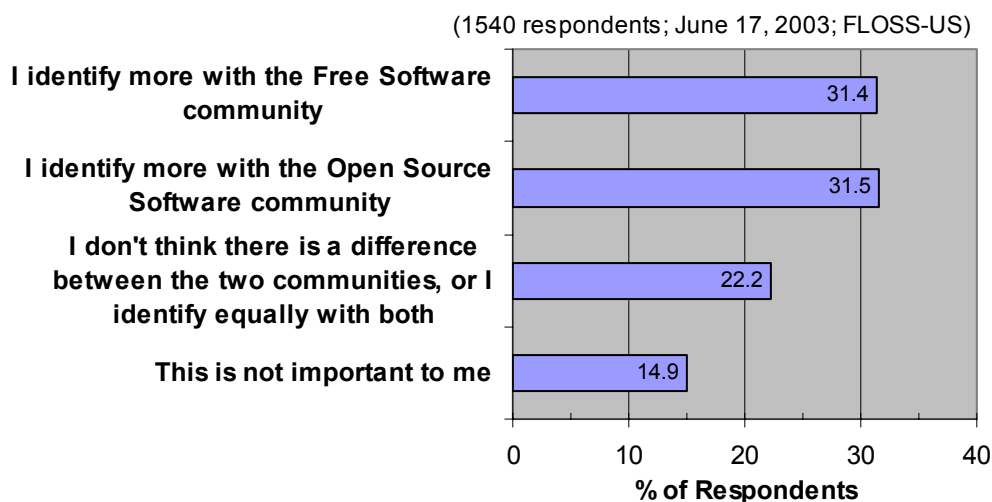
(1540 respondents; June 17, 2003; FLOSS-US)

Category	%
I identify more with the Free Software community	31.4
I identify more with the Open Source Software community	31.5
I don't think there is a difference between the two communities, or I identify equally with both	22.2
This is not important to me	14.9

% of Respondents

Figure 23: Identifying with the Free Software or Open Source communities (Q6)

We asked respondents to answer several questions regarding their current or most recent OS/FS project, and regarding the first project to which they ever contributed (if they have contributed to more than one project). Collecting answers regarding these two projects allows us to analyze how respondents' opinions, motivations, and habits have changed over the course of their career in OS/FS development.[10]

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[10] Asking respondents to consider their first and most recent projects provides data concerning a random sampling of projects at two stages in developers' careers. Some developers might currently working on more than one project, in which case they would choose for themselves which project to consider when answering the questions.

In a few interesting ways, respondents behaved differently when working on their first project than when working on their most recent project. Developers chose to participate in their most recent project because the project was "important and visible" or "technically interesting" more commonly than they chose to participate in their first projects for these reasons. (see Figure 24) Developers described their first projects as "unknown", but they described their current projects most commonly as "slightly known." (see Figure 25) Both results indicate that developers tend to gravitate toward slightly more prominent and well-known projects as their careers proceed.
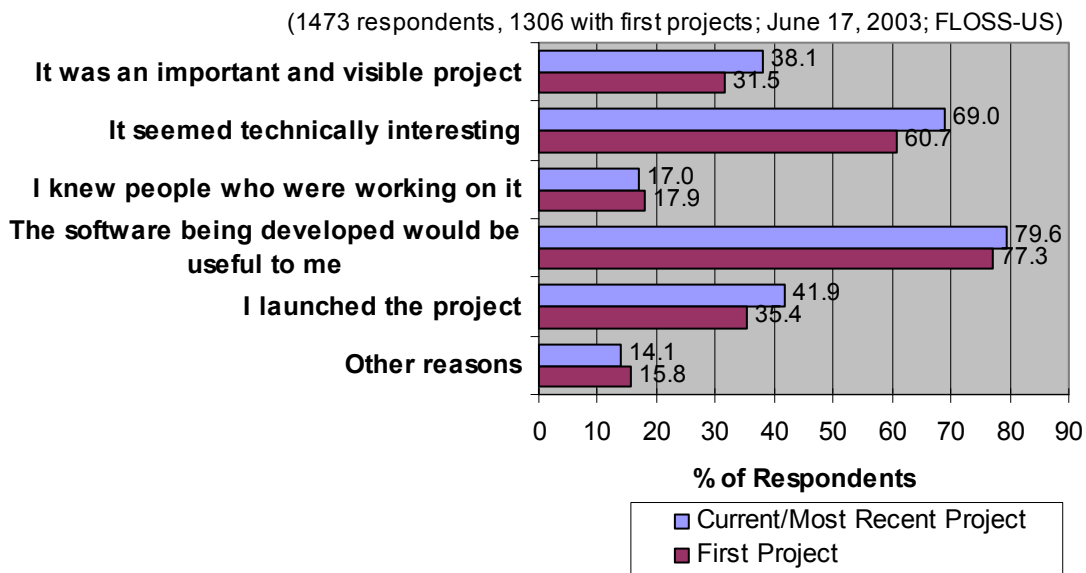
(1473 respondents, 1306 with first projects; June 17, 2003; FLOSS-US)

FIGURE 24: Reasons to participate in OS/FS projects (Q12)

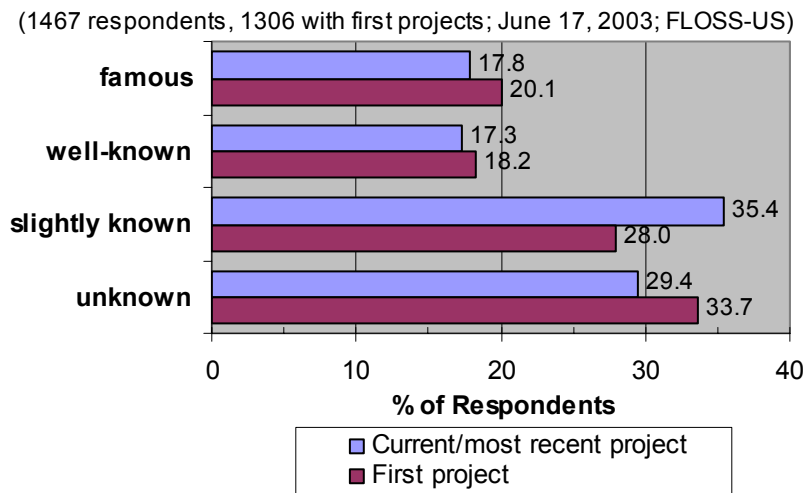(1467 respondents, 1306 with first projects; June 17, 2003; FLOSS-US)

Figure 25: Prominence of OS/FS projects (Q19)

V. EXTERNAL SUPPORT OF OS/FS PROJECTS

Open source and free software is most often developed and distributed entirely for free. However, it is still quite possible for open source developers to receive rewards – monetary or otherwise – for their contributions to an open source project. Proprietary software firms and other private firms can occasionally profit from the proliferation of some piece of open source or free software. Several companies, like IBM and Red Hat, have garnered revenues from sale of hardware or services complementary to the Linux operating system, and these companies have incentives to lend support to the further growth of Linux's user base. Proprietary software development and open source development are arguably complementary, not just rivalling paradigms for creating software.[11]

The FLOSS-US survey investigated the relationship between proprietary software firms and open source software development, by asking about the support that is given to respondents' open source projects by external corporations, consortiums, foundations, or other organizations. Over half of respondents (56.8%) have not earned any money through their work on OS/FS. However, in contrast to the perception of OS/FS as an entirely *free* contribution to the public, a fairly large portion (43.2%) has earned money through OS/FS development. Some respondents have earned money directly for developing (14.6%), supporting (13.0%), or administrating OS/FS projects (13.2%). Others have gotten a job because of their experience developing OS/FS (15.9%), developed OS/FS within their professional occupation (13.1%), or earned money through OS/FS by other means (15.8%), such as through consulting or freelancing, government contracting to develop public domain software, research for school, teaching, or being paid to install OS/FS.[12] (see Figure 26)
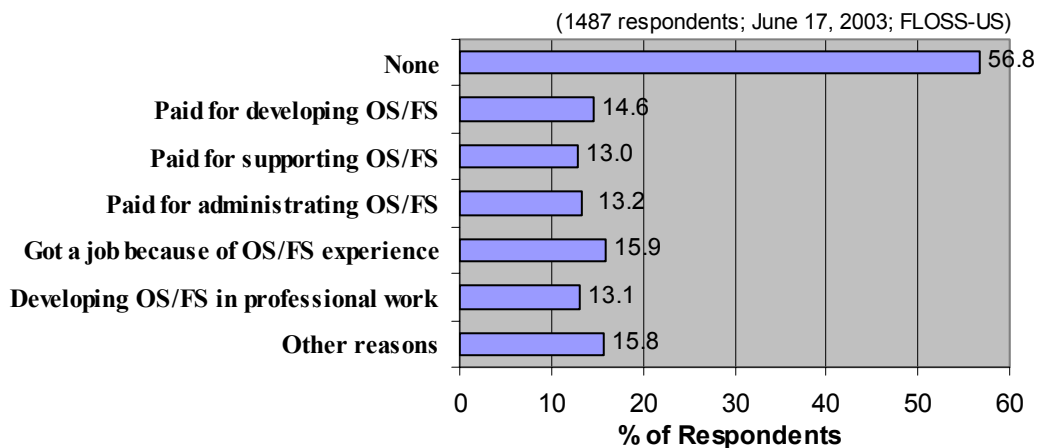

