

Open Source Read, but not Write: The Role of Project Administrators in Managing the Open Source Software Development Team Boundary

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Extended Abstract

Open source software (OSS) constitutes an increasingly important part of the global software economy. Many scholars and practitioners have identified an OSS project's ability to attract and retain developer interest as a key factor influencing its sustainability and success. Although what motivates individuals to participate in OSS development in general has been investigated extensively, little information exists regarding which specific OSS project they choose to contribute to. Discourse to date has also focused largely on understanding the developer side of the OSS project equation, assuming that open source meant open for participation in development by all interested volunteers. In reality, OSS team formation is a result of the bilateral choice of both project administrators and volunteer developers, i.e., project administrators may selectively accept volunteers into the development team. In short, open source software may ensure code read access to all interested user-developers, but code write access is not always open to all. In this study, we examined the direct and indirect influence that OSS project administrators can exert on development team formation.

Our study was conducted in two stages. In the first stage we empirically examined the growth in number of developers of new OSS projects in order to determine factors, especially factors that project administrators may have control over, that influenced developer choice of new projects to join. In the second stage we conducted a survey of project administrators in order to gain further insight into the role of administrators in OSS project team formation and the extent to which OSS project teams are open to participation from volunteer developers.

We found that project administrators may be able to increase the likelihood that other developers join their projects through decisions made in the early phase of projects – releasing working code “early and often” and instituting a means of procuring external financial resources (e.g., accepting user donations in the case of projects hosted on SourceForge.net). Project administrators' prior history in the overall open source community also had an impact on the likelihood that volunteer developers joined the project. Our findings also suggest that project administrators varied in how open they were in accepting developers interested in joining. They were less likely to allow volunteer developers into their projects when they had no prior interactions with developers and when projects already had enough participants.

Overall, our findings confirmed the key role played by OSS project administrators in determining the boundary of the development team. While volunteer developers' willingness to participate is unarguably important, project administrators can both directly influence development team formation by granting selective entry to volunteer developers as well as indirectly influence team formation through choices that affect the project's likelihood of attracting developer interest.

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Interest in open source software development (OSSD) as a viable alternative to the conventional proprietary model of producing software has grown as a result of the success of some notable projects such as the Apache web server and the Linux operating system kernel (O'Reilly 1999, Raymond 2001). However, in reality, to date a vast majority of OSS projects have failed to take off and become abandoned (Chengalur-Smith and Sidorova 2003). Many OSS scholars and practitioners have identified that the success of an OSS project is related to its ability to attract developer interest (Crowston et al. 2006, von Krogh et al. 2003). Unlike software development groups in organizational settings whose members are unilaterally assigned by project managers based on their experiences and skills, OSS project teams are formed as a result of the bilateral choice of both project administrators and volunteer developers. Most accounts of the open source process, however, tend to emphasize the open, voluntary nature of participation in OSS projects where participants freely join and leave projects. While this account may reflect the nature of participation at the periphery of OSS projects – asking and answering questions regarding the use of the software – it does not fully capture the reality of volunteers joining the development team of an OSS project through contributions of code (von Krogh et al. 2003). In short, the formation of the core development team of OSS projects depends not only on developers' voluntary choices but also on actions and predispositions of project administrators, who can not only influence a project's potential to attract external developer interest but may also exercise discretion regarding which external developers to accept into the core development team.¹

We report herein on the practical implications to be drawn from the results of a study examining new OSS project team formation within SourceForge.net, the largest open source software project-hosting site. We studied the growth in development team size of a sample of 2349 new OSS projects hosted on SourceForge.net in order to determine factors that influenced developer choice of new projects to join. We also conducted a survey of these projects' administrators' administration practices, focusing in particular on how they influenced development team formation. Details of the study are provided in Exhibit 1. The actual survey items and responses are shown in Exhibit 2. In the following sections we report our major findings.

