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

A diagnostic report.

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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” to tech careers. OSS contributors come from diverse backgrounds and represent a wide range of identities, cultures, and nations. They work together to develop and maintain software projects.

Despite the widespread use of OSS, there is a lack of diversity of contributors in OSS. A lack of diversity among contributors can have negative consequences. Firstly, OSS projects miss out on the diversity of thought that can help make OSS products more innovative. Secondly, contributors from underrepresented groups miss out on OSS projects' learning and career opportunities.

Diversity is a complex social construct and consists of several dimensions, such as gender, language abilities, ethnicity, age, and other distinguishing characteristics. In addition, factors such as ethnicity also plays a role in shaping contributors' perceptions of diversity and inclusion in OSS.

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

The ASF is one of the largest OSS organizations, with over 460,000 contributors and over 350 active projects. The Apache DEI project is dedicated to studying and promoting diversity and inclusion within the OSS community. Respect, empathy, openness, patience, sincerity, and dependability serve as the project's guiding values. Several initiatives have been undertaken to increase diversity in OSS communities, such as having Project Management Committee (PMC)-built committer onboarding and retention plans.

This study analyzes data from surveys that were carried out within ASF projects in 2020 and 2022. The study considered various diversity attributes, such as gender, age, region, seniority, educational background, English proficiency, and compensation. It explored the experiences of individuals, communities, and organizations concerning the current state of DEI at ASF projects.

Our study shows that contributors from ASF projects:

Click here view the survey questions

This study represents years of primary research conducted by a team of research professionals, community leaders, and members of the “ASF Diversity and Inclusion Committees.” We hope that you have found this study to be an informative and helpful resource to help you foster an inclusive environment in OSS where everyone is welcome.

We thank all survey respondents for contributing to this research. This work is supported by the Google Award for Inclusion Research Program and National Science Foundation.

Executive summary

The Apache Diversity and Inclusion project aims to promote diversity and inclusivity in the ASF community through innovative tools and frameworks. At the heart of our work are key values, such as respect, empathy, openness, patience, candor, and dependability, which guide us in our efforts to create a more diverse and inclusive community.

Contributors to ASF projects have different motivations, such as learning opportunities, bug fixes, and reputation building, highlighting the need for motivating, engaging, and retaining new contributors.

The ASF community is creating a welcoming environment, with a decline in feelings of being patronized and contributions barriers lowered. There is a positive trends in ASF projects, which might be from efforts to promote DEI in the ASF community.

The ASF community is making strides towards gender diversity and inclusivity. The number of contributors from underrepresented gender groups (women, non-binary, prefer-to-self describe) reported fewer instances of unfriendly or toxic environments than in 2020.

The ASF community is actively working towards supporting newcomers in their projects, which is reflected in the increased proportion of newcomers participating in code-related activities. Additionally, newcomers reported facing fewer toxic environment challenges

Respondents across all demographics responded as being sought out as parental figures.

Introduction

Encouraging diversity is a way to enhance the overall quality of OSS projects and to promote a more inclusive and equitable technology industry [1 - 4]. Individual contributors in OSS community, particularly those from underrepresented groups, may miss out on significant learning opportunities and face obstacles in progressing their careers if they work alone [3].

In OSS community, diversity initiatives aim to remove barriers to participation and increase the representation of underrepresented groups [1, 2]. Research has demonstrated that teams with a greater gender diversity perform better [4]. Promoting and mentoring women to leadership positions may be an effective solution to foster gender diversity [1]. Studies have investigated how location and language can impact the acceptance of code [5].

Therefore, DEI is a multidimensional construct arising from various demographic and background attributes. Demographic attributes include factors such as age, gender, and ethnicity. Other individuals' characteristics such as role, expertise, personality, and cognitive styles also play a role in how individuals interact and perceive their community. When analyzing DEI, it is therefore essential to consider the different attributes that define an individual.

DEI in OSS is a multifaceted concept that arises from the attributes that differentiate individuals, whether those attributes are demographic (such as age and gender) or non-demographic (such as role, expertise, personality, or cognitive styles).

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 to do so. 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 in ASF projects.

This first objective of this study was to gain a deeper understanding of the current perceptions, sense of

[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.

belonging, and level of inclusion among ASF contributors, disaggregated by diverse demographic groups.