(1487 respondents; June 17, 2003; FLOSS-US)

Category	%
None	56.8
Paid for developing OS/FS	14.6
Paid for supporting OS/FS	13.0
Paid for administrating OS/FS	13.2
Got a job because of OS/FS experience	15.9
Developing OS/FS in professional work	13.1
Other reasons	15.8

% of Respondents

Figure 26: Monetary earnings through OS/FS (Q33)

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[11] See Arora, S. and P. David. (2003) "Commercialization of Open Source Software: Symbiotic or Parasitic?" SIEPR – Project NOSTRA Working Paper.
[12] See http://www.stanford.edu/group/floss-us/stats/q33.html for all other ways that developers earned money through OS/FS.

Many OS/FS projects are also directly funded or otherwise supported by organizations with an interest in their success, such as private business firms or consortiums, private or public foundations, universities, government organizations, or individuals. The number of projects supported by such organizations has grown significantly during the last decade. Only 8.0% of respondents who worked on projects over 10 years ago had some form of external support. The number rose to 15.0% between 6-10 years ago, 35.4% between 3-5 years ago, and within the past 2 years, 53.9% of respondents have had external support. (see Figure 27) We estimate that the average number of externally supported projects per person was only 0.18 over 10 years ago, 0.31 6-10 years ago, 0.69 3-5 years ago, and 1.13 within the past 2 years. The proportion of developers who have been employed by proprietary software firms and have externally supported OS/FS projects also has risen dramatically in the past 2-3 years. (see Figure 28) This trend may indicate that proprietary software firms have sharply increased their support for OS/FS projects, or that more open source developers have become employed in proprietary software firms.
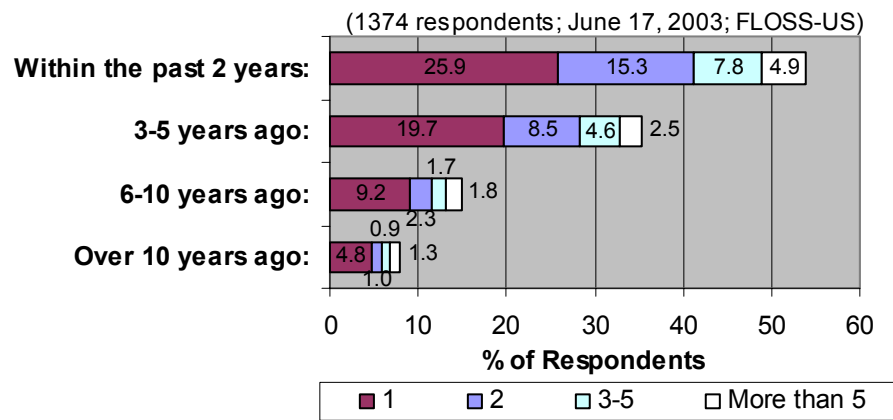

Figure 27: Experience on OS/FS projects receiving support from a business corporation or consortium, private or public foundation, or other source of funding (Q31)
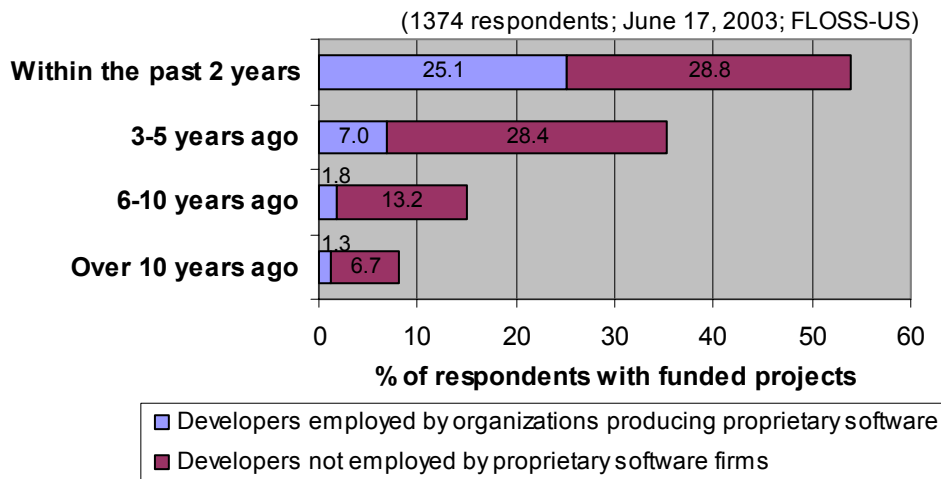

Figure 28: Employment and external support for OS/FS projects (Q30 & Q31)

Respondents indicated the types of organizations, if any, that have supported their OS/FS projects in the past, allowing us to estimate how different organizations' support for OS/FS has grown over the last several years. On average, between 3-5% of OS/FS projects were supported by each type of organization (computer hardware companies, proprietary software vendors, software consulting companies, universities, etc.) 3-5 years ago, and 4-7% of projects were supported by each type of organization in the last 2 years. Support for OS/FS projects has increased during this time the most coming from software consulting companies (+3.1%), and support has increased the least from makers of PDAs and other internet devices (+0.4%). (see Figure 29)
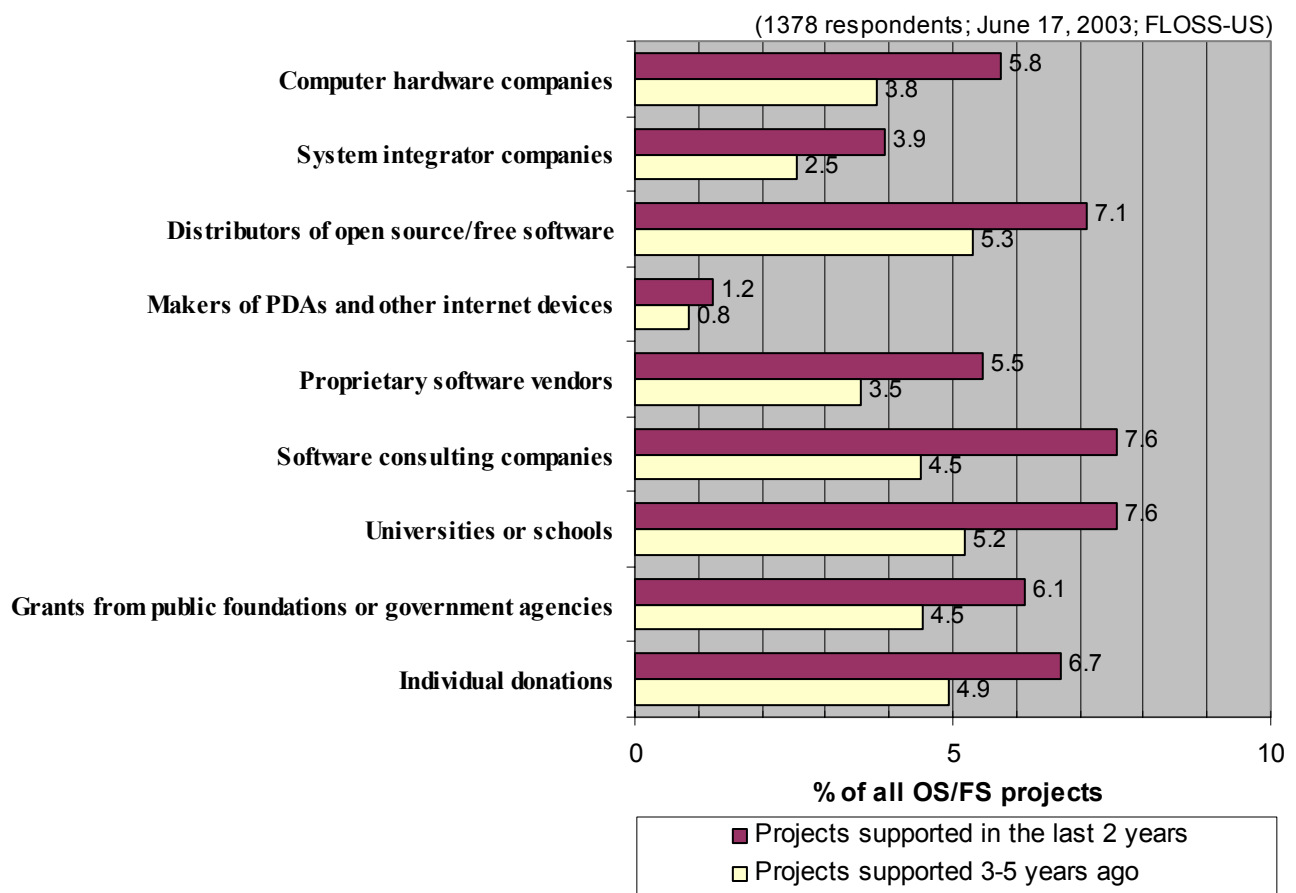