How Project Administrators Influence Developer Participation Decisions

Project administrators can influence the perceived attractiveness and promise of OSS projects by setting the overall project direction and coordinating the development efforts of project members, thus indirectly influencing the likelihood that developers join. Project administrators' past connections to other developers within the open source community also directly affect who is likely to join the project. Figure 1 presents an overall summary of the factors influencing the likelihood of developers joining a new OSS project from our study of new SourceForge.net projects.

¹ In most OSS projects, the administrators at the outset are the owners of the project code – those who start the project by writing and releasing the goals and blueprint of the project and (in most cases) the initial version of the software as well.

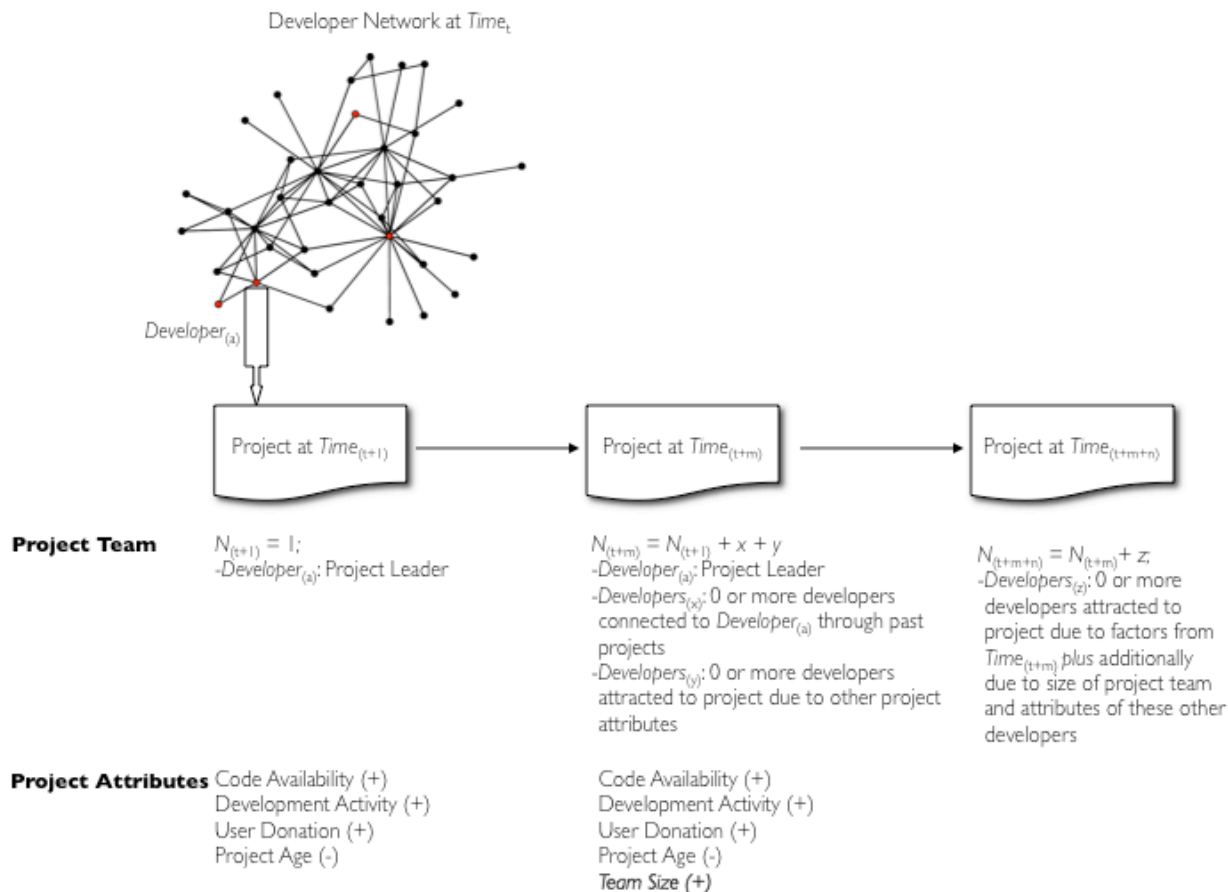


Figure 1. Schematic of Factors Influencing OSS Team Formation²

Each of the major factors influencing OSS team formation is summarized below:

- **Code release.** An OSS project is typically registered and initiated by a single developer within SourceForge.net who becomes the de facto administrator of the project. The administrator may decide whether and when some initial working code will be released to the public. Developers were more likely to join a project that had released some initial software code outlining the functionalities envisioned by the project administrator and demonstrating the potential merits of the project. This is consistent with the argument that some minimal code needs to be assembled in order for the project to receive reaction from the OSSD community (Lerner and Tirole 2002, Raymond 2001).
- **Development activity.** Evidence of active development in the project increased the likelihood that developers would join the new project. Developers tend to consider a project that exhibited a higher level of development activity more favorably and are more likely to be attracted to the project because it may have a higher probability of success.

² The diagram is meant to be illustrative and is not intended to indicate the necessary phases or stages of project development team growth.

- **Donation Acceptance.** Our results suggested that projects that were set up to accept donations from users were more likely to attract developers.
- **Project Administrator's Past Participation in Other Projects.** We found that project administrators' prior history with members in the overall open source community also had an impact on the likelihood that developers joined the project. A developer is more likely to join a new project whose administrator had collaborated with him in past OSS projects than a project whose administrator is a stranger to him. In short, project administrators launching new OSS projects may increase the chances that developers contribute to and join their projects early on (i.e., $Time_{(t+m)}$ in Figure 1) by first establishing strong collaborative relationships with other developers through participation in existing OSS projects.
- **Development Team Size and Importance of Early Momentum.** Our study findings also indicated that developers were more likely to join a new project earlier rather than later, and were more likely to join a new project that had already been successful at attracting additional developers other than the administrator – a unit increase in project team size increased the likelihood that an additional developer joined almost twelve-fold.

Taken together these findings suggest that project administrators have an influence on the assembly of project teams through their past participation history with others and through project administrative decisions made early in the project development process – releasing working code “early and often” and instituting a means of procuring external financial resources (e.g., accepting user donations in the case of projects hosted on SourceForge.net). Once a developer joins the new project ($Time_{(t+m)}$ in Figure 1), there is a greatly increased likelihood of attracting additional developers ($Time_{(t+m+n)}$ in Figure 1).

How Project Administrators Control Project Membership As Gatekeepers

In addition to affecting the likelihood of developers seeking to join their project, OSS project administrators also play a more proactive role in delineating the boundaries of development team membership, i.e., they serve as gatekeepers and exert direct influence over who should be allowed to join the project. Of the administrators we surveyed, sixty (15.6%) actively invited other developers to join their project. Eighty-six (22.4%) of the administrators we surveyed had received and granted at least one joining request from other developers during the first three months of the sample projects. Only 6 (1.6%) of them have ever actually rejected joining requests.

How open, in general, are OSS project administrators to requests for joining? When asked how likely the project administrators are to refuse other developers' joining requests in the early phase of their projects, 41.1% expressed they were unlikely to do so; 30.6% of the respondents expressed a neutral attitude; 28.3% indicated they were likely to reject such requests. The administrators gave similar responses when asked about their attitude toward requests in the later stage and mature stage of projects.

We further examined the antecedents of their predisposition towards accepting or rejecting others' joining requests, i.e., we estimated the possible factors that influence the likelihood of project administrators rejecting the joining requests they may receive from other developers.³ Our findings suggested:

- Existence of past interactions between the administrator and the requesting developer positively influenced the tendency of administrators to accept the joining request. In open source software development, due to the lack of opportunities for face-to-face interaction, developers need to overcome greater barriers to effective communication and coordination and are more likely to be concerned about these issues. Hence, project administrators were more likely to allow developers with whom they have interacted in the past into the development team.

