

Women in Free/Libre/Open Source Software: The Situation in the 2010s

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Abstract. Women are underrepresented in the IT sector. But the situation in FLOSS (free, libre, open source software) development is really extreme in this respect: past publications and studies show a female participation of around 2% to 5% and have shed some light into this problem. In this paper, we give an update the state of knowledge to the current situation of gender in FLOSS, by analyzing the results of surveying more than 2,000 contributors to FLOSS projects in 2013, of which more than 200 were women. Our findings confirm that women enter the FLOSS community later than men, do primarily other tasks than coding, participate less if they have children, and have slightly different reasons to enter (and to stay in) the development communities they join. However, we also find evidence that women are joining FLOSS projects in higher numbers in recent years, and that the share of women devoting few hours per week to FLOSS and full-time dedication is higher than for men. All in all, comparing our results with the ones from the 2000s, the context of participation of women in FLOSS has not changed much.

Keywords: Gender · FLOSS · Free software · Open source · Survey

1 Introduction, Motivation and Goals

The percentage of female participation in FLOSS projects is by all means very low (from 2% to 5% according to several surveys, such as FLOSS 2002 [7]). Although the IT industry already shows a disparity in gender, the amount of women is estimated to be between 25% and 30% [8], in FLOSS projects this disparity is even larger. Some projects, such as GNOME, have been actively promoting participation of female collaborators by means of scholarships exclusively for women. In many projects, as for instance Debian, there are specific mailing lists to welcome new female contributors and discuss how to increase participation of women. However, even if this fact has been known for over a decade now, the situation changes at a slow rate.

The goal of this paper is to provide some insight on the current participation of women in FLOSS development communities, testing and extending findings from previous studies on female participation in FLOSS. For that, we have used data obtained by means of an open web survey, answered by FLOSS contributors. We have analyzed answers by men and women to different questions, mainly regarding their involvement with FLOSS, their educational level and background, and their personal status.

The structure of this paper is as follows: next, related research, in particular studies on the involvement of women in FLOSS, is presented. Section 3 contains the research questions. Then, we will introduce the methodology. Section 5 offers the results obtained for the research questions. Finally, some conclusions are drawn.

2 Related Research

An ample research literature exists on gender issues in IT. In the context pertinent to this paper, many efforts have been devoted to better understand why the number of women in science, technology, engineering and mathematics (STEM) is so low [8]. It is interesting to note that this gender gap has not only been reported at the professional level, but as well on related activities such as accessing the Internet [2]. In this regard, scholars have studied whether the problem of such a low share of women lies in a “leaky pipeline” or in a “gender filter” [4], even to the point of asking students directly about this issue [11], and have theorized about it [15].

Among STEM, computer science and programming are areas where male predominance is among the largest [10], something which is not easy to explain. Some recent studies postulate that a wider perspective of the problem is needed, keeping into account “metaphors of programming, inclusion and exclusion, the notion of beautiful code, understandings of masculinity and programming” to “obtain a more complex analysis than a dualistic focus on differences between men and women” [3].

Some studies focus on the area of FLOSS, where the amount of women is dramatically low [5]. For example, Adam has written about gender and the hacker phenomenon [1], or Vasilescu et al. have studied StackOverflow, the largest Q&A site for programming and technical questions nowadays, to measure quantitatively online participation and representation of gender [16].

Other studies have studied female joining and participation patterns in FLOSS (and if they differ from the ones of males). So, Qui et al. have studied how women join and socialize in the KDE-women group [13], while Kuechler et al. found a disproportionate participation rate in several FLOSS projects under study [9].