(1378 respondents; June 17, 2003; FLOSS-US)

Organization	Projects supported in the last 2 years	Projects supported 3-5 years ago
Computer hardware companies	5.8	3.8
System integrator companies	3.9	2.5
Distributors of open source/free software	7.1	5.3
Makers of PDAs and other internet devices	1.2	0.8
Proprietary software vendors	5.5	3.5
Software consulting companies	7.6	4.5
Universities or schools	7.6	5.2
Grants from public foundations or government agencies	6.1	4.5
Individual donations	6.7	4.9

% of all OS/FS projects

■ Projects supported in the last 2 years
□ Projects supported 3-5 years ago

Figure 29: Estimated support for OS/FS projects (Q31 & Q32)
Q31 asked, "Among the OS/FS projects in which you have been involved, how many received some support from a business corporation (or consortium), private or public foundation, or other sources of funding?" in the past 2 years, and 3-5 years ago. Q32 asked, "Who supported any of the OF/FS projects in which you have been involved during the past 5 years?" If someone had 3 projects supported by 2 different types of organizations – computer hardware companies and system integrator companies – we would estimate that 1.5 projects were supported by each type of organization. We also assume here that all respondents work on different projects.

VI. LEADING AND LAUNCHING PROJECTS

A large number of developers launched their most recent OS/FS projects: ⅓ of respondents launched their projects alone, while 13.8% launched their project with the help of others. (see Figure 30) 52.9% of respondents launched their current projects, 49.6% have the role of "project maintainer"[13] for their current projects, and 42.1% launched their current project *and* are the project's "project maintainer." (see Figure 31) Only 31.6% of respondents have never been a project maintainer, and we estimate that developers have been project maintainers on average 2.2 times. (see Figure 32)
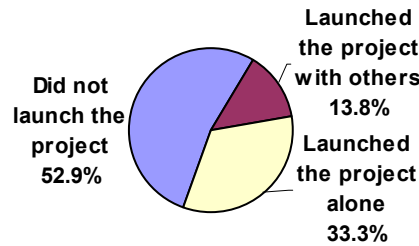
(1487 respondents; June 17, 2003; FLOSS-US)

Launched the project with others 13.8%

Did not launch the project 52.9%

Launched the project alone 33.3%

FIGURE 30: Launching current OS/FS projects (Q22)

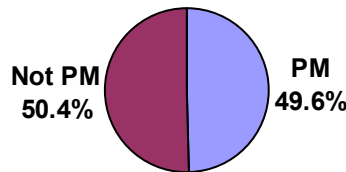(1481 respondents; June 17, 2003; FLOSS-US)

Not PM 50.4%

PM 49.6%

FIGURE 31: Respondents who are the "project maintainer" for their current OS/FS project (Q24)

(1480 respondents; June 17, 2003; FLOSS-US)

Never — 31.6
1 time — 27.6
2 times — 15.7
3-5 times — 15.6
5-10 times — 3.8
More than 10 times — 5.7

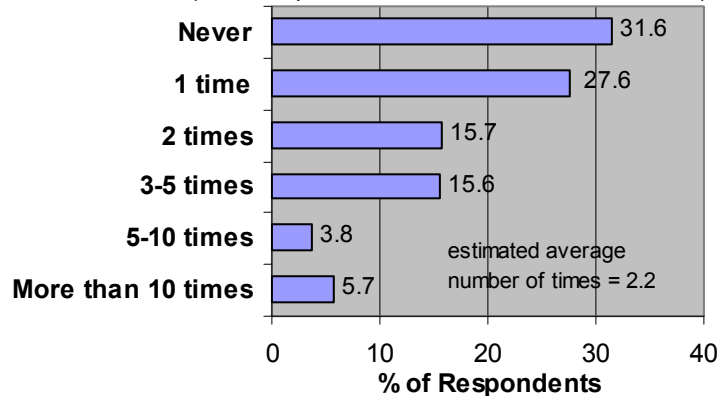estimated average number of times = 2.2

% of Respondents

FIGURE 32: Number of times occupying the "project maintainer" role (Q25)
We estimated the average number of times as PM by assuming that those who selected "3-5 times" have on average been PM 4 times, "5-10 times" on average 7.5 times, and "More than 10 times" on average 12 times.

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[13] The "project maintainer" of an OS/FS project is generally the person in charge of the project, who oversees the project's development and decides which code is included in the project's release version, among other responsibilities.

The questionnaire asked respondents what roles in OS/FS development they expect the project maintainer to have, and what they think the project maintainer should expect other developers to contribute. A large majority of respondents believed project maintainers ought to coordinate the contributors to a project (87.5%), resolve technical disagreements between contributors (81.3%), release new versions of the code (81.9%), select which code will be included (slightly fewer, at 68.9%), and give credit to a contributing developer (73.8%). Very few respondents believed a project maintainer should intervene as little as possible (22.9%) or do nothing at all (0.5%). (see Figure 33)

Almost all respondents thought the other project contributors can be expected to test the software and submit bug reports or patches (92.8%). Slightly fewer respondents, but still a majority, expect other contributors to use the software and request features (72.7%), to program new enhancements (76.9%), to help fellow participants and less experienced users of the software (75.4%), and to acknowledge the work of other developers who take over the project (57.8%). (see Figure 34)
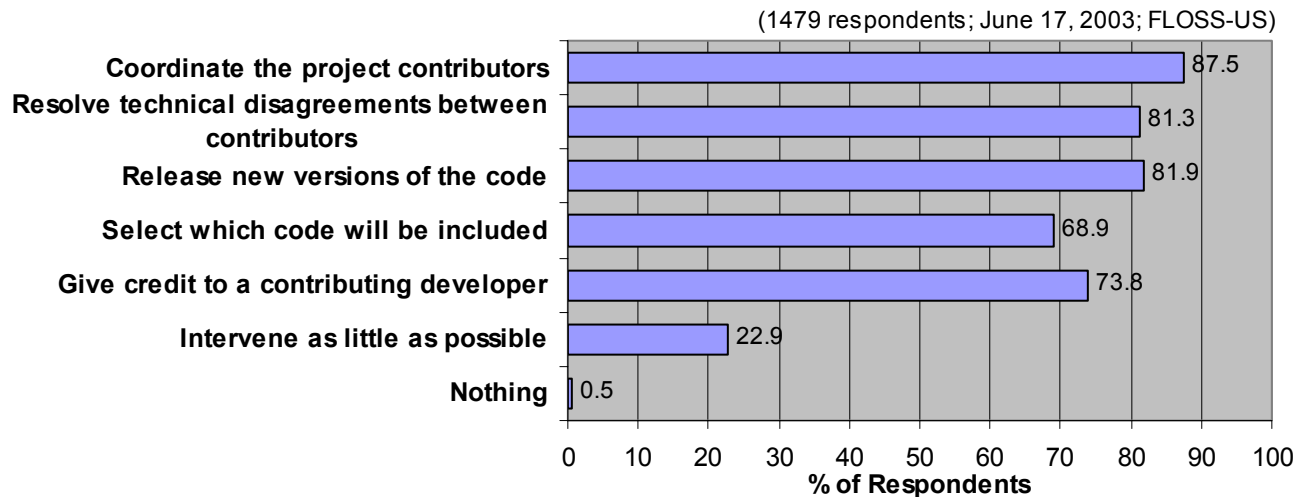