The second objective was to examine the evolution of DEI at ASF community by comparing the results of this survey with that conducted in 2020. Understanding the evolution of the state of DEI among ASF projects allows us to identify areas where progress has been made, areas of opportunities for improvement, and areas that need attention. This information can then be applied to the design of new, targeted DEI initiatives that address particular issues that contributors in ASF projects are facing.

Chapter 1

The State of DEI in ASF projects

“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

Strengthening community through DEI

A welcoming and inclusive environment that respects the diversity of backgrounds and perspectives helps foster diversity of thoughts helping OSS projects be resilient and create more innovative products.

There are several things that a project can do to create an inclusive environment. Encouraging and engaging potential contributors from underrepresented groups through outreach and events is a first step in attracting a diverse contributor base. Simply attracting contributors is not enough. It is also important to retain diverse contributors. Projects can do so by recognizing the diverse contributors and their diverse contributions. Creating mentorship and career advancement opportunities is also essential.

This section provides demographics details of our 432 survey respondents who are active ASF contributors.

Gender and Age: Out of 432 respondents, 87% identified as men, while 5% identified as women, 2% identified as gender variant/non-conforming/non-binary/self-described, 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 research has found the distribution of women contributors to range between 3% to 10%. When it comes to the age range, the majority of survey respondents are between the ages of 35 to 54 years old (35 to 44 years old: 36%, 45 to 54 years old: 26%).

Compensation, Seniority, and Education: More than half of the respondents (55%) were compensated for their contributions to ASF projects, indicating a healthy distribution of paid and volunteer contributors. More than half of respondents (54%) have contributed to ASF projects for more than six years (6 to 10 years: 22%, over 10 years: 32%), while only 6% are newcomers (have less than one year of experience). With respect to educational background, 85% of respondents hold a bachelor's degree or higher (Undergraduate degree: 31%, Master degree: 44%, Ph.D.: 10%), 8% of respondents have completed high school or have no formal education.

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

Demographics categorization

Gender minority: In this study we combine the responses from women with those from non-binary, gender variant, non-conforming, and self-described together, since these categories are underrepresented in our response pool, as well as in OSS as identified by research [1, 2, 3].

[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] Prana, Gede Artha Azriadi, et al. "Including everyone, everywhere: Understanding opportunities and challenges of geographic gender-inclusion in oss." IEEE Transactions on Software Engineering 48.9 (2021): 3394-3409.
[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 A Snapshot of Demographics of 2022 DEI survey of ASF contributors

	Demographics	Number of respondents	%
Gender	Men	374	87%
	Women	22	5%
	Gender variant/Non-conforming/Non-binary/Self-described	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 educations	36	8%
	Undergraduate degree	136	31%
	Master	191	44%
	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 survey respondent: 432			

Newcomers face many challenges in getting on-boarded and finding mentors in the project [1], which can make it difficult for newcomers to get started, find their place in the community, and make meaningful contributions. We classified newcomers as those who have “less than 1-year” experience in Apache projects.

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 [2, 3].

Contributors without undergraduate or higher education background 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 [4].

[1] 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.
[2] 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.
[3] Igor, Steinmacher, et al. "Being a Mentor in open source projects." Journal of Internet Services and Applications 12.1 (2021).
[4] “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/.

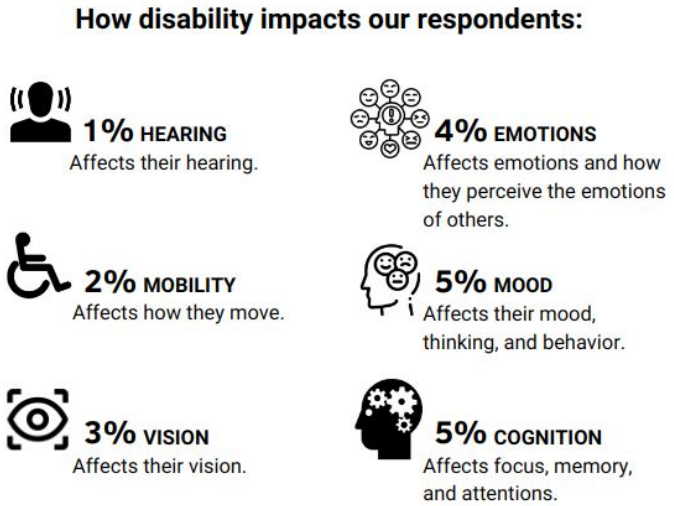
Contributors who are not confident in English or who are from non-western countries are underrepresented in OSS projects as the majority of contributors in OSS come from North America and Europe, and English is often the primary language used for communication and documentation.

