Promoting and Studying Diversity, Equity, and Inclusion in the ASF Community

A diagnostic report.

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Zixuan Feng, Oregon State University
Anita Sarma, Oregon State University
Luis Cañas-Díaz, Bitergia
Katia Rojas, Apache Software Foundation

In partnership with: Oregon State University, Bitergia

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Foreword

Open source software (OSS) has grown and evolved over the past decade, giving rise to a variety of successful products and serving as a "springboard" for tech careers. Contributors to OSS come from diverse backgrounds and represent a wide range of identities, cultures, and nations. They collaborate to develop and maintain software projects.

Despite the widespread use of OSS, there is a noticeable lack of diversity among its contributors. This absence of diversity can lead to several negative consequences. Firstly, OSS projects without a diverse range of contributors miss out on valuable innovative insights. Secondly, contributors from underrepresented backgrounds might miss the learning and career opportunities that these projects provide.

Diversity is a multifaceted social construct encompassing dimensions such as gender, language abilities, ethnicity, age, and other distinguishing characteristics. Furthermore, factors like ethnicity can shape contributors' perceptions of diversity and inclusion in OSS.

This study aims to investigate the state of Diversity, Equity, and Inclusion (DEI) within the Apache Software Foundation (ASF) community and to provide community-driven recommendations to enhance DEI.

The ASF community is one of the largest OSS communities, with over 460,000 contributors and more than 350 active projects. The Apache DEI project is dedicated to studying and promoting diversity and inclusion within the ASF community. Openness, empathy, collaboration, inquisitiveness, professionalism, conciseness, and respect are the project's guiding values. Several initiatives have been undertaken to increase diversity in OSS communities, such as Google Summer of Code and the Apache mentoring programme.

This study analyzes data from surveys conducted within the ASF community in 2020 and 2022. It considers diversity attributes like gender, age, region, seniority, educational background, English proficiency, and compensation to understand the current state of DEI in the ASF community.

This study represents years of primary research conducted by a team of research professionals, community leaders, and members of the "ASF Diversity and Inclusion Committee." We hope that you find this study to be an informative and valuable resource in fostering an inclusive environment in the ASF community where everyone is welcome.

We extend our gratitude to all the survey respondents for their contributions to this research. This work is supported by the Google Award for Inclusion Research Program and National Science Foundation.

Click here view the survey questions

Executive Summary

The Apache Diversity and Inclusion project aims to promote diversity and inclusivity within the ASF community using innovative tools and frameworks.

Central to our work are core values like respect, empathy, openness, patience, candor, and dependability. These guide our efforts to cultivate a more diverse and inclusive community.

Contributors to the ASF community are driven by various motivations, including learning opportunities, bug fixes, and reputation building. This underscores the importance of motivating, engaging, and retaining new contributors.

The ASF community is committed to fostering a welcoming environment, especially for underrepresented contributors, and is actively working to minimize barriers to contributions.

Furthermore, the ASF community is diligently supporting newcomers in their projects. This is evident in the rising number of newcomers engaging in code-related activities.

Introduction

Encouraging diversity enhances the overall quality of OSS projects and promotes a more inclusive and equitable technology industry [1-4]. Individual contributors in OSS community, especially those from underrepresented groups, might miss out on learning opportunities and face challenges advancing their careers if they work in isolation [3].

Within the ASF community, diversity initiatives strive to eliminate barriers to contributions and improve the representation of underrepresented groups [1, 2]. Research indicates that teams with greater gender diversity tend to perform better [4]. Actively promoting and mentoring women contributors into leadership roles might be an effective strategy to enhance gender diversity [1]. The study also found that location and language can influence code acceptance [5]. DEI is a multifaceted construct influenced by various demographic and background attributes. These demographic attributes encompass factors like age, gender, and ethnicity. Individual characteristics, such as role, expertise, personality, and cognitive styles, also influence how people interact with and perceive their community.

Thus, it is crucial to consider various attributes to understand DEI within the ASF community. The first step in improving DEI in a community is to understand the current state of DEI.

The ASF DEI initiative has performed a series of community surveys. This report focuses on the latest survey conducted in July 2022, where we surveyed over 400 ASF contributors from more than 40 countries to investigate the state of DEI within the ASF community. The primary objective of this study was to gain a deeper understanding of the current perceptions, sense of belonging, and level of inclusion among ASF contributors, disaggregated by diverse demographic groups. The second objective was to investigate the evolution of DEI in the ASF community by comparing the results of this survey with the results from a survey conducted in 2020. Understanding the evolution of DEI enables us to identify areas of progress, opportunities for improvement, and areas requiring attention. This information can then inform the design of targeted DEI initiatives addressing specific issues faced by ASF community contributors.

[1] Bosu, Amiangshu, and Kazi Zakia Sultana. "Diversity and inclusion in open source software (OSS) projects: Where do we stand?." 2019 ACM/IEEE International Symposium on Empirical Software Engineering and Measurement (ESEM). IEEE, 2019.
[2] Trinkenreich, Bianca, et al. "Hidden figures: Roles and pathways of successful oss contributors." Proceedings of the ACM on human-computer interaction 4.CSCW2 (2020): 1-22.
[3] Singer, Leif, et al. "Mutual assessment in the social programmer ecosystem: An empirical investigation of developer profile aggregators." Proceedings of the 2013 conference on Computer supported cooperative work. 2013.
[4] Hoogendoorn, Sander, Hessel Oosterbeek, and Mirjam Van Praag. "The impact of gender diversity on the performance of business teams: Evidence from a field experiment." Management Science 59.7 (2013): 1514-1528.
[5] Rastogi, Ayushi, Nachiappan Nagappan, and Georgios Gousios. Geographical bias in GitHub: Perceptions and reality. 2016.

Chapter 1

The State of DEI in the ASF Community

“Diversity is often incredibly valuable, but not for its own sake. It's valuable because “with many eyes, all bugs are shallow”. We, the ASF, profoundly need diverse minds. Diverse bodies may produce that, but diverse immutable characteristics are no guarantee of meaningful diversity. Inclusion is great all around! The more the merrier!! Except when people are belligerent, in which case, they ought to be actively excluded until they change their behavior.” --- [ASF-33[1]]

[1] Survey respondent

Demographics of the Survey Respondents

Gender and Age: Out of 432 respondents, 87% identified as men, 5% identified as women, 2% identified as non-binary and transgender, and 7% preferred not to state their gender identity. This skew reflects the gender imbalance among ASF contributors. This is in line with other OSS communities, where studies have found the distribution of women contributors to range between 3% and 10% [1,2]. Regarding the age range, the majority of survey respondents are between the ages of 35 and 54 years old (35 to 44 years old: 36%, 45 to 54 years old: 26%).

Compensation, Seniority, and Education: Over half of the respondents (55%) were compensated for their contributions to the ASF community, indicating a healthy distribution of both paid and volunteer contributors. Additionally, more than half of the respondents (54%) have contributed to the ASF community for over six years (6 to 10 years: 22%, over 10 years: 32%), while only 6% are newcomers (with less than one year of experience). The remaining 40% have contributed to the ASF community for durations ranging from 1 to 5 years (1 to 2 years: 14%, 3 to 5 years: 26%). In terms of educational background, 85% of the respondents hold an undergraduate degree or higher (Undergraduate degree: 31%, Master's degree: 44%, Ph.D.: 10%), while 8% of respondents have completed high school or have no formal education.

Language and Region: The majority of respondents (84%) reported being confident in their ability to communicate in both spoken and written English. (Note that this survey was created in English, which may contribute to this skew in the demographics of our respondents.) Our respondents were located across 46 countries; 79% were from 29 different Western countries (countries in North America and Europe), while only 16% of respondents were from 17 non-Western countries, such as India, China, or Japan.

Demographics Categorization

Newcomers face many challenges in getting onboarded and finding mentors in the project [2], which can make it difficult for them to get started, find their place in the community, and make meaningful contributions. We classify newcomers as those who have less than 1-year experience within the ASF community.

[1] Champa, Arifa I., et al. "Insights into Female Contributions in Open-Source Projects." 2023 IEEE/ACM 20th International Conference on Mining Software Repositories (MSR). IEEE, 2023.
[2] Trinkenreich, Bianca, et al. "Women's participation in open source software: A survey of the literature." ACM Transactions on Software Engineering and Methodology (TOSEM) 31.4 (2022): 1-37.
[3] Steinmacher, Igor, et al. "Why do newcomers abandon open source software projects?." 2013 6th International Workshop on Cooperative and Human Aspects of Software Engineering (CHASE). IEEE, 2013.

TABLE 1.1 Demographics of the survey respondents

	Demographics	Number of respondents	%
Gender	Man	374	87%
	Woman	22	5%
	Non-binary&Transgender	7	2%
	Prefer not to say	29	7%
Age range	24 or younger	9	2%
	25 to 34	80	19%
	35 to 44	157	36%
	45 to 54	114	26%
	55 to 64	47	11%
	Over 65	11	3%
	Prefer not to say	14	3%
Seniority	Less than 1 year	28	6%
	1 to 2 years	59	14%
	3 to 5 years	114	26%
	6 to 10 years	93	22%
	Over 10 years	138	32%
Compensation	Paid	239	55%
	Unpaid	140	32%
	Prefer not to say	53	12%
English proficiency	Confident in English	364	84%
	Not confident in English	31	7%
	Prefer not to say	37	9%
Education	High school or other education	36	8%
	Undergraduate degree	136	31%
	Master's	0	0%
	Ph.D.	44	10%
	Prefer not to say	25	6%
Region	From Western countries	340	79%
	Not from Western countries	68	16%
	Prefer not to say	24	6%
Total number of survey respondents: 432			
Non-binary and genderqueer refer to gender identities that are not solely male or female, representing identities beyond the gender binary [4].			

Unpaid Contributors face several challenges in finding the time to volunteer, lack of access to necessary tools and technologies, barriers to entry, and a lack of recognition and incentives compared to paid contributors. These challenges can make it harder for unpaid contributors to get involved and be valued [1, 2].