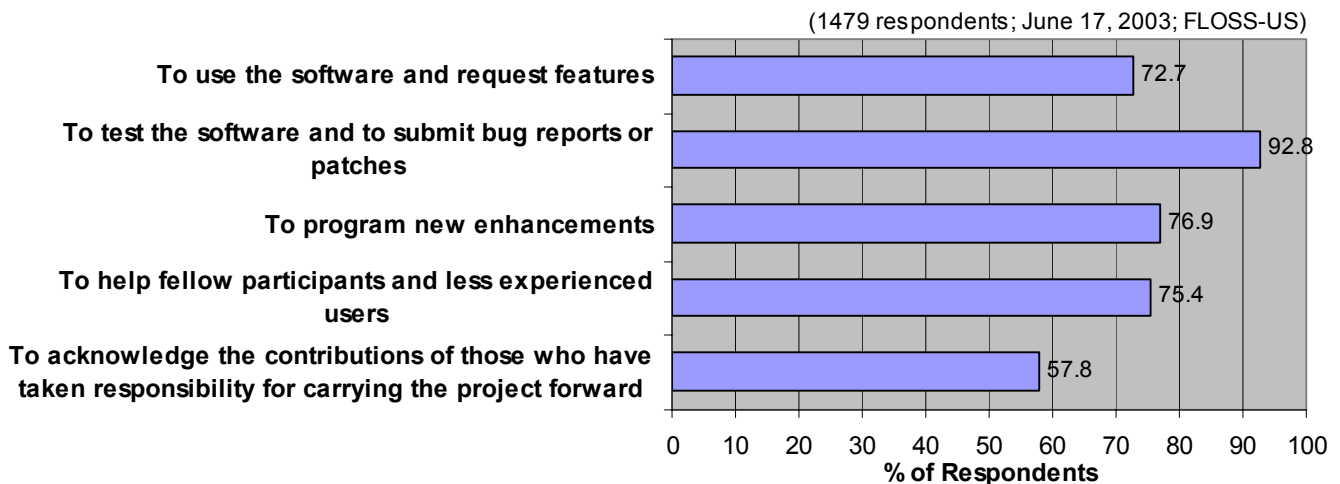**FIGURE 33: Expected roles for project maintainers (Q26)**

FIGURE 34: Expected roles of contributors other than the project maintainer (Q27)

Those who launch or lead each project will most often choose what open source or free software licensing restrictions should apply to the project. When asked what they consider the proper roles of an OS/FS license, most respondents believed that an OS/FS license generally protects the software's users' freedom (83.0%) – demonstrating the dominant ideology that software developed proprietarily does not give its users enough freedom and control. However, almost half of respondents still wish to allow commercial firms to use the OS/FS they create (46.0%). Even OS/FS developers, who give away their software for free, are commonly concerned about taking credit for their work (45.6%) and preventing others from appropriating their work (59.7%). (see Figure 35)

Almost all OS/FS developers choose to use development tools that also are protected by open source licenses. 73-90% of respondents used compilers, editors, development environments, and code depositories falling under the GNU General Public License or the LGPL, 24-39% used tools with BSD licenses or other open source licenses, and only 6-21% used proprietary tools. (see Figure 36)
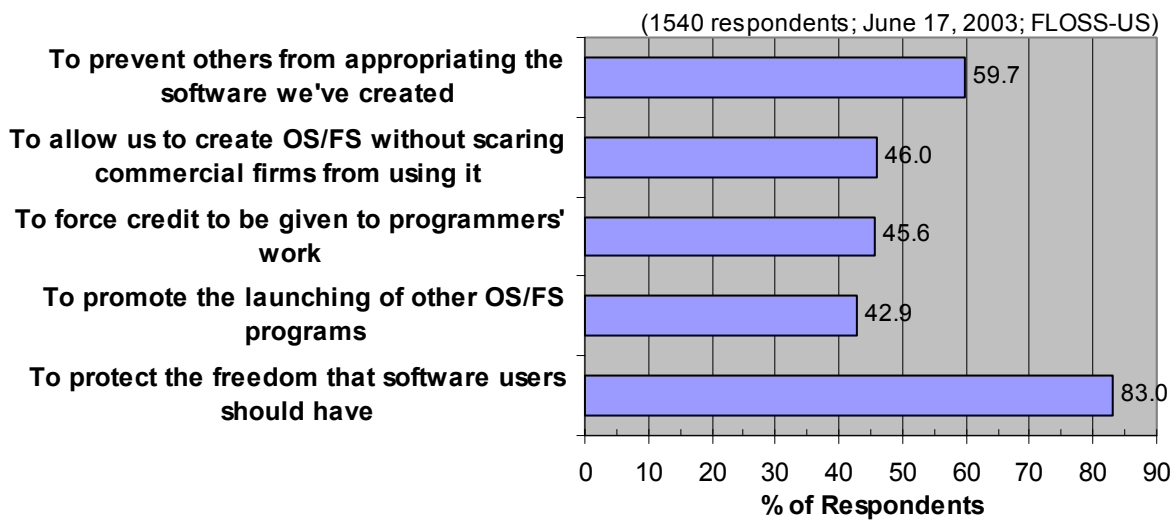
(1540 respondents; June 17, 2003; FLOSS-US)

	% of Respondents
To prevent others from appropriating the software we've created	59.7
To allow us to create OS/FS without scaring commercial firms from using it	46.0
To force credit to be given to programmers' work	45.6
To promote the launching of other OS/FS programs	42.9
To protect the freedom that software users should have	83.0

Figure 35: Roles of an OS/FS license (Q7)

(1519 respondents; June 17, 2003; FLOSS-US)

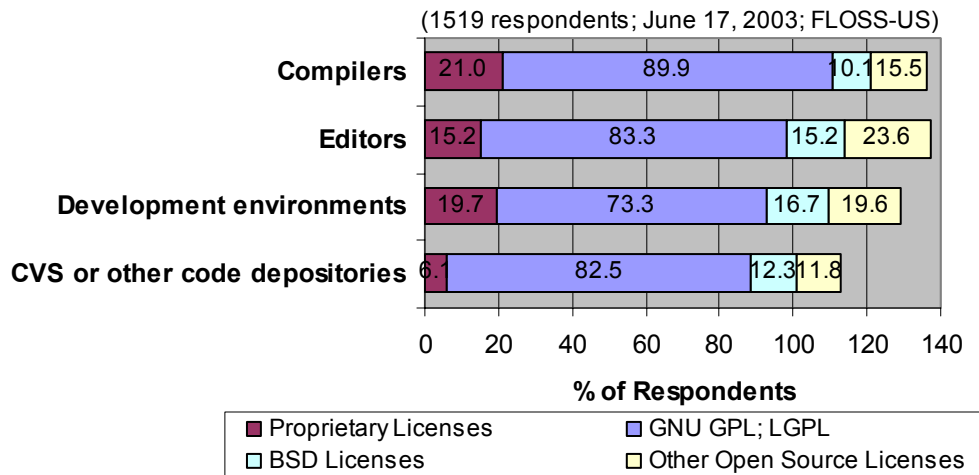|	Proprietary Licenses	GNU GPL; LGPL	BSD Licenses	Other Open Source Licenses
Compilers	21.0	89.9	10.1	15.5
Editors	15.2	83.3	15.2	23.6
Development environments	19.7	73.3	16.7	19.6
CVS or other code depositories	6.1	82.5	12.3	11.8

% of Respondents

Figure 36: Licensing restrictions on OS/FS programming tools (Q8)

VII. CONTRIBUTIONS TO OS/FS PROJECTS

Most of the developers surveyed have contributed to only a few projects[14], although some have contributed to quite a few projects. The average number of projects to which they have contributed is 5.5, and the median number is 3. About 100 respondents have contributed to 10 projects, and others have contributed to more projects, with one person claiming to have contributed to 50 projects. The number of projects roughly follows a Poisson distribution, as would be expected if there is some constant probability that a developer would join a new project. (see Figure 37)
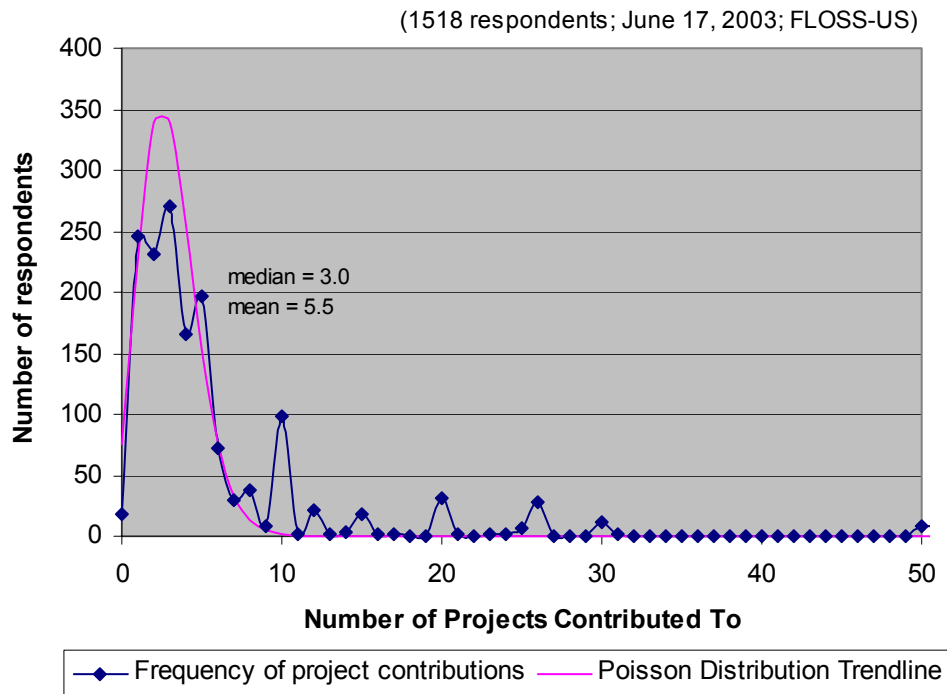

FIGURE 37: Number of projects to which developers have contributed (Q9)

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[14] Several respondents found Q9 difficult to answer, because they did not know exactly what defines a "project" or a "contribution." Should a large module of Linux be considered a "project," or is only Linux itself a "project"? Does a single bug report count as a "contribution" to a project, or is only code included in the project's release version considered a "contribution"? Nevertheless, interesting trends emerge in Figure 37 and 38, despite the variations in answers that would arise from ambiguous language.