Cognitive, developmental, intellectual, or physical disabilities may exist

Disabilities are not binary and can manifest in various ways. Depending on its nature, a disability may be evident or invisible [1].

Out of 432 respondents, 74 (17%) reported that their disability affects their life. Among the different dimensions of disability, 5% out of 432 survey respondents reported that their disability affects focus, memory, attention, mood, thinking, and behaviors. 4% said their disability affects their emotions and how they perceive the feelings of others. 6% of respondents preferred not to specify their disability in their answers.

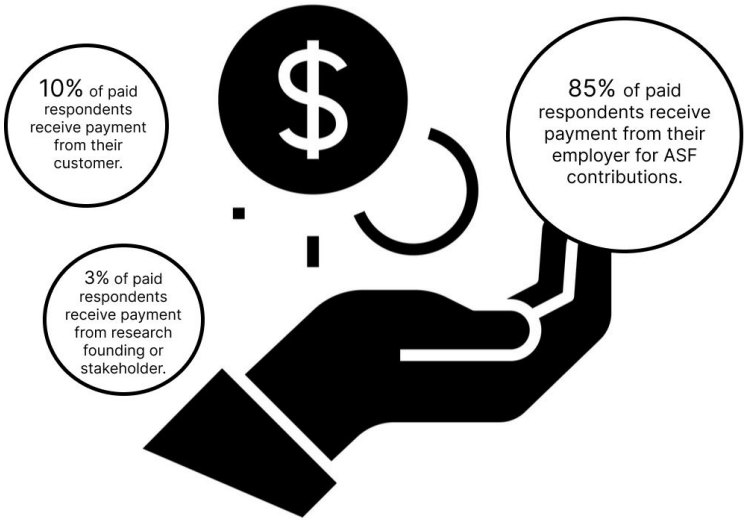
These findings suggest that the ASF community could support the different needs of different individuals and help form support groups where individuals with disability can seek support.



[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 55% out of the 432 respondents receive compensation (including part-time) for their work at the ASF (12% of respondents did not provide answers). The average number of hours for which they were compensated was 20 hours per week. When considering the paid contributors, 85% out of 239 compensated contributors were paid by their employer, 10% were paid by their customer or contract, and 3% were paid by a research foundation or via a stakeholder-sponsored study.



We asked participants 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% of respondents stated they were not looking to get paid more, "*I have no more time*" [ASF-189]. Policies and laws were another constraint: "*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].

Not knowing how to find paid opportunities was another factor; 15% of respondents said that they did not know how to ask to be paid: "*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 were 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 Apache

“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]

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Contributors in a large, globally distributed community contribute to projects for various reasons, including an opportunity to learning, the need to fix a bug, and building reputation in the community. OSS communities need to motivate, engage, and retain new contributors to remain sustainable [1].