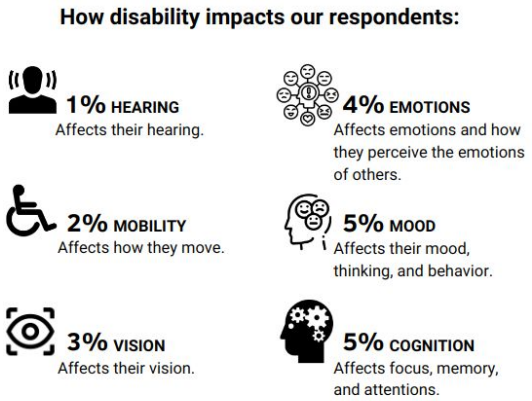
Contributors Without Undergraduate or Higher Education Backgrounds in computer science or software engineering may face challenges when contributing to OSS projects due to a lack of foundational knowledge, limited access to resources such as textbooks and academic journals, and a lack of networking opportunities such as internships and events [3].

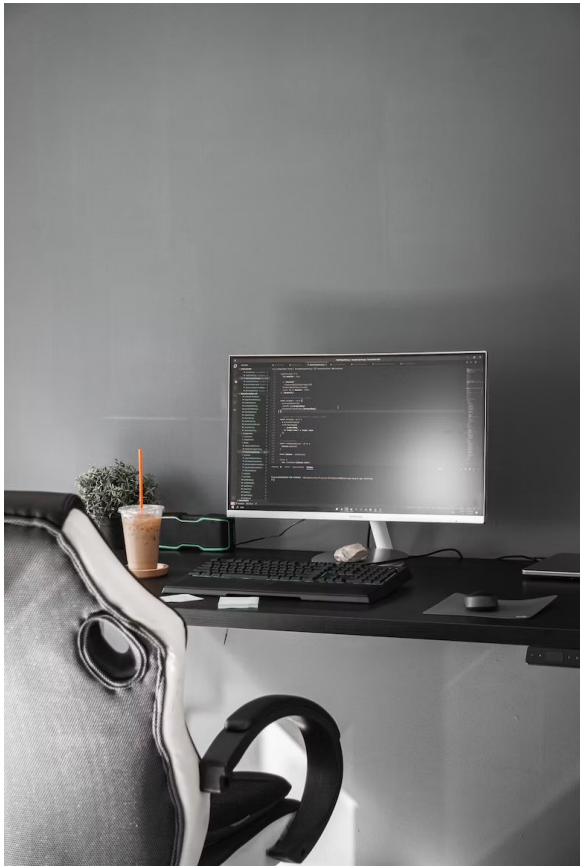
Contributors Who are Not Confident in English or Not from Western Countries are underrepresented in OSS projects. This is because most contributors to OSS come from North America and Europe, where English is often the primary language used for communication and documentation.

[1] Guizani, Mariam, et al. "The Long Road Ahead: Ongoing Challenges in Contributing to Large OSS Organizations and What to Do." Proceedings of the ACM on Human-Computer Interaction 5.CSCW2 (2021): 1-30.
[2] Igor, Steinmacher, et al. "Being a Mentor in open source projects." Journal of Internet Services and Applications 12.1 (2021).
[3] "Best Open Source Programs for Students to Participate." GeeksforGeeks, GeeksforGeeks, 5 Aug. 2022, https://www.geeksforgeeks.org/best-open-source-programs-for-students-to-participate/.
[4] Richards, Christina, et al. "Non-binary or genderqueer genders." International Review of Psychiatry 28.1 (2016): 95-102.

Cognitive, Developmental, Intellectual, or Physical Disabilities May Exist

Disabilities are not binary and can manifest in various ways. A disability may be evident or invisible [1]. Among the different dimensions of disability, 5% out of 432 survey respondents reported that their disability affects their focus, memory, attention, mood, thinking, and behaviors. Additionally, 4% mentioned that their disability affects their emotions and how they perceive the feelings of others. Furthermore, 6% of respondents preferred not to specify their disability in their answers.

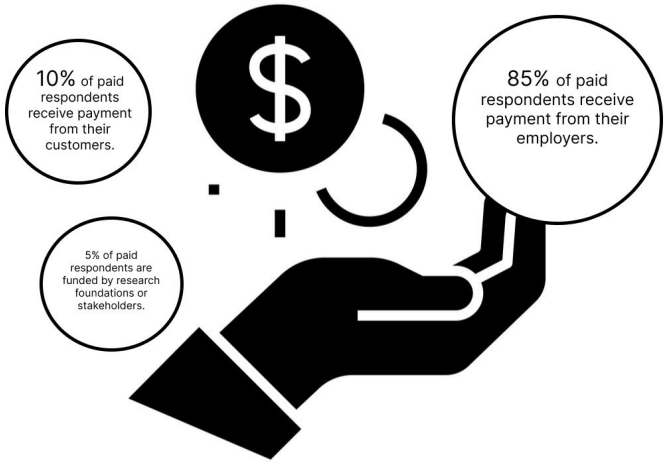




[1] Francis, Leslie, and Anita Silvers. "Perspectives on the Meaning of "Disability"." *AMA Journal of Ethics* 18.10 (2016): 1025-1033

Compensation for Contributions

Our survey indicates that 55% of the 432 respondents receive compensation (including part-time) for their work in the ASF community (12% of respondents did not provide answers). The average number of hours they were compensated for was 20 hours per week. When considering the paid contributors, 85% out of the 239 compensated contributors were paid by their employer, 10% were paid by their customer or contract, and 5% were paid by a research foundation or through a stakeholder-sponsored fund.



We asked contributors if they wished to be paid more and what prevented them from doing so. The availability of free time was a factor in their decision: 40% out of the total 432 respondents stated that they were not looking to get paid more, "*I have no more time*" [ASF-189]. Policies and laws were also constraints: "*German tax law prohibits being paid for stuff without a lot of red tape*" [ASF-70], "*Only recently had my GitHub sponsors opened; as someone living in South Africa, receiving international donations can be a mission*" [ASF-124].

Among the 432 respondents, 35% mentioned that they didn't know how to find paid opportunities, and 15% stated they were unsure about how to ask for compensation: "*I like the work I do for my current employer, but my current employer is not paying me for OSS activities. I would like to be paid for the OSS work I do in my spare time though*" [ASF-186]. Another obstacle mentioned by the respondents was their business relationships "*I am a salaried employee whose position resulted from the acquisition of a company I formerly owned. Given the nature of that, I didn't feel my salary was up to negotiation as much as the overall purchase was up to negotiation*" [ASF-43].

Chapter 2

Welcome to the ASF Community

“ASF is a great organization and I love it!” --- [ASF-90]

“Everyone are treated equally, I feel totally comfortable in the current environment.” --- [ASF-104]

Contributors in a large, globally distributed community contribute to projects for various reasons, including the opportunity to learn, the need to fix a bug, and build a reputation in the community. OSS communities need to motivate, engage, and retain new contributors to ensure sustainability [1].

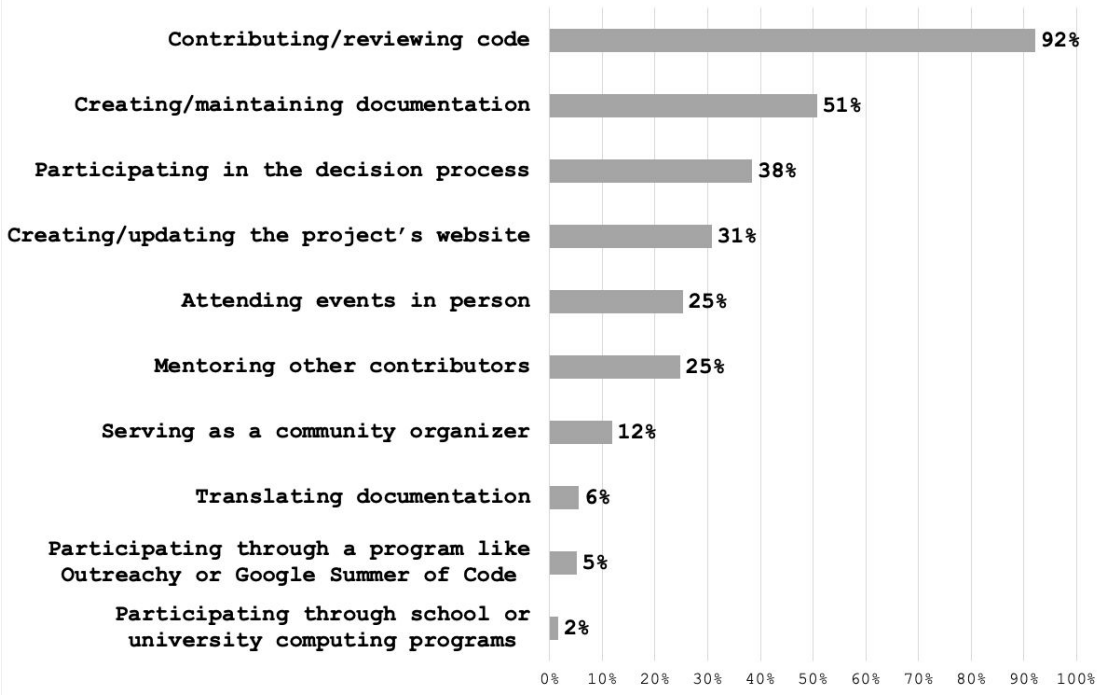
Newcomers to a project often confront a wide array of technical and social challenges. A smooth onboarding process can help new contributors understand how to contribute effectively, aiding them in avoiding frustration while feeling welcomed and valued. Newcomers to OSS encounter several obstacles, including a lack of guidance and mentorship, an unfamiliarity with community norms and expectations, and inadequate support for underrepresented groups. These challenges can lead contributors to lose motivation and potentially cease participation [2].

In this section, we will first describe the various entry pathways into the ASF community by analyzing survey responses regarding respondents' initial tasks within the ASF community.

The different entry pathways can shed light on the different experiences of the contributors. To improve contributors' experiences within the ASF community, it is also essential to understand the perception of social obstacles, such as their work environment. A toxic environment can make contributors feel unwelcome and devalued, which can cause high turnover rates. Thus, we also investigate how the ASF contributors evaluated their collaborative environment.

[1] Qureshi, Israr, and Yulin Fang. "Socialization in open source software projects: A growth mixture modeling approach." Organizational Research Methods 14.1 (2011): 208-238.
[2] Guizani, Mariam, et al. "Perceptions of the State of DEI and D&I Initiative in the ASF." Proceedings of the 2022 ACM/IEEE 44th International Conference on Software Engineering: Software Engineering in Society. 2022.