"I recruited people I knew in person to join the project team, and they sent requests to join if they believed they were qualified."

– Project Administrator (Firewall Domain), SF.net Member since 2005

"It was more a matter of me asking developers, than developers asking me."

– Project Administrator (Database Engine/Server Domain), SF.net Member since 2000

- Administrator's general attitude about the openness of OSS projects also significantly impacts their decisions to accept requests from other developers. Although some project administrators expressed their concerns about potential developers' skills and willingness to contribute to projects, most administrators were more concerned about attracting additional developers, and hence were more receptive of external developers' joining requests. Over 30% of the survey respondents indicated they usually approved all joining requests that they received.

"Everyone should be allowed to participate in open source. ... That is the nature of open source."

– Project Administrator (Domain Not Listed), SF.net Member since 2004

"I would refuse if the developer has nothing useful to contribute or produces no results and just has the idea that they want to be a developer on the project with no specific ideas."

– Project Administrator (Communications Domain), SF.net Member since 2000

- When projects have had enough participating members, project administrators are less likely to accept additional developers. Although the decentralized nature of the OSS development process has been regarded as a key feature of this software production model, successful projects rely on the effective coordination efforts of administrators. As more developers join the project and the project grows larger in scale, the risk of administrator information overload and burnout also increases. Consequently, there may be a limit on the team size depending on how much effort the administrator is willing to invest in the project as well as the intended scope of the software. Our survey results also suggested that 90.1% of the administrators had an intended size for the project membership given the original scope of the project (See Figure 2). When the intended team size is reached project initiators were more reluctant to accept further joining requests.

³ Using a proportional odds model for ordinal logistic regression, we estimated the possible factors that influence the likelihood of project administrators rejecting the joining requests they may receive from other developers. The predictors explained 31.4% of the variation in the dependent variable, indicating a reasonable level of model fit.

“If I had received request in the early stage of the project I surely would reject them because I want to keep the dev group small in that stage.”

– Project Administrator (Games/Entertainment Domain), SF.net Member since 2005

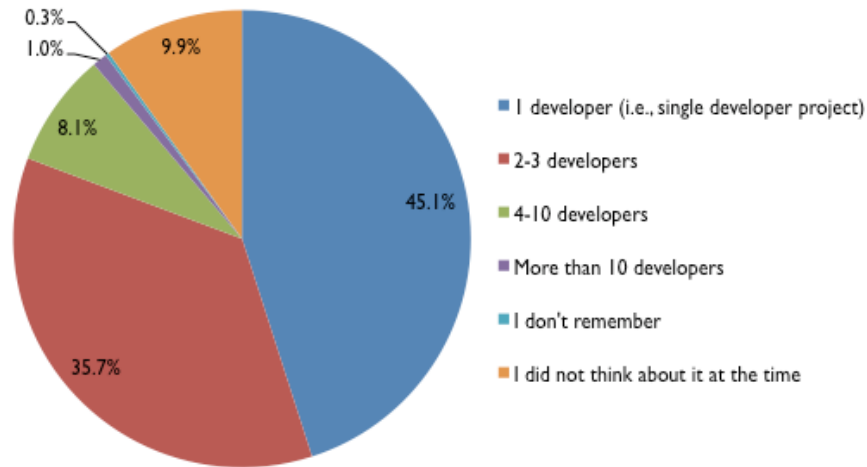


Figure 2. Intended Team Size for Sample Projects

We expected project initiators would consider different factors depending on the software development phase. For example, some may be more open to joining requests during the early phase of the project in order to gain early momentum. At the mature stage, the increased code complexity would become an entry barrier to new developers, and would require little additional development effort as the project is likely to have met the original project objectives. Hence, we expected that administrators would be less likely to accept joining requests after the project has reached a mature stage. However, contrary to what we expected, we did not find development phase to have any significant effect on whether they were likely to reject volunteer requests to join the development team (See Figure 3).