Probably, the most significant effort on the gender issue on FLOSS is the integrated report of findings authored by Nafus, Leach and Krieger in the framework

of the European funded FLOSSPOLs research project [12]. As one of the key findings, FLOSSPOLs states that “[w]omen are actively (if unconsciously) excluded rather than passively disinterested” and offers some interesting insight on how this is related to the hacker ethic. The research presents some evidence that women start later using computers and having computers on their own, and explains some of its findings by stating that women engage mainly in activities different than coding or that women have a burden as they normally still assume a disproportionate amount of domestic responsibilities. To some extent, this research wants to update the findings from the FLOSSPOLs project, with data from almost a decade later – the FLOSSPOLs data is from 2005, while the one used in this research is from late 2013.

3 Research Questions

This paper addresses specifically the following questions:

1. Do men and women incorporate themselves to the FLOSS movement at the same age? Is the number of women entering FLOSS growing in the last years?
2. Do men and women perform the same type of contributions in FLOSS projects? Do they lead (coordinate) the same number of projects?
3. Is the proportion of men and women with children and collaborating in FLOSS projects similar?
4. Are reasons to start and to stay in FLOSS development similar for men and women?
5. Do men and women devote the same amount of time to FLOSS projects?

With these questions, we aim to address not only the reasons, as perceived by the studied individuals, but also the actual situations that could help to learn about the context for those reasons.

Finally, we would like to compare our results with the ones known from the FLOSSPOLs project, to see if any changes can be seen in the “gender issue” in FLOSS after one decade.

4 Methodology

The data used for this research has been obtained by means of a survey. This survey, called FLOSS 2013, tried to follow the same philosophy as the one of the original, and well-known FLOSS 2002 survey [7]. Thus, it is an open web-based survey, where participation is self-selected. The strategy to attract survey respondents has been to announce the survey in those channels where FLOSS developers communicate, specifically community news sites (such as Slashdot) and mailing lists. In addition to communication flows already used in FLOSS 2002, we spread the news of the survey through Twitter and other (free) social networks.

We made an important effort to preserve the privacy of the survey respondents. Thus, the survey could be answered anonymously, as IP addresses of respondents were not tracked and cookies were not used. However, participants were asked to provide their e-mail address –or some part of it– to validate that they really were FLOSS contributors. Respondents were also informed that their answers would be made publicly available in an anonymized way. Hence, if the e-mail address had been introduced, this would be handled as private information that would not be made public or shared with other research groups.

We intended to be as close as possible to the original FLOSS 2002 questionnaire in order to allow comparisons. However, some questions were added, others removed and some modified, after over a dozen meetings involving the authors where the questions were individually addressed for their meaning and goals. Mainly the changes were because of the following reasons: (1) the experience from the original FLOSS 2002 survey had shown that the question was not clear enough; (2) we modified the question adopting it to the current situation; (3) we wanted to obtain information about a new phenomenon/situation that was not relevant ten years ago; and (4) we removed the question because we thought it was of no interest for the survey or that this information can be gathered by other means, such as by mining software repositories (versioning systems, issue tracking systems, mailing lists, Q&A-sites, etc.).

An example of a question added to address the current situation (type 2 and 3) is the one related to the type of contribution to FLOSS. The original FLOSS 2002 survey focused exclusively on software developers, but the FLOSS phenomenon, even if the final product is a software, includes a number of other participants that do not code, such as translators, artists, community managers, promoters, etc. As a consequence, we target with FLOSS 2013 not only FLOSS developers, but all type of contributors. To implement this, a first question was added asking about the type of contribution to FLOSS projects by the respondent. This was a branching question, as subsequent developer-related questions were only shown to developers. All questions in the survey were optional except this first one.

The survey consisted of a total number of 58 questions¹. The survey opened November 12th 2013 and closed December 6th 2013. The survey responses are publicly available on the survey website in several formats and is described in [14].

A limitation of the methodology is that our results are not representative of the percentage of women in FLOSS projects in general. This is because of the self-selected participation in the survey. However, the results of our survey allow to draw a picture of the context in which participation in FLOSS occurs, trying to identify differences. Actually, the survey has been especially promoted in female-specific mailing lists and communication channels to have sufficient respondents to be representative of this context.