FIGURE 2.1. Which of the following tasks did you start with when you got involved in the ASF?

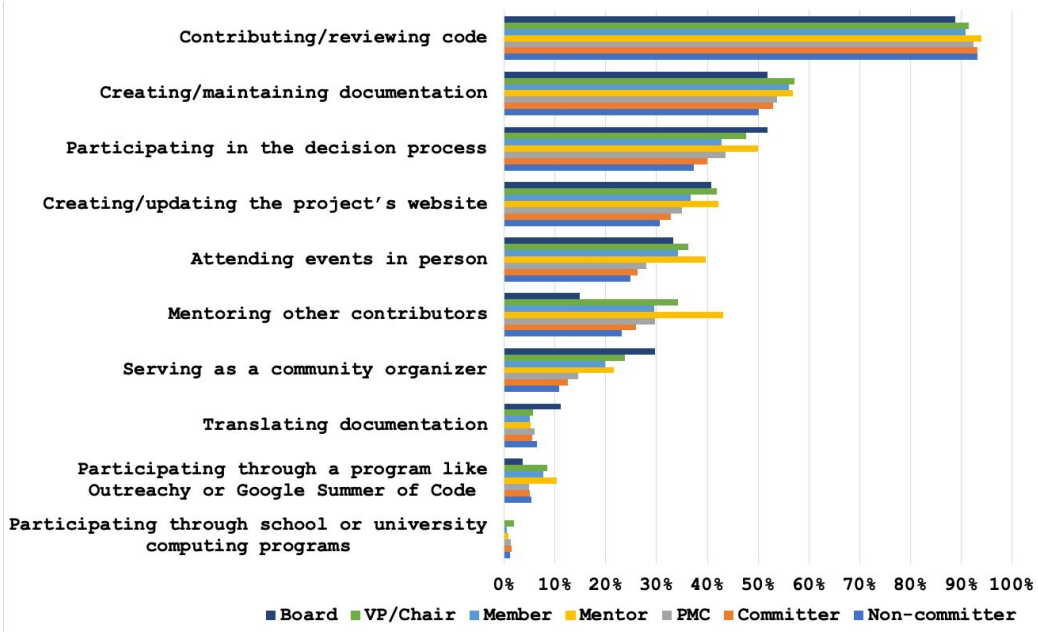


Total sample size: 432. We value all contributions to the ASF community, both technical and non-technical. While technical contributions often take the spotlight due to their traceability in issue-tracking systems, many other roles are crucial to a project's success. Currently, 6% of the 432 contributors selected "Other" for contributions not listed in the survey, such as communication on mailing lists or Slack, indicating a potential lack of recognition. However, we are actively working towards improving recognition for all contributions/contributors.

We asked contributors from the ASF community about the tasks they began with when they first started contributing. The most common starting task was contributing/reviewing code (92%), followed by creating/maintaining documentation (51%). About 38% of respondents began contributing by participating in the decision-making process. 31% of respondents began by creating/updating the project's website. Other common starting tasks included attending events in person (25%), mentoring new contributors (25%), and working as a community organizer (12%).

Less common starting tasks included translating documents (6%), participating in programs such as Outreachy or Google Summer of Code (5%), and participating in school or university computing programs (2%). These findings provide insight into the various ways in which contributors begin contributing to the ASF community and can inform strategies for onboarding and engaging new contributors.

FIGURE 2.2. Which of the following tasks did you start with when you got involved in the ASF? (Comparison between current roles at ASF)

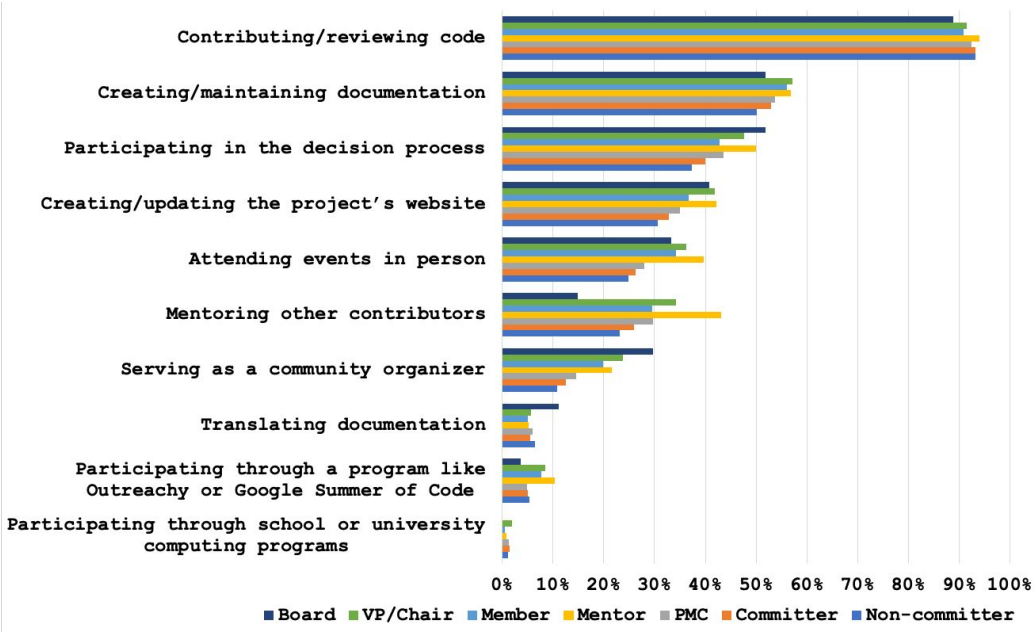


Total sample Size: 432; Board (n=27); VP/Chair (n=105); Member (n=196); Mentor (n=116); PMC-project management committee(n=303); Committer (n=400); Non-committer (n=353)

Next, we analyzed the starter tasks of contributors, disaggregated by their current roles. The most common task for all roles was contributing/reviewing code, followed by creating/maintaining documentation. This pattern holds true even for contributors in leadership roles, such as Board/VP/Chair. Participating in decision-making was a common starting task, particularly for those currently in leadership roles or mentoring positions. Notably, the largest group of respondents who began by mentoring others are also mentors themselves.

For mentors, attending events in person is crucial as it enables them to build relationships with fellow community members and share their knowledge and experiences. These community events in the ASF community attract a wide range of talent who remain committed to the community's growth. Respondents in leadership roles more frequently indicated that they started as community organizers compared to other roles. This suggests that community organizers maintain a strong commitment to the community.

FIGURE 2.2. Which of the following tasks did you start with when you got involved in the ASF? (Comparison between current roles at ASF) (repeat from last page)

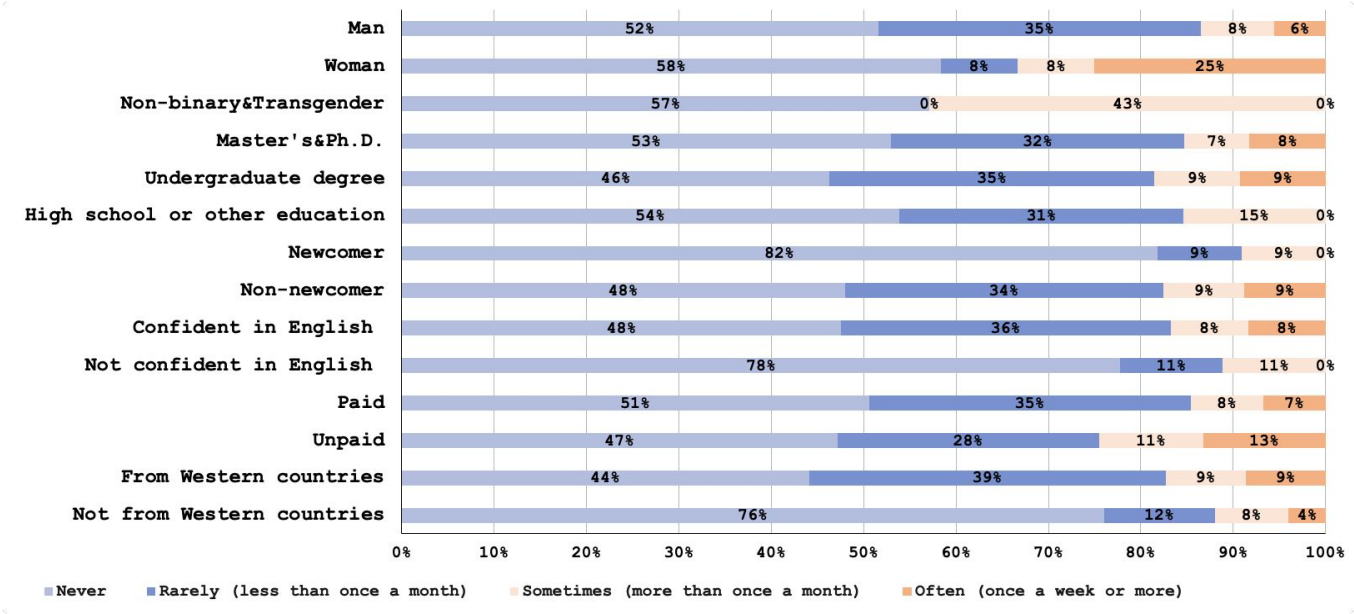


Total sample Size: 432; Board (n=27); VP/Chair (n=105); Member (n=196); Mentor (n=116); PMC-project management committee(n=303); Committer (n=400); Non-committer (n=353)

When it comes to creating/updating the project website, no significant variations were observed among the different roles within the ASF community.

The other three starting tasks—translating documentation, participating in programs like Outreachy, and taking part in school or university computing programs—received the fewest votes among respondents. We observed that over 10% of Board members mentioned they began by translating documents, while the remaining tasks accounted for about 5%. Additionally, about 10% of mentors identified Outreachy or Google Summer of Code as their initial task when they began contributing to the ASF community.