The number of developers contributing to any *single project*, however, obeys a distinctly different distribution. As shown in Figure 38, the relationship between the number of contributors, **N**, and the number of projects with **N** contributors, **F(N)**, roughly follows a "power law distribution," where **F(N) =** **c·N$^{-\delta}$** for some coefficient **c** and some "degree" coefficient $\delta > 0$ (and therefore **log$_{10}$ F(N)** slopes downward linearly with **log$_{10}$ N**). A similar power law distribution was observed by Healy and Schussman[15].

Few projects have more than a handful of contributors. Only 37.8% of projects had more than 10 total contributors. The average number of contributors per project was 325.3, but the median was 6.[16] In Healy and Schussman's data set, only 5% of projects had 5 or more developers, the average number of developers per project was 1.7, and the median was 1.
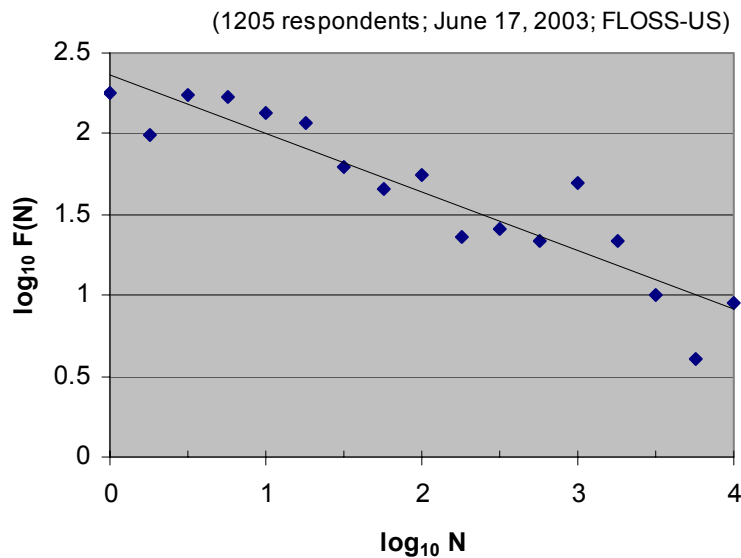

FIGURE 38: Number of developers that have contributed to current OS/FS projects since the projects were launched (Q20)
(where **N** is the number of contributors to a project, **F(N)** is the number of projects with **N** contributors, and all values of **N** were rounded to the nearest multiple of 0.25 on the **log$_{10}$ N** scale)

[15] See Healy, Kieran and Schussman, Alan. (January, 2003) "The Ecology of Open-Source Development." Working paper, http://opensource.mit.edu/papers/healyschussman.pdf.

[16] The values of **F(N)** shown in Figure 38 indicate the total number of respondents who answered the question, "Approximately how many people have contributed since the project's launch?" with a value near **N**. These values of **F(N)** might be skewed too high for higher values of **N**, since it is likely that multiple respondents working on the *same* project all answered the question. If the true values of **F(N)** are in fact lower, then the large projects like Linux are even less common than Figure 38 would indicate.

These results refute the assumption that huge number of contributors to Linux is typical of all OS/FS projects. Linux, with tens of thousands of contributors, is more appropriately thought of as the *outlier* of all OS/FS projects, which has happened to gain notoriety for being so large a project and for competing against Microsoft Windows. Most OS/FS projects, instead, do not benefit from many developers' contributions and must be completed by only a small group of devoted programmers.[17]

The sizes of the OS/FS projects, however, do not follow a power law distribution. Instead, Figure 39 shows that on the log scale, the number of lines in a project approximately follows a normal distribution, with a mean of 4.22 and standard deviation of 1.14 (that is, an average of $10^{4.22} = 16600$ lines of code). The "typical" OS/FS project has around 10,000 lines of code, even though the majority of projects are coded by fewer than 10 developers.
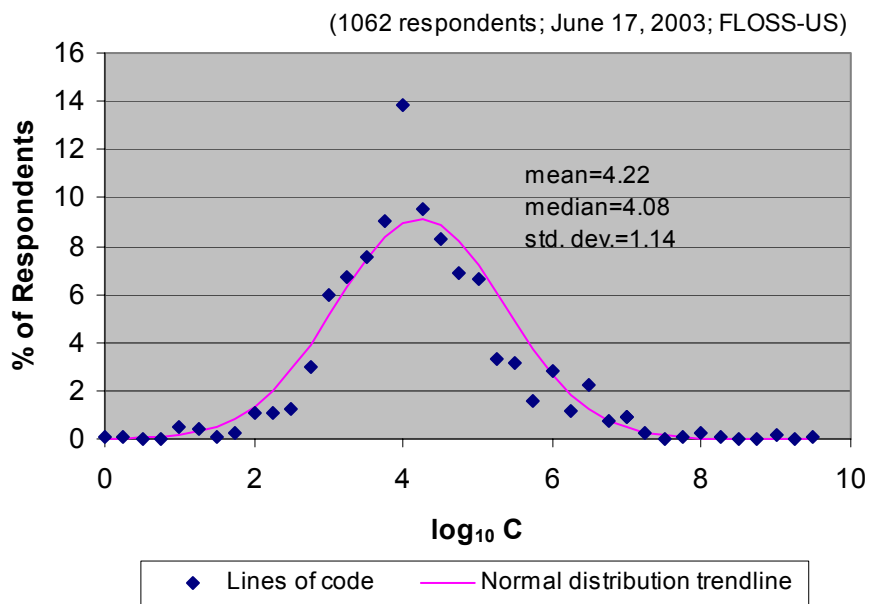

(1062 respondents; June 17, 2003; FLOSS-US)

mean=4.22
median=4.08
std. dev.=1.14

FIGURE 39: Lines of code in developers' current OS/FS projects (Q20)
(where **C** is the total number of lines of code in a project)

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[17] If a few programmers must do all the work needed to complete a project themselves, and their project will gain little publicity, why do they choose to publish their source code openly and give away their software for free? We address this question, which has drawn answers from many economists and sociologists, in Waterman (2003). "Why They Do It, and What that Implies for the Boundaries of Open Source Development Projects" SIEPR – Project NOSTRA Working Paper.

A significant fraction of respondents (30.4%) wrote more than 95% of the code that was included in their project. Nevertheless, a significant fraction of respondents (30.7%) contributed less than 5% of their project's code, including all who contribute small pieces of code or bug-fixes to large projects. (see Figure 40) Also, 45.1% of respondents considered their contributions to their most recent project "very significant," while 24.7% considered their contributions "nominal" or "insignificant." (see Figure 41) There appear to be two significant groups of developers: those who do all of their project's coding, and those who contribute only incrementally.
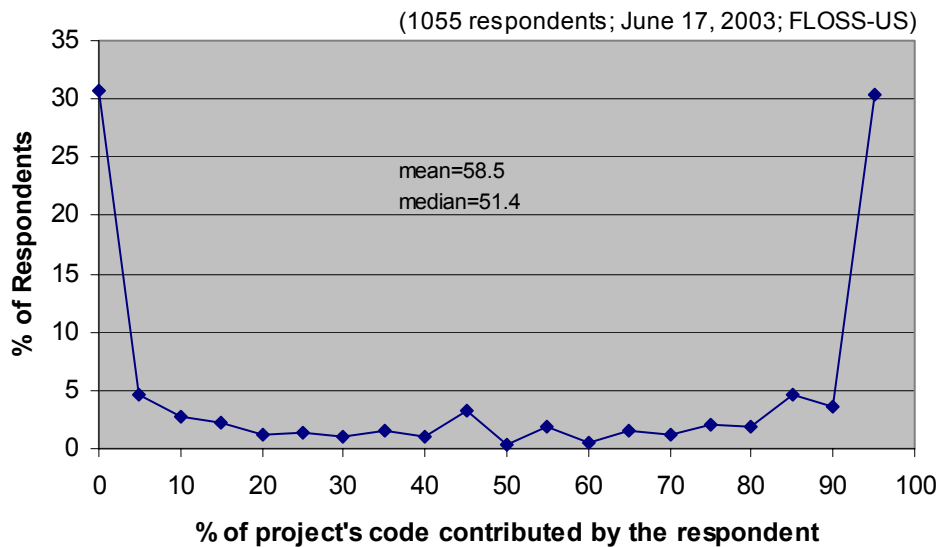