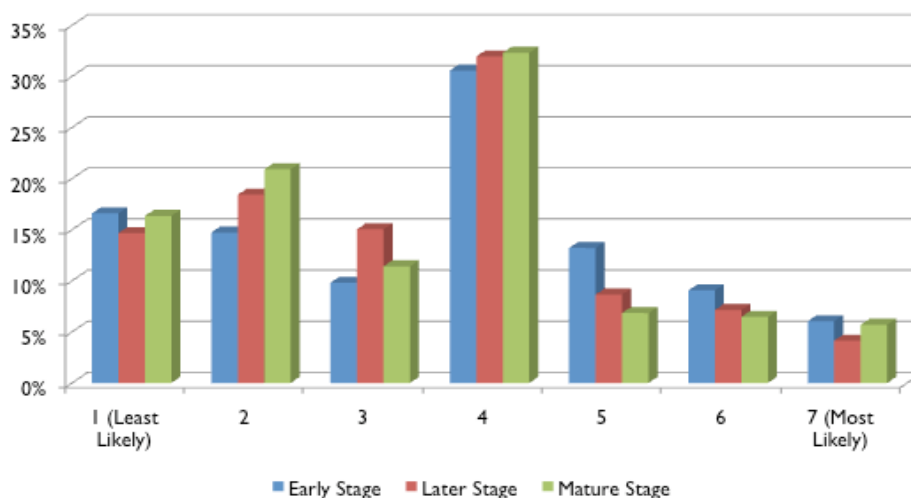


Figure 3. Likelihood of Rejecting Joining Requests

Conclusion

This study represents a first step toward understanding the bilateral nature of open source software project development team formation. Overall, our findings confirmed the influence that project administrators can exert on attracting developers to participate in core project teams. While we acknowledge the importance of volunteer developers' willingness to participate, project administrators can directly influence project team formation by actively recruiting developers and declining joining requests from volunteer developers, and indirectly influence team formation through their past participation in OSS projects and their decisions related to the project that affect the project's visibility and attractiveness to prospective project members.

Our key findings suggest that project administrators may increase the probability of attracting additional developers by releasing code early, maintaining a high level of development activity, and instituting a means of procuring external financial resources. In addition, we found that open source software projects, while open in terms of source availability, were not always open with respect to participation. Project administrators exhibited varying levels of openness towards developers expressing an interest to contribute to their projects. While one-third of the project administrators we surveyed maintained a favorable attitude toward developers interested in participating in the project, and were likely to accept most developers into the development team, others were less inclined to favor open participation. These project administrators were less likely to accept participation from developers with whom they had no prior interactions, and were less receptive of new developer participation when the project already had enough developers working on it. This may be due to the increasing difficulty in assessing the true quality of developers volunteering to become part of the development team and administrators' concerns about coordination and control in the development process.

One area worthy of further exploration is the impact of project administrators' attitudes regarding open participation in the development team and the criteria used to evaluate requests to join on the subsequent performance of the OSS project. Would a more receptive attitude lead to a larger number of participating developers and a more sustainable project? Or, would project administrators favoring developers whom they already know be more likely to have a more cohesive and high-performing group? Another direction that warrants further exploration involves the changes of project administrators in their predispositions over time as they administer more projects and acquire more experience in managing open source projects.

Acknowledgement

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Exhibit 1: How the Study was Conducted

At SourceForge.net, a developer interested in initiating a new project submits a request to the SourceForge.net staff. After the project is approved for hosting, the developer becomes the project administrator who can start utilizing the services and tools provided by the site and upload contents to the project site. External developers wishing to become a member of the project must first contact the project administrator, who then either approves the joining request and adds him to the project membership or rejects the request. Project administrators may also send out invitations to targeted developers to become involved in the project. A joining event occurs when a developer is added to the developer list by the project administrator.