FIGURE 2.3. Frequency of social challenges and toxic environment faced by ASF contributors



Sample size: Man: 126; Woman: 12; Non-binary&Transgender: 7;
Master's&Ph.D.: 85; Undergraduate degree: 54; High school and other education: 13;
Newcomer: 11; Non-newcomer: 148;
Confident in English: 143; Not confident in English: 9;
Paid: 89; Unpaid: 53;
From Western countries: 127; Not from Western countries: 25

Creating Inclusive Environments for Underrepresented Groups

A toxic work environment where contributors are unpleasant, unhelpful, or behave in an elitist manner, is not uncommon in the realm of OSS [1, 2]. Both the ASF and other OSS communities heavily rely on volunteer efforts, and toxic or unwelcoming environments can lead to high turnover rates [3]. Our study reveals that respondents from underrepresented groups (women, non-binary and transgender respondents, newcomers, respondents from non-Western countries, respondents not confident in English) encounter fewer social challenges (see Figure 2.3) compared to their counterparts (men, non-newcomers, respondents from Western countries, and respondents confident in English). **This suggests that the ASF community is making progress toward fostering inclusivity.**

When project organizers or core developers do not welcome contributions and resist the participation of newcomers, it can become a significant issue. Our survey results indicate that newcomers face fewer challenges due to a toxic environment than experienced contributors.

More non-English speakers reported a welcoming environment compared to contributors from Western countries or those who are confident in English. This suggests that stereotypes based on region, culture, and English proficiency are not encountered by our survey respondents. No significant differences exist among responses from paid or volunteer contributors. This positive trend indicates that contributors are recognized for their individual contributions rather than being evaluated based on their employment.

Previous studies have identified women contributors as a minority in OSS [4, 5]. This imbalance can result in biases, leading to unfavorable reviews containing degrading language toward women and delayed feedback during code reviews [3]. Our findings reveal that survey respondents who identified as women, non-binary, and transgender encountered fewer instances of unfriendly or toxic environments as contributors. **This suggests that the ASF community's efforts to promote diversity and inclusion are having a positive impact.**

[1] Amiangshu Bosu and Kazi Zakia Sultana. 2019. Diversity and inclusion in open source software (OSS) projects: Where do we stand?. In 2019 ACM/IEEE International Symposium on Empirical Software Engineering and Measurement (ESEM). IEEE, 1–11
[2] Rajshakhar Paul, Amiangshu Bosu, and Kazi Zakia Sultana. 2019. Expressions of sentiments during code reviews: Male vs. female. In 2019 IEEE 26th International Conference on Software Analysis, Evolution and Reengineering (SANER). IEEE, 26–37.
[3] Margaret-Anne Storey, Alexey Zagalsky, Fernando Figueira Filho, Leif Singer, and Daniel M German. 2016. How social and communication channels shape and challenge a participatory culture in software development. IEEE Transactions on Software Engineering 43, 2 (2016), 185–204.
[4] Guizani, Mariam, et al. "Perceptions of the State of DEI and D&I Initiative in the ASF." Proceedings of the 2022 ACM/IEEE 44th International Conference on Software Engineering: Software Engineering in Society. 2022.
[5] Terrell, Josh, et al. "Gender differences and bias in open source: Pull request acceptance of women versus men." PeerJ Computer Science 3 (2017): e111.

Chapter 3

Obstacles and Challenges to DEI

“I think the ASF are trying to do a good job in the area of EDI but it is very difficult and getting a consensus on what is right or appropriate is almost impossible. ” --- [ASF-165]

OSS communities often comprise a large number of contributors from diverse backgrounds, each with varying levels of experience, skills, and perspectives. This diversity can pose challenges in creating an inclusive and welcoming environment for all members [1]. Moreover, since OSS communities are typically geographically dispersed, contributors work remotely from various parts of the world. This distribution complicates the task of building strong relationships and maintaining effective communication among team members [2].

To enhance DEI in the OSS community, understanding the challenges faced by contributors in a large, diverse OSS organization is crucial. In this section, we focus on analyzing the challenges encountered by ASF contributors. These challenges are categorized as social, process, and project challenges. By understanding who faces which challenges, we can work towards creating a more inclusive and welcoming environment for all contributors.

Process Challenges Related to

- Getting started on the project
- Navigating the contribution process
- Reception issues in the project
- Licenses

Social Challenges Related to

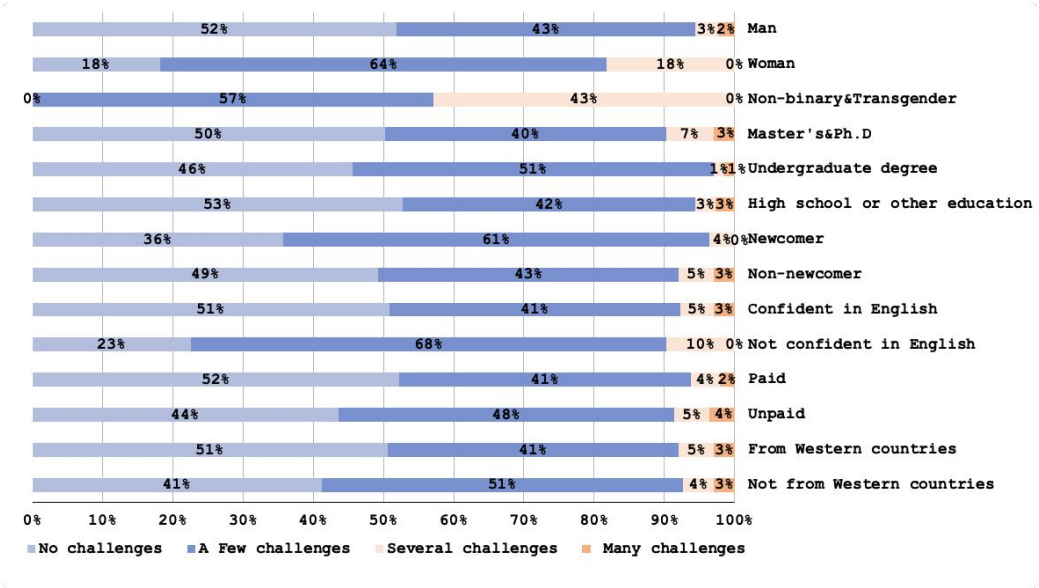
- Communication styles
- Feeling imposter syndrome/fear of making mistakes
- Facing a lack of recognition
- Toxic/unwelcoming environment
- Located in a different country/from a different nationality
- Cultural differences

Project Challenges Related to

- Documentation
- Technical Hurdles

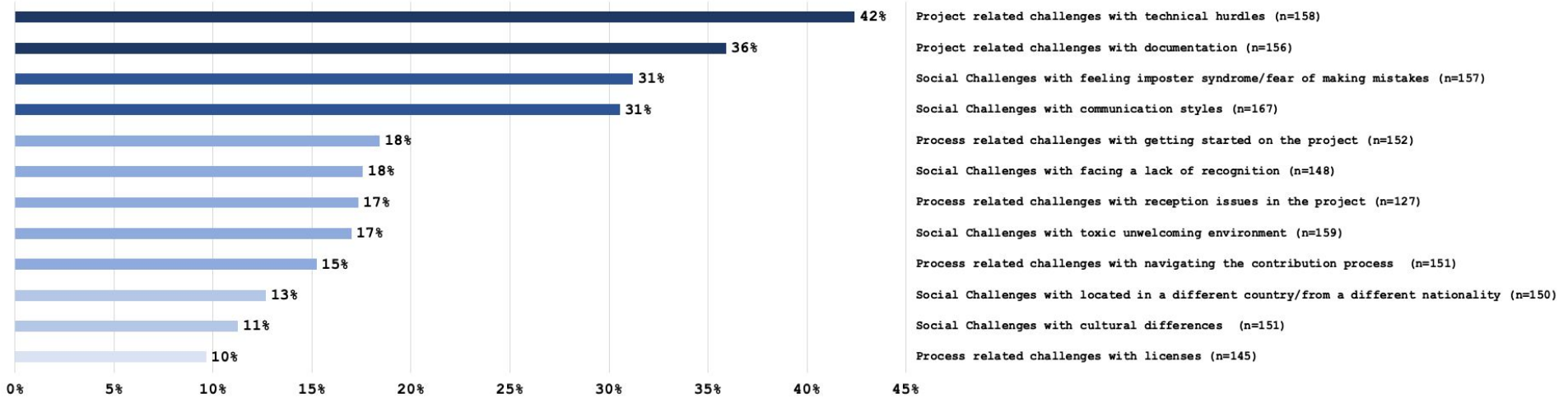
[1] Balali, Sogol, et al. "Newcomers' barriers... is that all? an analysis of mentors' and newcomers' barriers in OSS projects." Computer Supported Cooperative Work (CSCW) 27.3 (2018): 679-714.
[2] Steinmacher, Igor, et al. "A systematic literature review on the barriers faced by newcomers to open source software projects." Information and Software Technology 59 (2015): 67-85.

FIGURE 3.1 Do you face challenges when participating in the ASF community (e.g., language differences, technical expertise, cultural differences, etc)? (sample size : 432)



We found that over half of the men contributors reported facing no challenges when participating in the ASF community. However, over half of the women, non-binary, and transgender contributors reported encountering a few challenges. We observed no significant differences between respondents of various educational levels regarding educational background. In terms of seniority, more non-newcomers reported facing no challenges compared to newcomers. Only 23% of respondents who lacked confidence in English reported no challenges, whereas more than half of those confident in English did not face any challenges. While respondents from Western countries did not experience significant challenges in the ASF community, only 41% of respondents not from Western countries reported no challenges. Similarly, 44% of those who contributed without compensation faced no challenges, compared to 52% of those who were compensated for their contributions.