¹ The complete questionnaire, including answers, can be obtained from <http://floss2013.libresoft.es/>.

5 Results

Table 1 provides the number of respondents to the FLOSS 2013 survey by gender. As respondents could leave any question unanswered, from the total number of 2,183 respondents, we only have information on the gender of 2,002 of them. 226 of them are women.

Table 1. Gender self-definition: number of respondents.

Gender	Respondents	Percentage
Male	1,776	81.36 %
Female	226	10.35 %
Other	33	1.51 %
NA's	148	6.78 %
Total	2,183	100.00 %

The question was addressing gender self-definitions (“*Which of the following describes how you think of yourself?*”) so a third option “In another way” with a textbox was included. Since the total number of respondents who selected this option is small (less than 50), we have chosen only men and women as groups of study. As there are almost 10 times more men than women who answered the survey, our results are given in relative terms.

5.1 Age and Date of Entry

Figure 1 shows how old respondents were when they entered the FLOSS movement – the figure on the left is the one for men, women are depicted on the right. We can infer visually that men start participating at an earlier age than women. So, while men and women peak both at 21 years, the tail for men is much more abrupt than for women; the values for men in the early 30s are a third of the ones of 10 years younger, while for women the values in the early 30s are over 70% the ones in the 20s.

Table 2. Distribution of age when starting to participate in FLOSS projects.

	Min.	1st Qu.	Median	Mean	3rd Qu.	Max.
Men	10.00	19.00	23.00	24.49	28.00	55.00
Women	13.00	22.00	26.00	28.01	33.00	55.00

Table 2 provides a basic statistical analysis for this question². As it can be seen, the age of incorporation for women is always higher than for men,

² 10 and 55 is given as the minimum/maximum age, because the survey allowed only responses such as “10 years or less” or “55 years or more”.

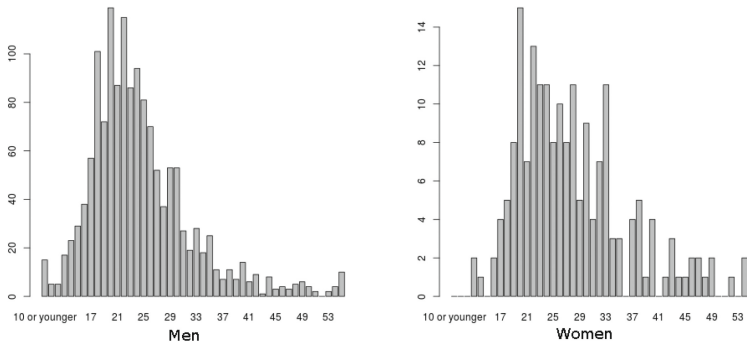


Fig. 1. Age of first contribution to FLOSS (men left, women right). The horizontal axis is in years, while the vertical axis gives the number of respondents of that age.

Table 3. Year of entry in FLOSS

	Men	%	Women	%
Before 1990	58	3.69	0	0,00
1990–1999	315	20.03	21	10.24
2000–2009	905	57.53	105	51.22
2010–2013	295	18.75	79	38.54
Total	1573	100.00	205	100.00

in general from three to five years. So, while half of the male contributors enter during their university years or before, for female this happens when many are already professionally active.

Table 3 shows that women entered the FLOSS movement more recently: 38.54% of women have started in the last four years (compared to only 18.75% of men) prior to the survey.