FIGURE 40: Respondents' contributions to OS/FS projects (Q20)
(Note: The point at 0 indicates answers between 0.0 and 5.0%;
the point at 5 indicates answers between 5.01 and 10.0%, etc.)
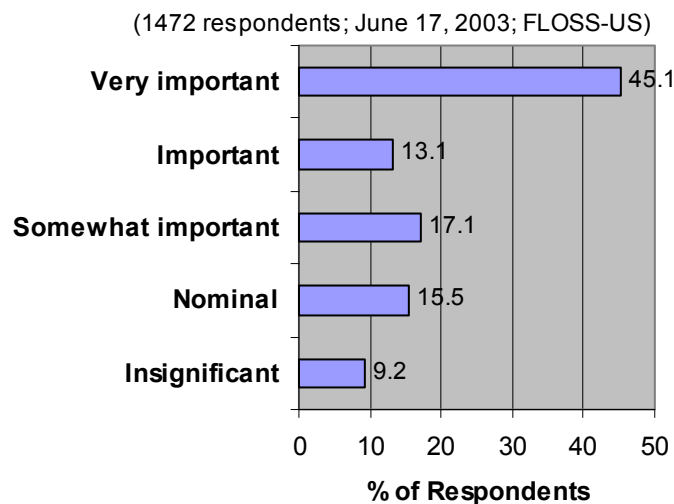

FIGURE 41: Importance of respondents' contributions to their current OS/FS projects (Q21)

Developers appear to become more influential contributors to their OS/FS projects over the course of their careers. On average, more of the code developers submit to their most recent projects is included in the project's release version than the code they submitted to their first projects. We estimate roughly that 63% of the code submitted to respondents' most recent projects was included in the release versions, while roughly 58% of their code was included in their first projects' release versions. (see Figure 42)

The time it takes for code to be included in the release version once it is accepted seems to decrease over a developer's career. We estimate that the average number of days for the code to be accepted was 21 during developers' first projects, but it only took 16 days on average for their code to be included in their most recent project's release version. (see Figure 43)

Also, developers tend to play more roles in their OS/FS projects, and perhaps more leadership-oriented roles, as their careers progress. As shown in Figure 44, respondents play *every* role more commonly in their most recent projects than in their first projects. The percentage of respondents increase most notably from their first to their most recent projects increase in project maintaining (+10.4%), algorithm design (+9.8%), documentation (+8.9%), user interface design (+7.9%), communication (+7.6%), and coding (+6.4%) – all of which are tasks done often by a software project's leaders. Only 1.7% more respondents, however, provided feedback on bugs, features needed, and enhancements in their most recent project than in their first project, indicating that such roles are either left to the "newbies" or simply less desirable.
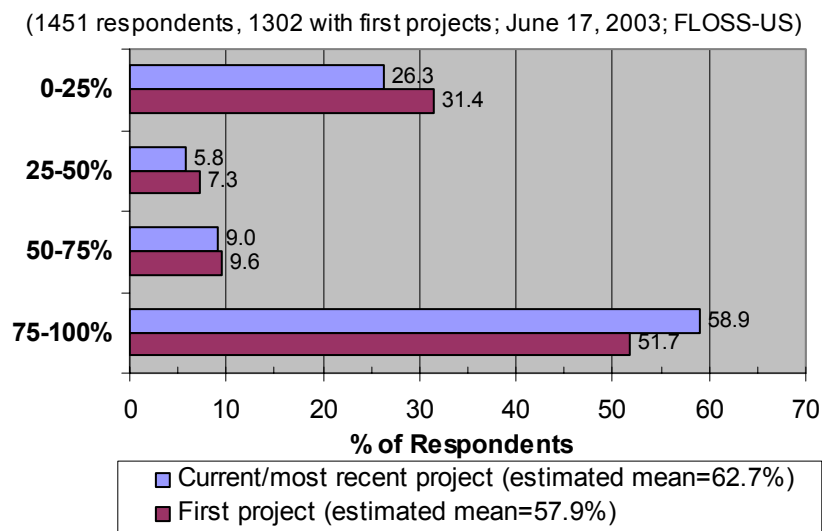
(1451 respondents, 1302 with first projects; June 17, 2003; FLOSS-US)

	Current/most recent project (estimated mean=62.7%)	First project (estimated mean=57.9%)
0-25%	26.3	31.4
25-50%	5.8	7.3
50-75%	9.0	9.6
75-100%	58.9	51.7

% of Respondents

FIGURE 42: Amount of code submitted that is included in a project's release version (Q17)
(Note: The estimated means are calculated by approximating the answer 0-25% with 12.5%, 25-50% with 37.5%, 50-75% with 62.5%, and 75-100% with 87.5%)
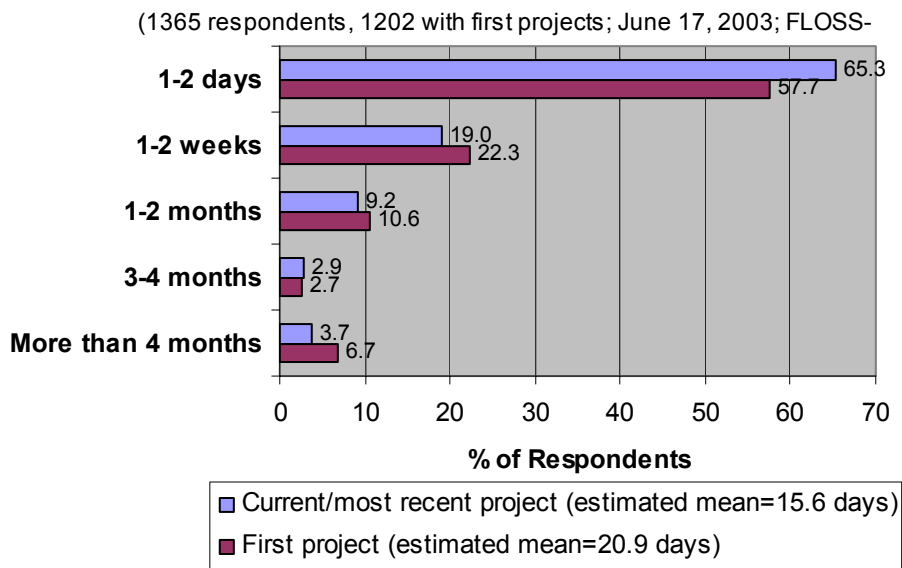
FIGURE 43: Time for submitted code to be included in a project's release version (Q18)