FIGURE 3.2. How often do you face the following challenges when participating in the ASF? [percentage of respondents who chose "often" or "sometimes"] (sample size: n)



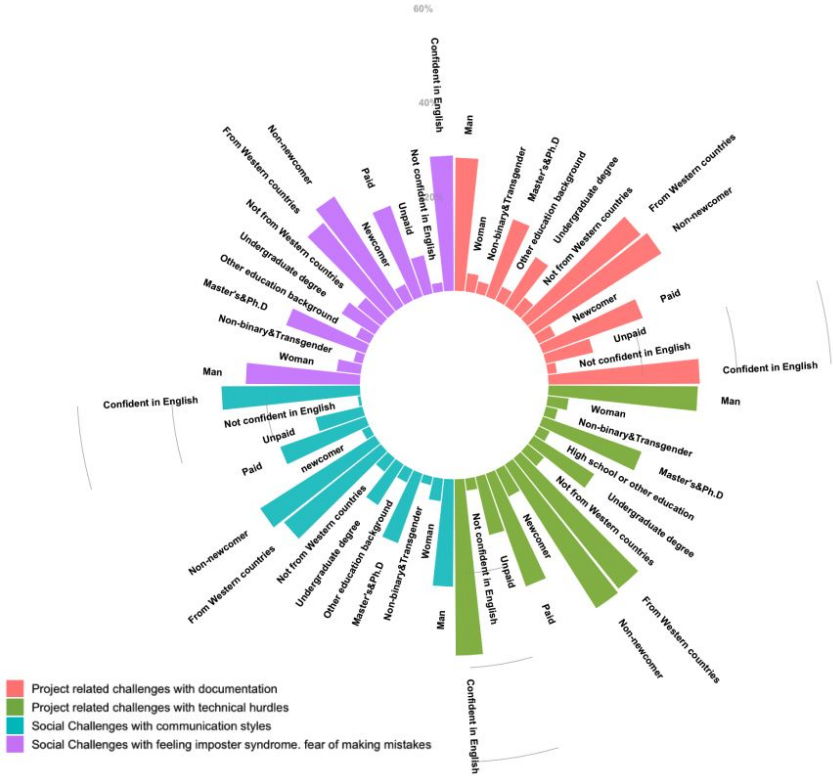
The survey revealed that the most commonly reported challenge among respondents was project-related, particularly technical hurdles, with 42% indicating this as an issue. The second most common challenge was related to project documentation, reported by 36% of respondents. Social challenges were also notable: 31% of respondents expressed feelings of imposter syndrome or a fear of making mistakes, and an equal percentage encountered challenges with communication styles. Next, we delve deeper into the demographics behind these top-voted challenges.

In Depth-Look at Highly Voted Challenges

Technical project-related challenges were most frequently reported by men, respondents with Master's or Ph.D. degrees, respondents from Western countries, non-newcomers, paid contributors, and those confident in English. Similarly, challenges concerning project documentation were more often reported by men, those with Master's and Ph.D. degrees, respondents from Western countries, non-newcomers, and those confident in English, as compared to their counterparts.

Regarding social challenges related to communication styles, they were more frequently reported by respondents confident in English, those who were paid, non-newcomers, respondents from Western countries, those holding a Master's or Ph.D. degree, and men. Challenges linked with feelings of imposter syndrome and fear of making mistakes were more commonly reported by respondents confident in English, paid contributors, non-newcomers, those from Western countries, men, and respondents with undergraduate or higher educational backgrounds compared to their counterparts.

FIGURE 3.3 In depth look at highly voted challenges (>30%)



Locating Information for Contributing to the ASF Community

When contributing to OSS, it's important to locate information about the project's processes, policies, and guidelines. This ensures that contributions align with the project's goals and standards [1]. Such information can encompass coding standards, documentation requirements, code review processes, the code of conduct, and project release management policies, among other topics [2, 3].

The ease with which contributors access this information significantly affects their satisfaction when participating in the project. If contributors can quickly and effortlessly locate the necessary details, they can not only contribute more promptly and efficiently but also have a higher likelihood of delivering high-quality contributions that project maintainers will readily accept [1, 2, 5].

Furthermore, certain pieces of information, such as a code of conduct, can play a pivotal role in OSS communities. Such guidelines help foster a social environment that is both encouraging and welcoming. A code of conduct primarily consists of a set of guidelines that members of a community are expected to adhere to in their interactions with one another. These guidelines can help prevent harassment, discrimination, and other undesirable behaviors that might prompt individuals to leave a community [4, 5].

Besides fostering a more positive social environment, a code of conduct can also attract a diverse range of newcomers to projects. Contributors from underrepresented groups are more likely to feel comfortable contributing to a project when they are aware that clear guidelines are in place to prevent harassment and discrimination [6].

In contrast, if contributors struggle to find the information they need, they might experience frustration and face delays in their contributions. Additionally, their inputs might not meet the project's standards, leading to potential rejection by the maintainers. Here, we investigate the ease of locating information to understand whether any barriers exist that may prevent or hinder contributors from contributing.

[1] Steinmacher, Igor, et al. "Overcoming open source project entry barriers with a portal for newcomers." Proceedings of the 38th International Conference on Software Engineering. 2016.
[2] Simmons, Andrew J., et al. "A large-scale comparative analysis of coding standard conformance in open-source data science projects." Proceedings of the 14th ACM/IEEE International Symposium on Empirical Software Engineering and Measurement (ESEM). 2020.
[3] Balali, Sogol, et al. "Newcomers' barriers... is that all? an analysis of mentors' and newcomers' barriers in OSS projects." Computer Supported Cooperative Work (CSCW) 27 (2018): 679-714.
[4] Guizani, Mariam, et al. "Perceptions of the State of D&I and D&I Initiative in the ASF." Proceedings of the 2022 ACM/IEEE 44th International Conference on Software Engineering: Software Engineering in Society. 2022.
[5] Trinkenreich, Bianca, et al. "Women's participation in open source software: A survey of the literature." ACM Transactions on Software Engineering and Methodology (TOSEM) 31.4 (2022): 1-37.
[6] Tourani, Parastou, Bram Adams, and Alexander Serebrenik. "Code of conduct in open source projects." 2017 IEEE 24th international conference on software analysis, evolution and reengineering (SANER). IEEE, 2017.

FIGURE.3.4: When you need to locate information about ASF processes, policies, or guidelines, which of the following describes your experience? (sample size : n)

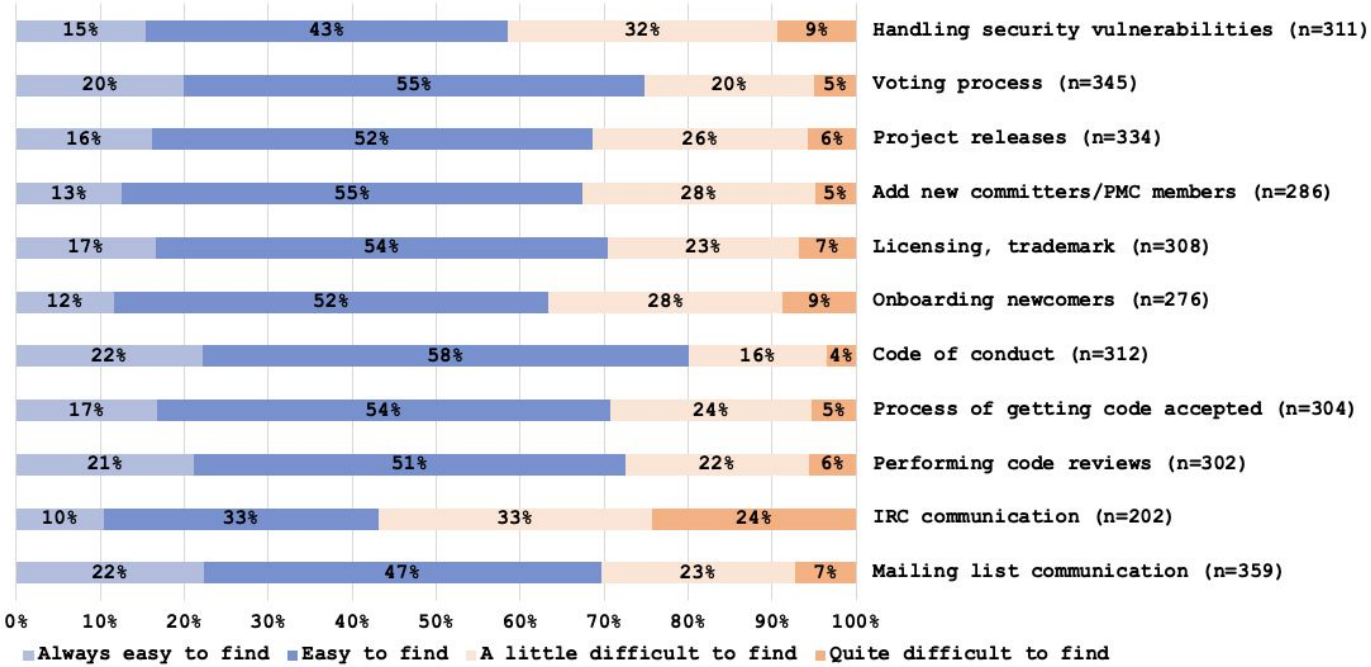
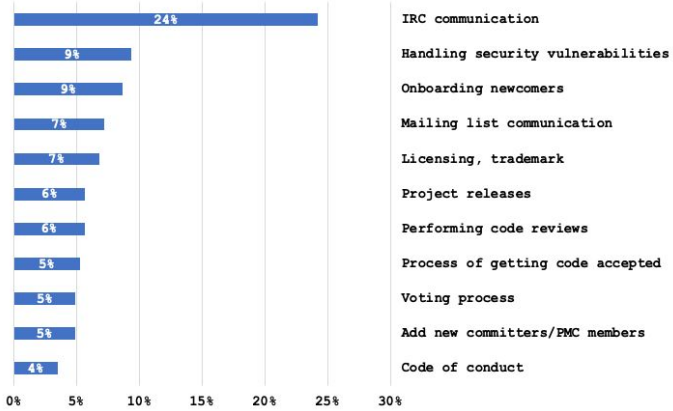


FIGURE.3.5 Difficulty in locating information: proportion of respondents reporting challenges



We evaluated the ease of accessing various documents and guidelines in the ASF community. As depicted in Figure 3.4 and Figure 3.5, IRC (Internet Relay Chat) communication was the most commonly reported type of information that was hard to find, with 24% of respondents indicating this. Handling security vulnerabilities and onboarding newcomers were the next most frequently cited topics, with 9% of respondents finding them difficult. Mailing list communication, licensing, and trademark issues were also mentioned by 7% of respondents as challenging to locate.