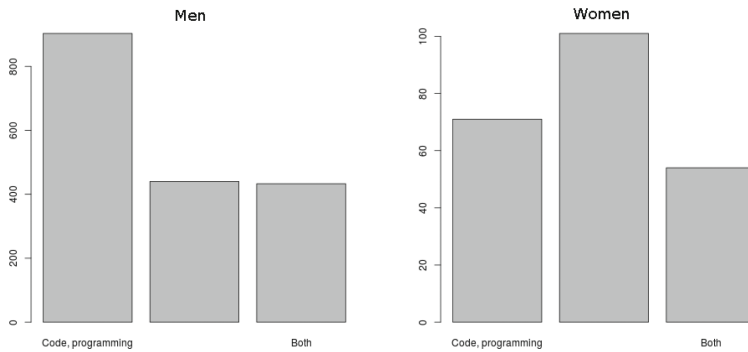
5.2 Type of Contributions and Number of Projects Involved

The FLOSS 2013 survey, in contrast to the original FLOSS survey from 2002, was open not only for FLOSS developers, but also to any other person who performed other type of contributions to FLOSS projects. Therefore a question was included, where respondents could specify if they were mainly coders, performed other activities (such as documentation, translations, tests, artwork...) or both.

Table 4 and Fig. 2 show that men are mostly devoted to coding and that the amount of male contributors who perform other tasks lies slightly above 20%. However, the distribution of contributions for women is different. In this case, other type of contributions is the main task performed (with almost 45%), while coding comes next (31%).

Table 4. Type of contributions to FLOSS projects.

Type	Men	Women
Code, programming	903	71
Other	440	101
Both	433	54

**Fig. 2.** Type of contributions to FLOSS projects (men left, women right). The vertical axis is given in number of respondents for the three choices: “code programming”, “other type of contributions” and “both”.

The survey asked in how many projects respondents were involved in as project leader, coordinator or administrator. Table 5 shows that 51.49% of women were involved in these kinds of tasks (compared to 65.89% of men). However, probably due to women entering FLOSS more recently, only (approx) 5% of women coordinate more than 3 projects (compared to 18.47% of men).

Table 5. Number of projects as leader, coordinator, or administrator.

	Men	Women
None	34.11 %	48.51 %
1	24.20 %	21.78 %
2	14.41 %	18.32 %
3	8.82 %	5.94 %
4 or more	18.47 %	5.45 %

5.3 Children

Figure 3 provides information on how many FLOSS contributors have children, sorted by gender. Results are presented in a bar plot, in such a way that the height of the “No” answer is the same, thus allowing to compare the proportions.

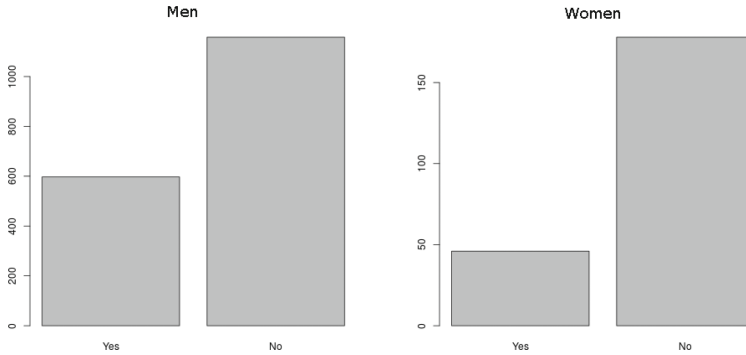


Fig. 3. Answers to the question “Do you have children?” (men left, women right). The vertical axis is given in number of respondents; it should be noted that the scale used in both graphs is not the same as it has been adjusted so that the number of “No”s are represented at the same height.

The graph shows that a minority of contributors to FLOSS have children, but that the number of men with children (34%) is proportionally twice as high as the number of women with children (19%).

5.4 Reasons to Start (and to Continue) Contributing to FLOSS

Table 6 shows the top seven reasons (with 20% or more respondents selecting them) to start in FLOSS for men, while Table 7 shows the reasons for women³.

The top reason for starting to contribute to FLOSS for both groups is to learn and develop new skills. Women give more importance to participate in new forms of cooperation, and men to improve FLOSS products of other developers. Improving job opportunities looks more important for women, but this could be because women are entering the FLOSS scene more recently, when the open source market has become more mature.