We selected all public open source software projects registered at SourceForge.net between September 30 and November 11, 2005 ($N = 2349$) as our study sample. The sample projects covered 19 top-level domain categories such as Software Development, Internet, and System. A software crawler visited these projects' web pages and kept track of their project-related information and membership information on a daily basis. This data collection process enabled us to capture the timing (i.e., the sequencing) of joining events as well as when important project events occurred (e.g., release of code, updating of project description). Daily tracking ended in early January 2006. A total of 520 projects had attracted additional developers during the data collection period and on average about 2 additional developers joined each of these projects.

In addition, we administered a survey of these projects' administrators. A week prior to the start of the survey, we emailed personalized invitations referencing their projects to participate in the online survey to the administrators in our project sample ($N=2349$). In the invitation, we outlined the purpose of the survey, ensured anonymity and reporting of results in aggregate form only, and gave the respondents the option to opt out by following a link in the email invitation. All respondents were also offered an executive summary of the research findings and to be entered into a drawing to win a US\$200 gift certificate. A total of 125 respondents opted out of the survey. All administrators who had not opted out were sent a link to the web-based survey. Survey responses were collected from December 6 to December 16, 2007. The survey generated 384 valid responses (response rate of 16.3% ($384/2349$) or effective response rate of 17.3% ($384 / (2349 - 125)$)).

The survey included both closed-ended and open-ended questions asking project administrators about the specific projects, whether developers had requested to join their projects, and their usual administrative practices regarding accepting and rejecting joining requests. Because many individuals are involved in multiple open source projects, the first set of questions in the survey instructed the project administrators to respond with reference to the particular OSSD project that was in our project sample. The second set of questions asked the respondents to answer with reference to their general administrative practices in all the OSSD projects that they had been in charge of. The survey instrument and a summary of the responses are shown in Exhibit 2.

We checked for non-response bias by comparing the responses received in the first five days (December 6 – December 10) with those received in the last five days (December 11 – December 16) of the survey. Results showed that there was no significant difference between the early responses and the late responses.

Exhibit 2. Survey Instrument and Summary of Results

Question / Options	# Responses	%
1. Did you start the "<project name>" project from scratch on SourceForge.net Or was it started somewhere else and later ported to SourceForge.net?	384	
<ul style="list-style-type: none"> Started from scratch on SourceForge.net Started elsewhere and ported to SourceForge.net I don't remember 	199 180 5	51.82 46.88 1.30
2. If the "<project name>" project was ported to SourceForge.net, did the team members (e.g., developers) of the original project, if there were any, also join the project on SourceForge.net?	172	
<ul style="list-style-type: none"> Yes No There were no additional team members before porting to SourceForge.net I don't remember 	58 24 89 1	33.72 13.95 51.74 0.58
3. Did you have some initial software code for the "<project name>" project at the time it was founded on SourceForge.net?	379	
<ul style="list-style-type: none"> Yes No I don't remember 	302 73 4	79.68 19.26 1.06
4. For the "<project name>" project, did you invite developers who have previously worked with you on other projects to join your project?	384	
<ul style="list-style-type: none"> Yes No Not applicable – This is my first project on SourceForge.net I don't remember 	60 125 196 3	15.63 32.55 51.04 0.78
5. At the time "<project name>" was founded on SourceForge.net, how large did you think the development team (including yourself) should be given the original scope of the project?	384	
<ul style="list-style-type: none"> 1 developer (i.e., single developer project) 2-3 developers 4-10 developers More than 10 developers I don't remember I did not think about it at the time 	173 137 31 4 1 38	45.05 35.68 8.07 1.04 0.26 9.90