FIGURE.3.6 In depth-look at the most voted challenges (IRC communication)

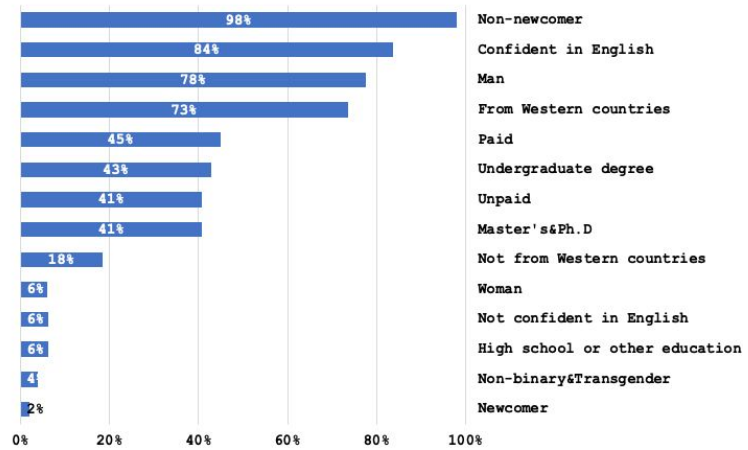


Figure 3.6 highlights the demographics that struggled with IRC communications information (49 respondents). Remarkably, within this group, non-newcomers reported the highest rate of difficulty at 98%. Those who lacked confidence in English reported challenges at 84%, while men and contributors from Western countries indicated difficulties at 78% and 73%, respectively. Moreover, respondents with an undergraduate degree, those unpaid, or from non-Western countries also reported challenges in locating IRC communication information.

Chapter 4

A Pulse Check on the State of DEI:

Comparison between 2020 and 2022

“More inclusion helps all. English is always a barrier but ASF's formal process helps here I think. I think the projects I work on do a good job on focusing on the merit of contributions over the style of communication.” --- [ASF-246]

In this section, we compare the results of two surveys on the experiences of contributing to the ASF community conducted in 2020 and 2022 with the aim of monitoring changes in the contributors' engagement, perception of DEI, ease of locating information, and the frequency with which contributors consult policies within the ASF community.

The 2020 survey received 624 responses, while the 2022 survey received 432 responses. Both surveys had similar distributions of demographic characteristics, with the largest differences being around 5%.

In this section, our analysis centers on contributors who have been traditionally underrepresented within the ASF community. This encompasses groups including women, non-binary and transgender individuals, newcomers to the ASF community, contributors not confident in English, those not from Western countries, unpaid contributors, and contributors without an undergraduate or higher education.

Section 4.1. Comparing Activity Engagement

Table 4.1 shows the proportional differences in responses between the two surveys, broken down by demographic attributes. The table presents engagement in the ASF community among respondents who answered "frequently" (either "more than once a week" or "more than once a month"). Arrows in the table indicate the percentage increase or decrease in responses between the surveys.

Gender: The analysis highlights the effects of role incongruity [1] on how contributors perceive the engagement levels of women, non-binary, and transgender contributors. Survey data from 2020 and 2022 reveal increased engagement from women, non-binary, and transgender contributors. For example, there was over a 30% rise in "code review contributions" in 2022 compared to 2020. Moreover, there was a 22% uptick in women respondents and a 13% increase in non-binary and transgender respondents engaging through "Outreachy programs." **This suggests that community awareness and efforts to promote inclusive participation are working.**

Newcomer: There has been a 20% increase in newcomers participating in code-related activities within the ASF community. Furthermore, there's been a 22% rise in newcomers joining the organization through various programs. However, it seems that newcomers are not as engaged in areas like "mentoring" or "decision-making," whether in code-related or non-code-related activities. The data suggests that, while the **ASF community is attracting newcomers, there's room to further involve them in these key areas to enhance their contributions.**

Language and Region: English is the predominant language used within the ASF community. However, contributors who don't consider themselves confident in English show a higher level of engagement in nearly all activities, with the exception of "serving as community organizers." This pattern mirrors that of respondents not from Western countries. Such trends suggest that the **ASF community is inclusive of contributors from non-Western countries.**

[1]. A member of a group will receive negative evaluations when stereotypes about the group misalign with the perceived qualities necessary to succeed in a role

Section 4.2 Comparing Changes in Perceptions of DEI:

It's essential for contributors to feel represented and valued by the community to be productive and satisfied. Table 4.2 shows the agreement results (either "Agree" or "Completely Agree") regarding contributors' perceptions of their ability to contribute to the ASF community. Arrows in the table indicate the percentage increase or decrease in responses between the surveys.

Role Stereotyping: The analysis indicates an increase in the percentage of respondents who felt they were perceived as a "parental figure" and that they were "expected to take care of others more than usual." This trend was observed across all demographic groups, with the exception of those who identify as women for the latter statement ("I feel some members of the community are patronizing to me"). There was also a rise in mentoring activity across all demographic groups, except among women respondents. This trend may reflect the perception of contributors in the ASF community who feel they are seen as parental figures and believe they are expected to care for and guide others. However, it's noteworthy that respondents who identified as women reported a decline in feeling obligated to care for others more than usual. **Our findings suggest a positive trend in the ASF community toward creating a more welcoming and equitable environment.** The percentage of respondents who felt that members were "patronizing" them decreased across all demographics, with the exception of those with a high school or other education. This decline was particularly significant for respondents who were not confident in English, showing a more than 10% decrease.

Ability to Contribute: Our findings suggest that barriers have diminished for the demographic groups studied. An increasing number of contributors now feel they have an "equal chance" of getting their contributions accepted. This feeling is particularly pronounced among those who identify as women (7%), non-binary and transgender respondents (7%), and those not confident in English (19%). Moreover, a significant percentage of newcomers (10%) express optimism about having an "equal opportunity." Additionally, there's a positive shift in agreement with the statement, "Nothing keeps me from contributing." This sentiment is echoed in the responses of 29% of women respondents, 59% of non-binary and transgender respondents, and 14% of those not confident in English. **Such trends in the ASF community suggest successful efforts to promote DEI within the ASF community.**

When investigating perceptions such as having a "network of peers" or "finding a mentor they are comfortable with," the data present mixed results. **Overall, a higher percentage of survey respondents, especially those identifying as women, non-binary, and transgender, believe they have access to a supportive peer network and mentors with whom they can comfortably collaborate.**

However, our analysis reveals a negative trend for contributors who are not compensated for their efforts and those without a formal education degree. Those respondents often feel they don't have an equal opportunity to contribute to the ASF community. Particularly, 22% of respondents without a formal education degree increasingly agree with the statement, while a decreasing number disagree: "Nothing keeps me from contributing to the project." Unpaid contributors and those without formal education increasingly feel it's challenging to find a suitable mentor. This sentiment might correlate with their perception of accessing a supportive peer network.

Being Represented: The data suggests a growing agreement among underrepresented groups that the Project Management Committee (PMC) accurately represents society. This sentiment is shared by non-binary and transgender respondents (17%), respondents not confident in English (14%), and those from non-Western countries (14%). The proportion of respondents from these underrepresented groups feeling included in the decision-making process has risen, with the exception of women respondents.

Code of Conduct: Most projects within the ASF community predominantly rely on content in English. As a result, cultural and geographical differences can lead to misunderstandings about regulations and procedures, thereby creating additional communication barriers. The code of conduct stands as a pivotal document outlining expected behavior and decorum within a project. Our findings indicate that awareness of the code of conduct has risen by 9% among non-native English speakers and by 15% among non-Western respondents. However, the analysis also shows a decrease in awareness among newcomers, with a 13% decline. A potential reason for this drop might be the reduced frequency of community events. Coupled with feelings of being patronized, this suggests that respondents from these minority groups might feel they lack the power to address these challenges.

On the other hand, respondents from these groups felt more empowered to participate fully in a project when it adhered to its code of conduct, especially if they were familiar with it. This might stem from the fact that codes of conduct are now often framed with specific procedures for addressing violations instead of merely being viewed as "aspirational" documents. However, respondents do not have formal education, and those not compensated for their contributions felt less empowered by the code of conduct, even when they were aware of it.

Section 4.3 Comparing Ease of Locating Policy Information

Table 4.3 presents the data comparing responses from the 2020 and 2022 surveys regarding the ease (either "Easy to find" or "Always easy to find") of locating information about policies and other details, broken down by diversity attributes. Arrows in the table indicate the percentage increase or decrease in responses between the surveys.

Gender: Our analysis reveals that respondents identifying as women experienced a 19% decrease in the ease of locating information on "mailing list communication," while those identifying as non-binary and transgender faced a 17% decrease. A similar decline was seen in how easily women respondents could locate information about the "voting process" and the "process of getting code accepted," with over a 20% difference between the 2020 and 2022 survey results. However, during these two years, there was an uptick in the ease of locating information about "IRC communication." These trends suggest a need to bolster efforts to improve the accessibility and clarity of information in the ASF community.

Newcomer: There was a 9% increase between 2020 and 2022 in the ease of finding information about "adding new committers to PMC members." Yet, a noticeable decrease was observed in how readily newcomers could access information on "onboarding newcomers" (16%) and "IRC communication" (15%).

Language and Region: There is a marked improvement in the ease with which respondents who are not confident in English or are from non-Western countries can locate policy-related information. Specifically, those not confident in English reported a 20% increase in the ease of finding the "Code of Conduct" and an 18% increase regarding "performing code reviews." Similarly, respondents from non-Western countries noted a 6% increase in the ease of accessing information about the "Code of Conduct." **These results imply that the ASF community has heightened the accessibility of information on policies, the Code of Conduct, and the process of code acceptance.** Such enhancements have particularly benefited those less confident in English or from non-Western countries.

Compensation and Education Background: When investigating the ease of locating information about "onboarding newcomers," "project releases," and "the voting process," our analysis reveals a slight decline for unpaid contributors, with decreases of no more than 5%. Similarly, those with high school and other education backgrounds noted a 12% drop in finding details on "project releases." On the brighter side, there is a positive trend regarding the accessibility of the "code of conduct." Those without a formal education background observed a 20% improvement in this area, while unpaid contributors reported a 7% rise. These results might suggest that **the ASF community is prioritizing the accessibility of its code of conduct.**

Section 4.4 Comparing Frequency of Locating Policy Information

Table 4.4 presents the data showing the differences in responses from the 2020 and 2022 surveys regarding how often (either "more than once a week" or "more than once a month") contributors locate information. Arrows in the table indicate the percentage increase or decrease in responses between the surveys.

Gender: There has been a decline in the frequency with which women contributors locate most types of information. For instance, there is a decrease of over 20% in locating the "onboarding newcomers" and the "voting process." Additionally, the frequency of locating information regarding the "code of conduct" has decreased for women, non-binary, and transgender respondents. This reduction in locating information could be due to challenges in finding the correct information, or perhaps contributors in these categories are already familiar with the details and see no need to revisit them.