To find out if the reasons to stay contributing were the same or not, we have selected women and men that started later than 2011 in FLOSS, and checked the respondents of the multiple-optional question “*And today? For what reason(s) do you go on with contributing to FLOSS?*”. Learning and sharing knowledge and skills are still at the top both for men (58.98% and 57.28%)

³ The multiple-optional question was: “Remembering the time you started contributing to FLOSS, what was the reason for this?”.

Table 6. Top 7 reasons to start in FLOSS (men)

Reasons to start	% Men
To learn and develop new skills	62.39
To share my knowledge and skills	38.01
To improve FLOSS products of other developers	35.87
To participate in the FLOSS scene	29.56
Because I think that software should not be a proprietary product	25.79
To participate in new forms of cooperation	25.23
To improve my job opportunities	19.65

Table 7. Top 7 reasons to start in FLOSS (women)

Reasons to start	% Women
To learn and develop new skills	67.70
To participate in new forms of cooperation	38.94
To share my knowledge and skills	37.17
To improve my job opportunities	34.07
To participate in the FLOSS scene	33.63
Because I think that software should not be a proprietary product	28.32
To improve FLOSS products of other developers	21.24

and women (64.78 % and 62.26 %), and participating in new forms of cooperation is still more important for women (31.45 %) than for men (25.10 %), while men still focus on improving FLOSS products of others (39.18 %, against 28.30 % of women). However, improving the job opportunities is a similar concern for both genders (25.85 % of men, 25.79 % of women selected that option).

5.5 Involvement in FLOSS

While FLOSS was merely a volunteer activity in the mid-90s, in the last decade it has seen a high professionalization [6] and more contributors work full or part-time on FLOSS projects. Figure 4 presents the amount of time that respondents commit to FLOSS by gender. Although the distribution seems very similar at first, it is noteworthy that the share of women devoting less than 5 hours/week (53.69 %) is higher than for men (49.71 %), and that the amount of women working 40 or more hours per week (14.77 % of women, 12.01 % of men). So, when contributing to FLOSS projects women are over-represented among the less active participants or among the *professional* full-time FLOSS contributors, in the latter case probably working for an industrial software company.

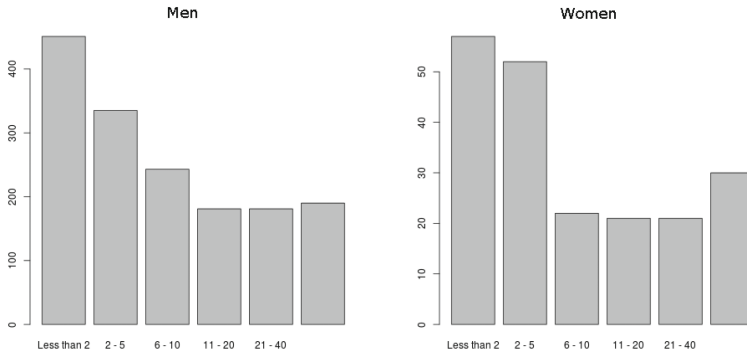


Fig. 4. Number of hours per week devoted to contributing to FLOSS projects (men left, women right). The vertical axis is given in number of respondents. Graphs have different scales.

6 Conclusions

In this paper we targeted a number of research questions presented in Sect. 3. Our results show that:

1. Women start to participate in FLOSS projects at a later age than men, and have begun to enter FLOSS projects in growing numbers in recent years.
2. Women perform majoritarily other types of contributions than coding, while men mostly contribute with code. More than half of the women are involved in leading, administering or coordinating FLOSS projects. The share of women leading projects is lower than for men.
3. The proportion of men with children contributing to FLOSS projects is almost twice the proportion of women.
4. Reasons to start and to stay in FLOSS development are similar for men and women, but men tend to focus on the product, and women in the forms of cooperation.
5. The share of women who devote less than 5 h and more than 40 h per week is higher than for men.