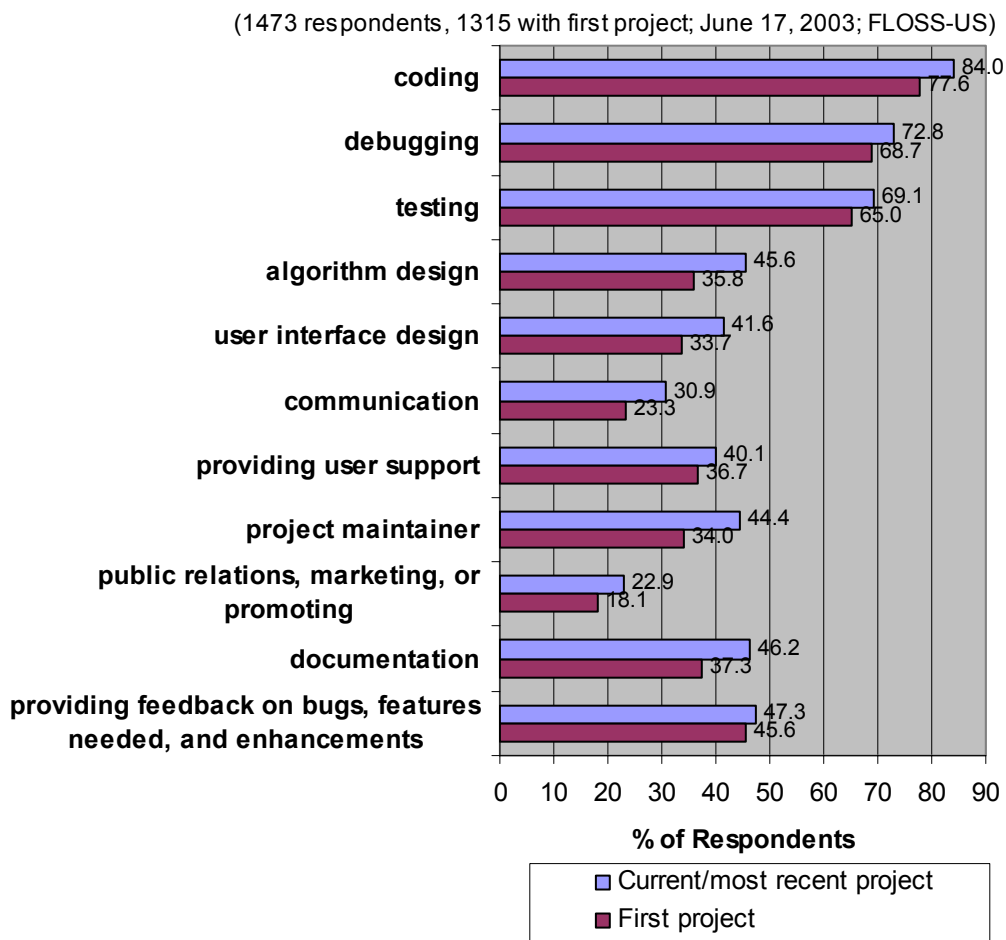(1473 respondents, 1315 with first project; June 17, 2003; FLOSS-US)

FIGURE 44: Roles played in OS/FS projects (Q16)[18]

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[18] We asked that respondents not select more than 3 roles per project; however 986 respondents still chose more than 3 roles.

VIII. TIME CONTRIBUTED

Working on their current or most recent projects, developers by far spend the most time coding or debugging and testing their software. 79.5% of respondents spent "a substantial amount" of time or more coding, and 80.4% spent that much time debugging and testing, but many more respondents spent "all or a majority" of their time coding (57.3%) than debugging and testing (35.9%). Many respondents also spent a substantial amount of time designing algorithms or the user interface (51.2%), communicating with other programmers (49.6%), or documenting the code (42.1%), but few developers spent a substantial amount of time promoting the project and in public relations (26.7%). (see Figure 45) Most developers work on OS/FS projects after work (73.1%) or on weekends (74.6%), and surprisingly many developers work on OS/FS while at work, either during work hours (40.7%) or off work hours (25.0%). (see Figure 46)
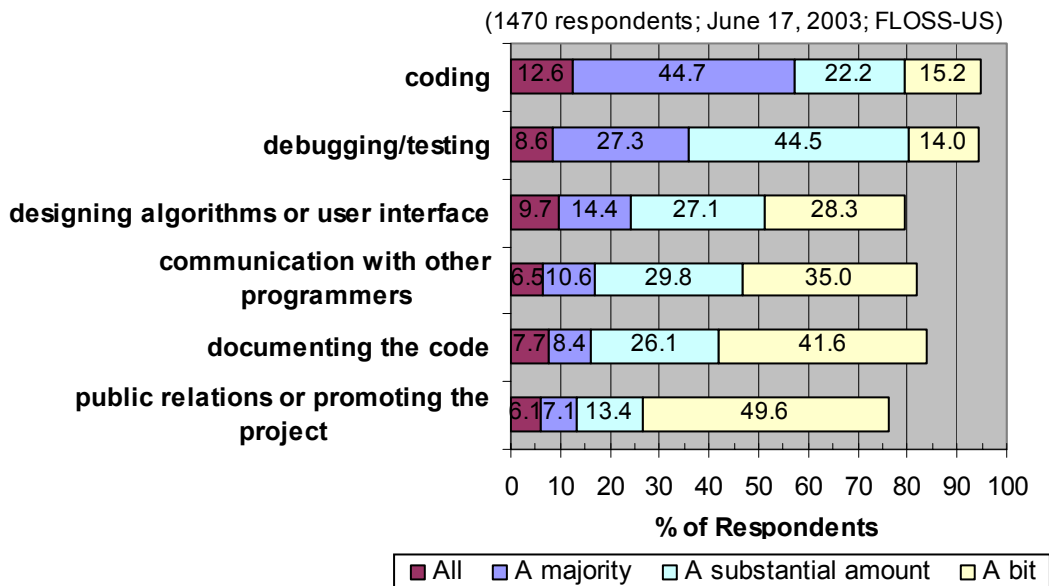
(1470 respondents; June 17, 2003; FLOSS-US)

	All	A majority	A substantial amount	A bit
coding	12.6	44.7	22.2	15.2
debugging/testing	8.6	27.3	44.5	14.0
designing algorithms or user interface	9.7	14.4	27.1	28.3
communication with other programmers	6.5	10.6	29.8	35.0
documenting the code	7.7	8.4	26.1	41.6
public relations or promoting the project	6.1	7.1	13.4	49.6

% of Respondents

■ All   □ A majority   □ A substantial amount   □ A bit

FIGURE 45: Time spent on different activities when contributing to OS/FS projects (Q23)

(1488 respondents; June 17, 2003; FLOSS-US)

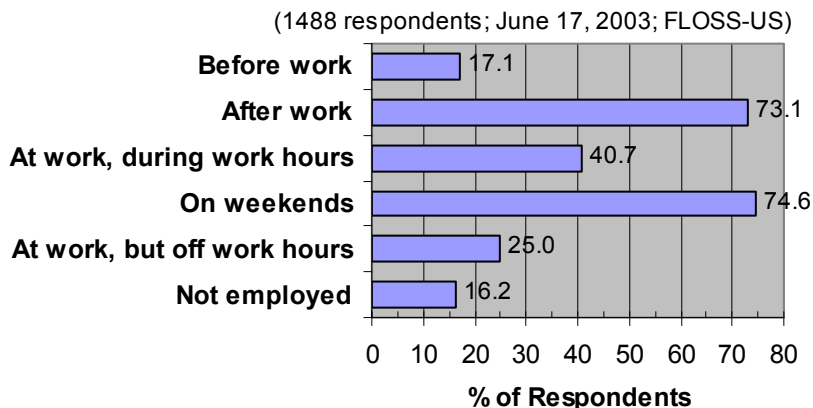|	% of Respondents
Before work	17.1
After work	73.1
At work, during work hours	40.7
On weekends	74.6
At work, but off work hours	25.0
Not employed	16.2

% of Respondents

FIGURE 46: When developers work on OS/FS projects (Q37)

Most projects last for less than two years (66.1% of current projects, and 55.6% of first projects). Developers' current projects last on average for 1.9 years, while their first projects were slightly longer, lasting on average for 2.6 years. (see Figure 47) Projects are completed more quickly perhaps because developers are spending more time on open source development every week. Developers spend an average of 11.4 hours per week on their current projects, more than the 9.5 hours per week they spent on average working on their first projects. (see Figure 48) Since developers accomplish more each week as their careers progress, their projects are completed more quickly.
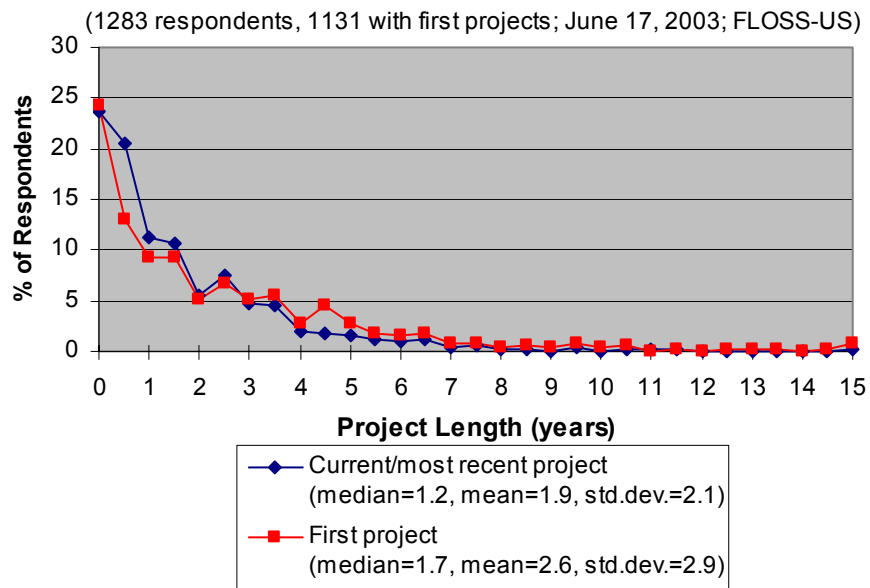

(1283 respondents, 1131 with first projects; June 17, 2003; FLOSS-US)

Current/most recent project
(median=1.2, mean=1.9, std.dev.=2.1)
First project
(median=1.7, mean=2.6, std.dev.=2.9)

FIGURE 47: Length of OS/FS projects (Q11)
(Note: The point at 0 indicates projects 0-0.5 years long;
the point at 0.5 indicates projects 0.51-1 year long, etc.)