Newcomer: The frequency with which newcomers locate the processes of "getting code accepted" has remained consistent. However, there has been a 7% decrease among newcomers in locating the "voting process" and "code of conduct." In contrast, the analysis reveals a 15% increase in newcomers frequently locating about "performing code reviews" and a 14% increase in often locating "project releases." This aligns with data showing an uptick in the number of newcomers contributing to code or engaging in code review activities.

Language and Region: Respondents not confident in English reported two notable increases in the frequency of locating information. There was a 22% uptick in locating about "adding new committers PMC members" and a 20% rise in locating regarding "project releases."
Our analysis also implies that respondents not fluent in English and those from non-Western countries actively locate information about onboarding newcomers and incorporating new committers and PMC members.

Compensation and Education Background: Our analysis reveals an 11% increase in the frequency of locating information about "adding new committers as PMC members" among contributors from high school or other educational backgrounds. However, there is a notable 19% decline in how often these contributors locate information related to "mailing list communication." For unpaid contributors, there is no significant change between the surveys concerning the frequency of locating information on "performing code reviews" and "IRC communication." Yet, there is an uptick of 3% to 4% in the frequency of their locating "adding new committers as PMC members" and "project releases."

TABLE.4.1 Comparison of proportional activity engagement between 2020 and 2022.

	Woman	Non-binary& Transgender	Newcomer	Not confident in English	Not from western countries	Unpaid	High school or other education
Contributing reviewing code	↑ 30%	↑ 39%	↑ 20%	↑ 3%	↑ 7%	↑ 6%	↑ 6%
Creating or maintaining documentation	↑ 7%	↓ -1%	↓ -5%	↑ 11%	↑ 18%	↑ 7%	↑ 4%
Translating documentation	↓ -3%	↑ 10%	↓ -5%	↑ 3%	↑ 4%	↓ -2%	↑ 1%
Participating in decision making about the project development	↓ -10%	↑ 21%	↑ 8%	↑ 2%	↑ 20%	↑ 6%	↑ 9%
Serving as a community organizer	↓ -30%	↑ 30%	↓ -9%	↓ -2%	↑ 18%	↑ 2%	↓ -1%
Mentoring other contributors	↓ -4%	↑ 18%	↑ 13%	↑ 26%	↑ 24%	↑ 10%	↑ 11%
Attending events in person	↓ -16%	↓ -4%	↓ -1%	↑ 3%	↑ 3%	↓ -1%	* 0%
Participating through school/university computing programs	* 0%	↑ 20%	↑ 3%	↑ 8%	* 0%	↑ 1%	↑ 5%
Participating through a program like Outreachy Google Summer of Code etc	↑ 22%	↑ 13%	↑ 22%	↑ 4%	↑ 15%	↑ 2%	* 0%
Helping with the ASF operations	↓ -1%	↑ 13%	↓ -1%	↑ 2%	↑ 10%	* 0%	↑ 2%

TABLE 4.2 Comparison of respondents' agreement on the perceptions of DEI between 2020 and 2022.

	Question	Women	Non-binary& Transgender	Newcomer	Not confident in English	Not from western countries	Unpaid	High school or other education
Role Sterotyping	Other members of the project see me as a parental figure	↓ -2%	↑ 51%	↑ 11%	↑ 9%	↑ 11%	↑ 11%	↑ 9%
	I am expected to take care of other members of the project more so than is usual	↓ -22%	↓ -2%	↑ 8%	↑ 8%	↓ -1%	↑ 3%	↑ 2%
	I feel some members of the community are patronizing to me	↓ -6%	↓ -24%	↓ -4%	↓ -14%	↓ -5%	↓ -4%	↑ 2%
Ability to contribute	I have an equal chance to get contributions accepted	↑ 7%	↑ 7%	↑ 10%	↑ 19%	↑ 5%	↑ 4%	↓ -8%
	Nothing keeps me from contributing to the project	↑ 29%	↑ 59%	↑ 10%	↑ 14%	↑ 2%	↓ -2%	↓ -22%
	I have a solid network of open source peers	↑ 16%	↑ 21%	↑ 2%	↑ 12%	↑ 13%	↓ -3%	↓ -2%
	It was easy to find a mentor with whom I felt comfortable	↑ 5%	↑ 23%	↓ -7%	↓ -8%	↓ -2%	↓ -6%	↓ -6%
	I have a hard time following discussions because of technical jargon	↓ -4%	* 0%	↑ 3%	* 0%	* 0%	↓ -4%	↓ -2%
Being represented	The PMC represents a diverse set of people	↓ -35%	↑ 17%	↓ -8%	↑ 14%	↑ 14%	↓ -6%	↓ -13%
	I feel represented in the decision making group	↓ -25%	↑ 3%	↑ 7%	↑ 9%	↑ 14%	↑ 1%	↑ 8%
The code of conduct	I was made aware of the code of conduct and how to report violations	↑ 1%	↑ 25%	↓ -13%	↑ 9%	↑ 15%	↑ 11%	↑ 4%
	I felt safer and more empowered to fully participate in this project because it followed the code of conduct	↑ 12%	↑ 8%	↑ 3%	↓ -1%	↑ 6%	↓ -4%	↓ -5%

TABLE 4.3: Comparison of proportion reporting "Easy to Locate Information" between 2020 and 2022.

	Woman	Non-binary& Transgender	Newcomer	Not confident in English	Not from western countries	Unpaid	High school or other education
Mailing list communication	↓ -19%	↓ -17%	↓ -5%	↑ 9%	↓ -3%	↑ 1%	↑ 1%
IRC communication	↑ 5%	↓ -13%	↓ -15%	↑ 8%	↓ -4%	↓ -9%	↑ 15%
Performing code reviews	↑ 1%	↑ 8%	↓ -4%	↑ 18%	↓ -2%	↑ 1%	↑ 2%
Process of getting code accepted	↓ -27%	↑ 22%	↓ -5%	↑ 14%	↑ 4%	↑ 2%	↓ -2%
Code of conduct	↓ -8%	* 0%	↓ -6%	↑ 20%	↑ 6%	↑ 7%	↑ 20%
Onboarding newcomers	↓ -7%	↑ 32%	↓ -16%	↑ 4%	↑ 3%	↓ -3%	↑ 2%
Licensing trademark	↓ -10%	↑ 2%	↓ -4%	↑ 22%	↑ 1%	↑ 6%	↑ 13%
Add new committers PMC members	↓ -1%	* 0%	↑ 9%	↑ 19%	↑ 7%	↑ 7%	↓ -2%
Project releases	* 0%	↓ -5%	↓ -7%	↑ 14%	↓ -3%	↓ -5%	↓ -12%
Voting process	↓ -20%	* 0%	* 0%	↑ 5%	↓ -1%	↓ -1%	↑ 4%

TABLE 4.4: Comparison of proportion reporting "Frequency to Locate Information" between 2020 and 2022.

	Woman	Non-binary& Transgender	Newcomer	Not confident in English	Not from western countries	Unpaid	High school or other education
Mailing list communication	↓ -12%	↑ 26%	↑ 4%	↓ -6%	↓ -1%	↓ -2%	↓ -19%
IRC communication	↓ -4%	↑ 8%	↑ 2%	↓ -17%	↓ -5%	* 0%	↑ 19%
Performing code reviews	↓ -7%	↑ 11%	↑ 15%	↓ -10%	↑ 1%	* 0%	↑ 5%
Process of getting code accepted	↓ -17%	↓ -3%	* 0%	↓ -11%	↓ -6%	↓ -4%	↓ -15%
Code of conduct	↓ -8%	↓ -12%	↓ -7%	↓ -6%	↓ -3%	↓ -3%	↑ 5%
Onboarding newcomers	↓ -23%	↑ 16%	* 0%	↑ 5%	↑ 5%	↓ -2%	↓ -5%
Licensing trademark	↓ -2%	↑ 8%	↓ -2%	* 0%	* 0%	↓ -4%	↓ -6%
Add new committers PMC members	↓ -6%	↑ 17%	↑ 1%	↑ 22%	↑ 5%	↑ 4%	↑ 11%
Project releases	↓ -14%	↑ 15%	↑ 14%	↑ 20%	↑ 3%	↑ 3%	↑ 1%
Voting process	↓ -21%	↑ 10%	↓ -7%	↑ 5%	↑ 2%	↓ -2%	↓ -11%

Chapter 5

Pathways to a Diverse, Equity, and Inclusive Community

“I am overall very happy with the exposure and support the community has given me…” --- [ASF-248]

The State of DEI is Improving

Results from our study suggest that biases and stereotypes are becoming less prevalent, particularly among underrepresented groups such as contributors who identify as women, non-binary and transgender, and newcomers. This positive shift can be attributed to a heightened awareness of the need for DEI, coupled with proactive measures taken by the ASF community, such as the Apache mentoring programme, to enhance community inclusivity.

Gender: Lack of representation, discrimination, and harassment have historically been obstacles for women contributors in OSS community [1-3]. These obstacles can make it more challenging for women to contribute to and succeed in OSS. Our study shows that the barriers caused by biases and stereotypes are decreasing in the ASF community. There is a significant improvement among women, non-binary, and transgender respondents in both their ability to make code and non-code contributions, as well as in their perception of their ability to contribute. Specifically, we observed a notable enhancement in their agreement with the statement ''nothing keeps me from contributing''.

Language and Region: Our analysis suggests that non-Western contributors and those who are not native English speakers are becoming more involved in all activities, including decision-making, mentoring, and code reviewing, among others. Additionally, there has been an increase in the number of respondents who agree that it is easy to find information regarding procedures and processes.

[1] Terrell, Josh, et al. "Gender bias in open source: Pull request acceptance of women versus men." PeerJ Prepr. 4 (2016): e1733.
[2] Lin, Yuwei. "Women in the free/libre open source software development." Encyclopedia of gender and information technology. IGI Global, 2006. 1286-1291.
[3] Trinkenreich, Bianca, et al. "Women's participation in open source software: A survey of the literature." ACM Transactions on Software Engineering and Methodology (TOSEM) 31.4 (2022): 1-37.

We attribute this to the efforts made by the ASF community to create more inclusive and welcoming projects.