Our results confirm (and extend) the main ones from the FLOSSPOLs study, even if almost 10 years have passed between both. So, although it is possible that the percentage of women in FLOSS may have slightly increased during these years⁴ –probably due to the involvement of the software industry–, many contextual patterns have remained the same. We can therefore talk about a *lost decade* in the general inclusion of women in FLOSS.

As future work, we plan to extend this study with the other questions included in the survey that might give more insight into the gender issue.

⁴ A study of GitHub developers from 2015 found that only around 6% were women, see <http://www.toptal.com/open-source/is-open-source-open-to-women>.

References

1. Adam, A.E.: Hacking into hacking: gender and the hacker phenomenon. *ACM SIGCAS Comput. Soc.* **33**(4), 3 (2003)
2. Bimber, B.: Measuring the gender gap on the internet. *Soc. Sci. Q.* **81**(3), 868–876 (2000)
3. Boivie, I.: Women, men and programming: knowledge, metaphors and masculinity. In: *Gender Issues in Learning and Working with Information Technology: Social Constructs and Cultural Contexts*, pp. 1–24 (2010)
4. Blickenstaff, J.C.: Women and science careers: leaky pipeline or gender filter? *Gend. Educ.* **17**(4), 369–386 (2005)
5. David, P.A., Shapiro, J.S.: Community-based production of open-source software: what do we know about the developers who participate? *Inf. Econ. Policy* **20**(4), 364–398 (2008)
6. Fitzgerald, B.: The transformation of open source software. *Mis Q.* **30**, 587–598 (2006)
7. Ghosh, R.A., Glott, R., Krieger, B., Robles, G.: Free, libre, open source software: survey and study (2002)
8. Hill, C., Corbett, C., Rose, A.S.: Why So Few? Women in Science, Technology, Engineering, and Mathematics. ERIC (2010)
9. Kuechler, V., Gilbertson, C., Jensen, C.: Gender differences in early free and open source software joining process. In: Hammouda, I., Lundell, B., Mikkonen, T., Scacchi, W. (eds.) *Open Source Systems: Long-Term Sustainability*. IFIP AICT, vol. 378, pp. 78–93. Springer, Heidelberg (2012)
10. Margolis, J., Fisher, A.: *Unlocking the Clubhouse: Women in Computing*. MIT Press, Cambridge (2003)
11. Miliszewska, I., Barker, G., Henderson, F., Sztendur, E.: The issue of gender equity in computer science-what students say. *J. Inf. Technol. Educ. Res.* **5**(1), 107–120 (2006)
12. Nafus, D., Leach, J., Krieger, B.: Gender: Integrated report of findings. FLOSSPOLS, Deliverable D 16 (2006)
13. Qiu, Y., Stewart, K.J., Bartol, K.M.: Joining and socialization in open source women’s groups: an exploratory study of *KDE-Women*. In: Ågerfalk, P., Boldyreff, C., González-Barahona, J.M., Madey, G.R., Noll, J. (eds.) *OSS 2010*. IFIP AICT, vol. 319, pp. 239–251. Springer, Heidelberg (2010)
14. Robles, G., Reina, L.A., Serebrenik, A., Vasilescu, B., González-Barahona, J.M.: Floss 2013: a survey dataset about free software contributors: challenges for curating, sharing, and combining. In: *MSR*, pp. 396–399 (2014)
15. Trauth, E.M., Quesenberry, J.L., Morgan, A.J.: Understanding the under representation of women in it: toward a theory of individual differences. In: *Proceedings of 2004 SIGMIS Conference on Computer Personnel Research: Careers, Culture, and Ethics in a Networked Environment*, pp. 114–119. ACM (2004)
16. Vasilescu, B., Capiluppi, A., Serebrenik, A.: Gender, representation and online participation: a quantitative study of stackoverflow. In: *2012 International Conference on Social Informatics (SocialInformatics)*, pp. 332–338. IEEE (2012)