6. During the early stages of the "<project name>" project on SourceForge.net (i.e., during the first couple of months of project founding), did you refuse the requests of developers who indicated an interest in joining the project team?			
<ul style="list-style-type: none"> • Yes • No • There were no additional developers who asked to join at the early stages • I don't remember 	6	1.57	382
81	21.20		
292	76.44		
3	0.79		
7. What criteria did you use in deciding whether to accept or refuse other developers' joining requests at the early stage? [Check all that apply]			
<ul style="list-style-type: none"> • Not applicable -- no additional developers asked to join the project • I refused because I did not know the developer • I refused because there were enough developers already in the team given the scope of the project • I refused because the project was not intended to be a multi-developer project • Even if I knew the develop, I refused because my prior experience with him/her was not positive • I usually accepted all requests to join the development team • Other. Please list your reasons below 	302	86.29	350
3	0.86		
0	0.00		
4	1.14		
1	0.29		
42	12.00		
17	4.86		
8. During the later stages of the "<project name>" project on SourceForge.net (i.e., after about 6 months into the project; or after a group of developers had been assembled), did you refuse the requests of developers who indicated an interest in joining the project team?			
<ul style="list-style-type: none"> • Yes • No • There were no additional developers who asked to join in the later stages • I don't remember 	12	3.13	384
70	18.23		
298	77.60		
4	1.04		
9. What criteria did you use in deciding whether to accept or refuse other developers' joining requests at the later stages? [Check all that apply]			
<ul style="list-style-type: none"> • Not applicable --- no additional developers asked to join the project • I refused because I did not know the developer • I refused because there were enough developers already in the team given the scope of the project • I refused because the project was not intended to be a multi-developer project • Even if I knew the develop, I refused because my prior experience with him/her was not positive • I usually accepted all requests to join the development team • Other. Please list your reasons below 	290	84.30	344
4	1.16		
3	0.87		
6	1.74		
0	0.00		
44	12.79		
10	2.91		

10. During the mature stages of the "<project name>" project on SourceForge.net (i.e., after a successful release of working code), did you refuse the requests of developers who indicated an interest in joining the project team?

• Yes	9	2.35
• No	65	16.97
• There were no additional developers who asked to join in the mature stages	221	57.70
• Not applicable --- the project has not yet released any working code	84	21.93
• I don't remember	4	1.04
Total	383	

11. What criteria did you use in deciding whether to accept or refuse other developers' joining requests at the mature stages? [Check all that apply]

• Not applicable -- no additional developers asked to join the project	291	85.59
• I refused because I did not know the developer	2	0.59
• I refused because there were enough developers already in the team given the scope of the project	3	0.88
• I refused because the project was not intended to be a multi-developer project	2	0.59
• Even if I knew the developer, I refused because my prior experience with him/her was not positive	1	0.29
• I usually accepted all requests to join the development team	41	12.06
• Other. Please list your reasons below	13	3.82
Total	340	

12. When administering or managing OSS projects, do you usually invite developers who have previously worked with you on other projects to join your projects?

• Yes	70	18.32
• No	58	15.18
• Sometimes	80	20.94
• Not applicable -- I have not administered other OSS projects	171	44.76
• I don't remember	3	0.79
Total	382	

13. For open source projects that you have administered or managed, how likely is it for you to refuse the requests of an unknown developer who indicates an interest in joining the project team when the project is in the early stages of development (i.e., during the first 2 months of project founding)?

[1: highly unlikely ~ 7: highly likely]

	1	2	3	4	5	6	7
# Responses	44	39	26	81	35	24	16
(%)	16.60	14.72	9.81	30.57	13.21	9.06	6.04
Total	265						

18. What criteria do you usually use in deciding whether to accept or refuse other developers' (both known and unknown) joining requests at the mature stages? [Check all that apply]	232	
• I usually refuse because I did not know the developer	41	17.67
• I usually refuse if there are enough developers already in the team given the scope of the project	63	27.16
• I usually refuse if the project is not intended to be a multi-developer project	50	21.55
• Even if I know the developer, I usually refuse if my prior experience with him/her is not positive	48	20.69
• I usually accept all requests to join the development team	108	46.55
• Other. Please list your reasons below	36	15.52