However, we observed a decrease in the frequency of locating information, such as how to get code accepted or communication policies, among respondents from non-Western countries or those not confident in English. **This may result from the ASF community's efforts in developing a welcoming environment for contributions, and perhaps these individuals encounter fewer friction points that would necessitate locating additional information.**

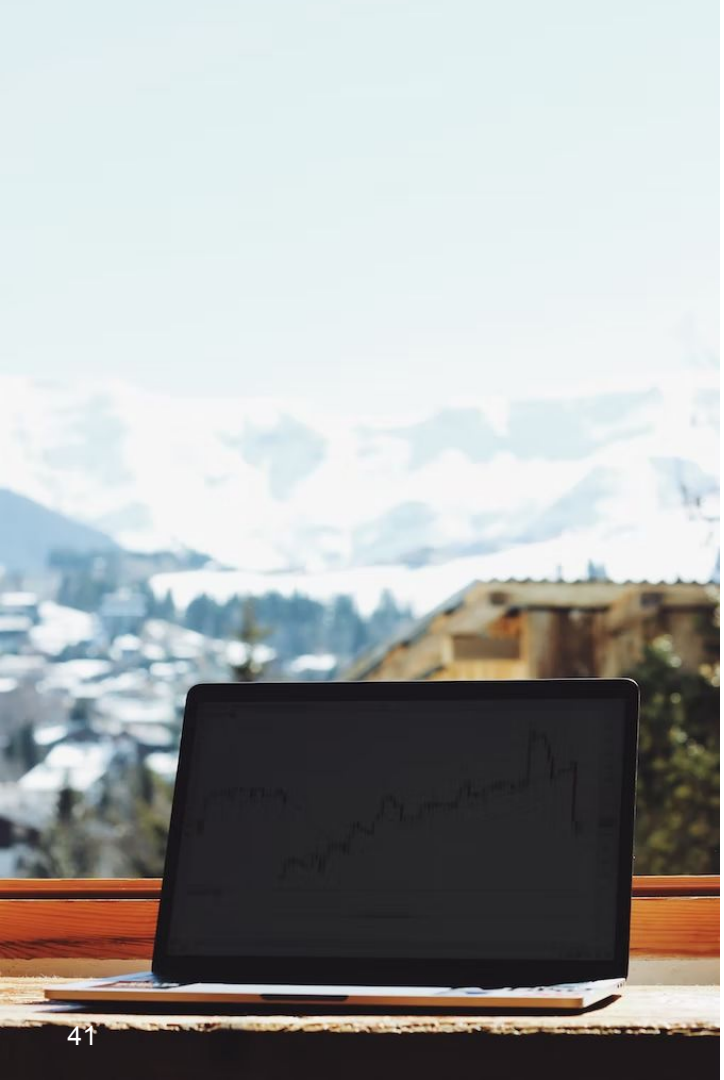
Compensation and Education Background: We have observed a rise in the level of engagement among contributors who lack higher education degrees or compensation, particularly in the aspect of mentoring other contributors. **This suggests that the ASF community is advancing in inclusivity for these groups.**

Progress is still needed

Gender: The disparity between the number of contributors identifying as men and those identifying as women, non-binary, and transgender remains significant. In OSS community, gender biases and obstacles persist, as historically, men have dominated and continue to do so [1]. Despite the progress that has been made, there is still work to be done in order to foster greater gender inclusivity within the ASF community. Engaging in Outreachy and mentoring programs should remain a priority for the ASF community to increase contributions from women, non-binary, and transgender contributors. Specifically, focusing on promoting and mentoring respondents of diverse genders into leadership positions within the ASF community can help attract and retain underrepresented contributors [1].

Newcomers: Successfully onboarding new contributors remains an ongoing challenge within OSS communities. The ASF community employs mentoring programs like Google Summer of Code and the Apache Mentoring Programme to train these new contributors. However, our findings reveal that while respondents engaged in mentoring other contributors more frequently, many of them encountered difficulties in finding a suitable mentor. Possible reasons for this challenge include conflicting time zones, disparities in interests between mentors and mentees, or negative perceptions regarding receiving constructive criticism. Newcomers are decreasingly locating the community's policies, possibly due to a lack of available mentors or insufficient orientation regarding the policies. Addressing this issue requires considering several potential solutions.

[1] Prana, Gede Artha Azriadi, et al. "Including everyone, everywhere: Understanding opportunities and challenges of geographic gender-inclusion in oss." IEEE Transactions on Software Engineering (2021).



First, it is crucial to recognize and acknowledge mentoring activities. For instance, implicit mentoring through code reviews, as proposed in a prior study, should be acknowledged [1]. Second, apart from formal mentoring programs, the ASF community could explore the possibility of facilitating informal mentoring. This could involve creating an environment where mentors and mentees can naturally connect and establish mentorship relationships [1].

English Skills: As mentioned earlier, the use of English as the primary language in the ASF community can pose challenges for non-native English speakers interested in contributing. We have put forward potential strategies to address these language barriers.

(1) **Providing a translation tool** to aid non-native speakers in comprehending rules, procedures, and recommendations [2].

(2) **Promoting mentoring programs** that offer additional support and guidance to non-native speakers. These programs enable them to better understand the community's culture and gain confidence in their contributions [3].

(3) **Encouraging contributions from a diverse group of contributors**, including non-native speakers, can help create a more inclusive and welcoming environment for all contributors. Such cohorts of contributors with similar demographics can foster a sense of belonging, aiding them in staying engaged with the project [3].

[1] Feng, Zixuan, et al. "A case study of implicit mentoring, its prevalence, and impact in Apache." Proceedings of the 30th ACM Joint European Software Engineering Conference and Symposium on the Foundations of Software Engineering. 2022.
[2] Bosu, Amiangshu, and Kazi Zakia Sultana. "Diversity and inclusion in open source software (OSS) projects: Where do we stand?." 2019 ACM/IEEE International Symposium on Empirical Software Engineering and Measurement (ESEM). IEEE, 2019.
[3] Balali, Sogol, et al. "Newcomers' barriers... is that all? an analysis of mentors' and newcomers' barriers in OSS projects." Computer Supported Cooperative Work (CSCW) 27.3 (2018): 679-714.

(4) **Provide various forms of communication channels** can benefit new contributors by allowing them to select a channel they are most comfortable with.

Language and Region: Contributors to the ASF community from various countries have diverse cultural backgrounds. These cultural variations can lead to differences in communication and working styles. To address such disparities, several strategies can be employed:

Providing communication templates that facilitate open and clear interaction among contributors. This can foster trust and mutual understanding. For instance, when reaching out to the community, it is vital to maintain politeness and respect, emphasize relevant skills and objectives, clearly articulate inquiries, and outline any prior attempts at resolving the issue before seeking community assistance [1].

Offering appropriate orientation and training on cultural differences along with best practices for effective communication and collaboration with contributors from diverse cultures [1].

Promoting role models from diverse cultural backgrounds for the community, such as the ASF DEI committee members [2].

Having a clear and enforceable code of conduct that promotes mutual respect and prohibits discrimination or harassment [2].

[1] Steinmacher, Igor, Christoph Treude, and Marco Aurelio Gerosa. "Let me in: Guidelines for the successful onboarding of newcomers to open source projects." IEEE Software 36.4 (2018): 41-49.
[2] Singh, Vandana, Brice Bongiovanni, and William Brandon. "Codes of conduct in Open Source Software—for warm and fuzzy feelings or equality in community?." Software Quality Journal (2021): 1-40.

Compensation: Our study reveals that a significant number of respondents, particularly newcomers to the project, do not receive compensation for their contributions. When we investigated contributors' willingness to receive increased compensation, we discovered that the issue is complex and cannot be solely addressed by augmenting financial support. Other factors, including policies, opportunities, and legislation, also come into play. Alongside financial compensation, the ASF community can acknowledge contributions through various means. This might encompass recognizing and rewarding efforts such as mentoring, issuing ''karma'' points, or employing other non-monetary forms of recognition for both code and non-code contributions [1].

Education Background: There are several strategies to enhance inclusivity for contributors without higher education, such as those without undergraduate degrees. One strategy is to provide clear documentation and guidelines for project contributions. This aids contributors in understanding how to engage [2]. Offering guidance and mentorship to new contributors, particularly those without formal education, is another approach. This not only empowers them to delve into the project and understand its technical features but also promotes an inclusive environment. It's crucial to be open to contributions that may not be as refined as others. Being adaptable and empathetic during the code review process can help ensure that every contributor feels appreciated and understood [1].

[1] Feng, Zixuan, et al. "A case study of implicit mentoring, its prevalence, and impact in Apache." Proceedings of the 30th ACM Joint European Software Engineering Conference and Symposium on the Foundations of Software Engineering. 2022.]
[2] Steinmacher, Igor, Christoph Treude, and Marco Aurelio Gerosa. "Let me in: Guidelines for the successful onboarding of newcomers to open source projects." IEEE Software 36.4 (2018): 41-49.

About the Authors

Zixuan Feng (Steve) is a Ph.D. candidate in the Department of Electrical Engineering Computer Science at Oregon State University. His research interests focus on developing an empirical understanding of collaboration in OSS communities.

Anita Sarma is a Professor at Oregon State University. Her work focuses on promoting sustainability of open source projects by helping attract and retain contributors, with a special focus in improving the state of DEI in OSS. Her work has been funded through the National Science Foundation (NSF) and Air Force (AFOSR), and she is the recipient of the NS CAREER award.

Luis Cañas Díaz Luis is a co-founder of Bitergia, a company that provides software analytics for open source ecosystems. Luis holds a degree in computer science from the Universidad Rey Juan Carlos in Madrid, where he worked for a decade studying OSS communities. Nowadays, he is a consultant at Bitergia and is focused on providing metrics with the data offered by the GrimoireLab platform, one of the software solutions developed in the CHAOSS project.

Katia Rojas: Katia is the VP for Diversity and Inclusion at the ASF where she supports the organization in their mission to build equity in their community by developing tools and frameworks to foster inclusion and increase diversity in all phases of Apache projects.

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Apache Diversity and Inclusion is a project dedicated to understanding and promoting the diversity and inclusion of our open source communities at the Apache Software Foundation. Our mission is to build equity in our community by developing tools and frameworks to foster inclusion and increase diversity in all phases of Apache projects.We are guided by the values of respect, empathy, openness, patience, candor & dependability.

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