(1437 respondents, 1257 with first projects; June 17, 2003; FLOSS-US)

Developer's most recent/current project
(median=7, mean=11.4, std. dev.=12.1)
Developer's first project
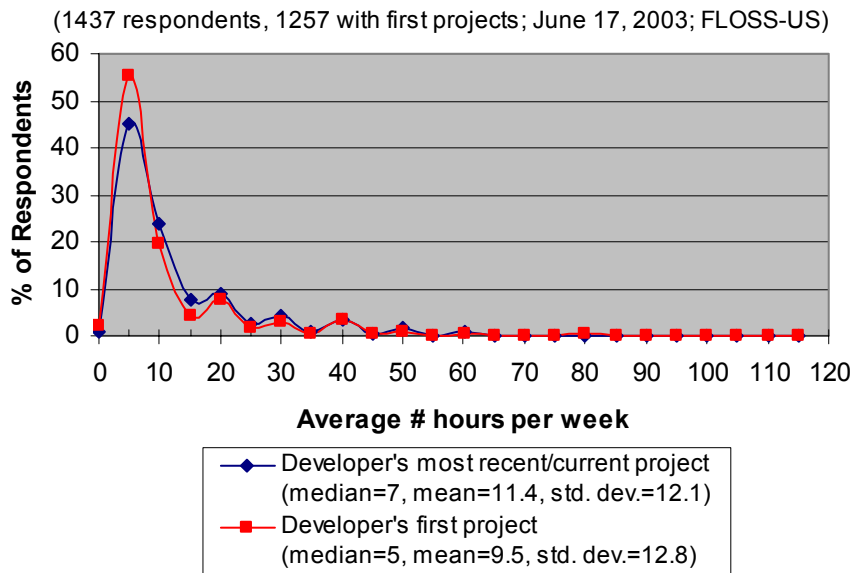(median=5, mean=9.5, std. dev.=12.8)

FIGURE 48: Average hours contributed per week to an OS/FS project (Q13)

The questionnaire also asked about developers' most intense period of work on their projects, in contrast to the average amount of work they do each week. Developers' most intense periods of work on their most recent project involved, on average, 11.0 hours in one day, and 217.1 hours of work at this rate day after day for approximately three weeks (with a median of only 39 hours of total work). Their most intense periods of work on their first projects were less strenuous, taking an average of 9.7 hours in a day and 177.8 total hours over several days (median 30 hours total). (see Figures 49 and 50) Again, developers are working harder now than they did on their first OS/FS projects.
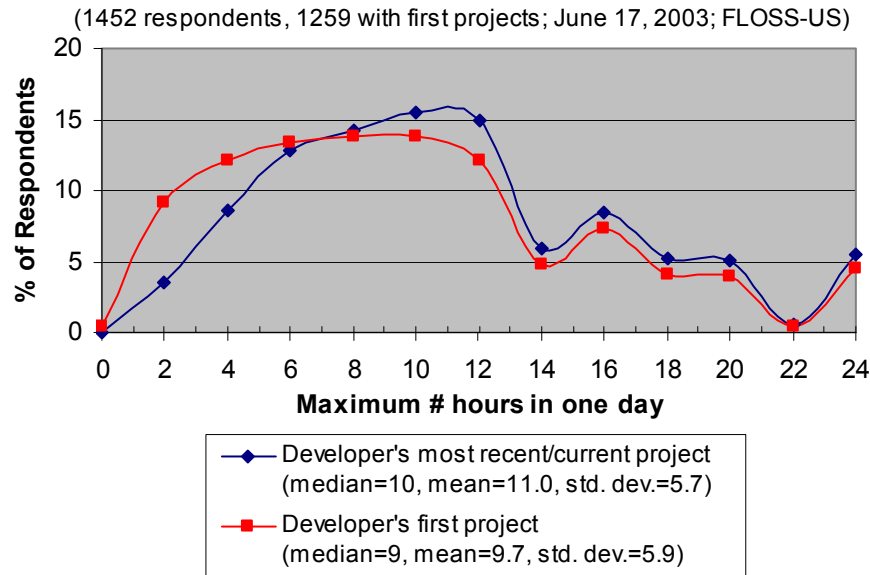

FIGURE 49: Maximum number of hours worked per day on a single OS/FS project (Q14)
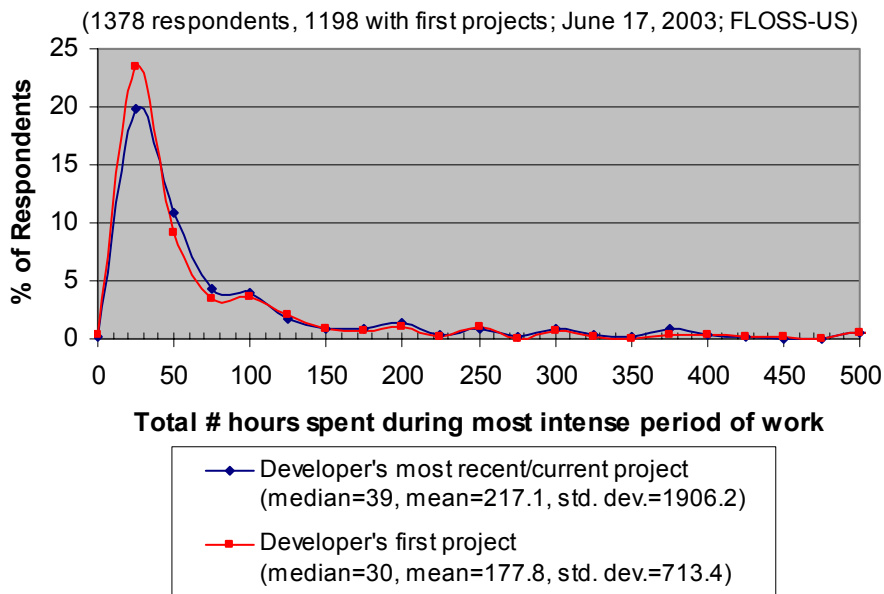

FIGURE 50: Total hours spent during a developer's most intense period of work (Q14 & Q15)
(Note: Q14 asks, "What was the greatest number of hours you can recall having worked in a single day on each project?" Q15 asks, "For approximately how many days did you work with that intensity on each project?" The total hours a developer spent during his most intense period of work is calculated here as the product of his answers to Q14 and to Q15.)

IX. CONCLUSIONS

The responses collected in the FLOSS-US survey yield a few general conclusions we may draw about the field of open source and free software developers:

- OS/FS developers tend to be highly educated and employed, with ambitions of advancing their careers in the future.

- Contributing to the community of developers, promoting the OS/FS movement, and improving software's functionality all frequently motivated respondents to start developing OS/FS. OS/FS developers tend to believe OS/FS development can supplant much of proprietary development.

- Approximately ½ of developers have earned money through their work on OS/FS. Support for OS/FS projects from external businesses and organizations has increased significantly since a decade ago. Now, more than half of developers have worked on externally supported projects.

- Approximately ½ of developers launched their projects and are the "project maintainer" for their current project.

- Most respondents support OS/FS licenses as means of protecting software users' general freedom and ensuring that credit is given for their work.

- Developers have contributed to an average of 5.5 projects, but most projects have very few contributors (median 6).

- Approximately ⅓ of developers have written almost all of their most recent project's code, and approximately ½ consider their contribution very important. Approximately ⅓ of developers have contributed only incrementally to their most recent project.

- Developers tend to be more influential in their projects, and they tend to work more hours per week and more intensely, as their career in OS/FS development progresses.

- Developers spend the most amount of time coding, debugging, and testing their software. They work on OS/FS mostly on weekends and after their employed work day is finished, although many work on OS/FS at their employed work.

These conclusions can be drawn about the majority of OS/FS developers who responded to the FLOSS-US questionnaire. However, the field of OS/FS developers is certainly not homogenous. Developers come from all over the world, with quite varied backgrounds, experience, motivations for joining OS/FS, levels of commitment to OS/FS, and roles in OS/FS projects. To understand what drives programmers to develop OS/FS, how they successfully work together, and how OS/FS development can successfully produce high-quality software, we must consider all the characteristics of, and the differences between, real OS/FS developers.