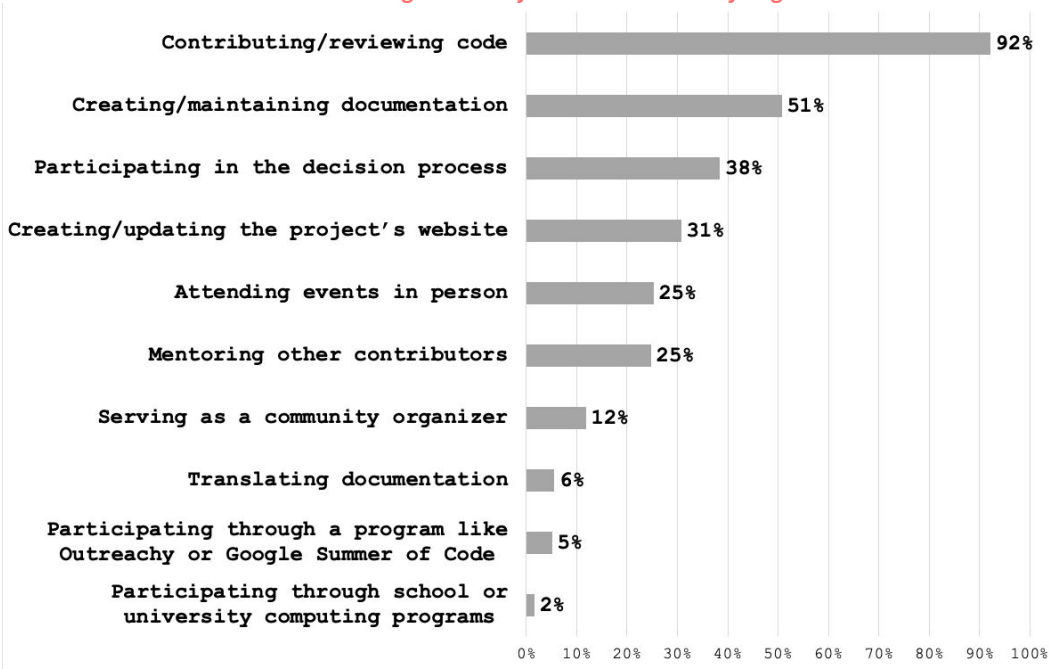
Newcomers to a project often have to deal with a wide variety of technical and social challenges. A smooth onboarding process can help new contributors understand how to contribute effectively, which helps them avoid frustrations and feel welcomed and valued. Newcomers to OSS can face multiple obstacles, such as a lack of guidance and mentorship, lack of understanding of community norms and expectations, and a lack of support for underrepresented groups, which can make contributors lose motivation and even stop participating. [2].

In this section, we first describe the different entry pathway to ASF projects by analyzing the survey responses about respondents' initial tasks when they joined ASF projects.

The different entry pathways can shed light into the different experiences of the contributors. To improve contributors' experiences within the ASF, it is also essential to comprehend the perception of social obstacles, such as their work environment. A toxic environment can make contributors feel unwelcome and devalued, which can in turn 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?

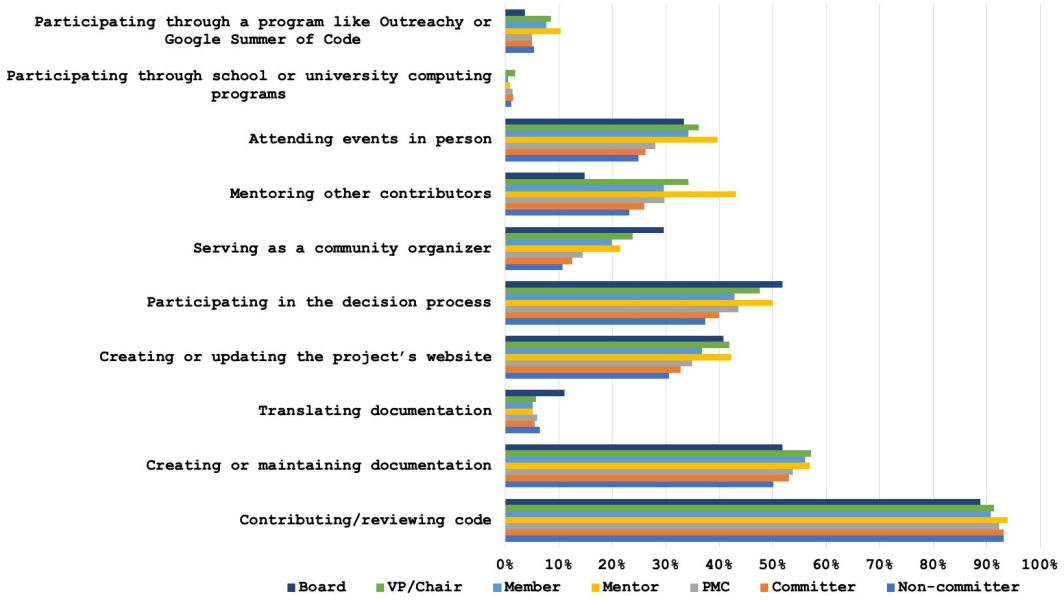


Total sample size = 432

We asked contributors from ASF projects about the tasks they began with, when they first started contributing. The most common starting task was contributing/reviewing code (92%) followed by creating or updating documentation (51%). About 38% of respondents began contributing by participating in the decision-making process, such as voting. 31% of respondents began by creating or 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 respondents begin contributing to ASF projects 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)



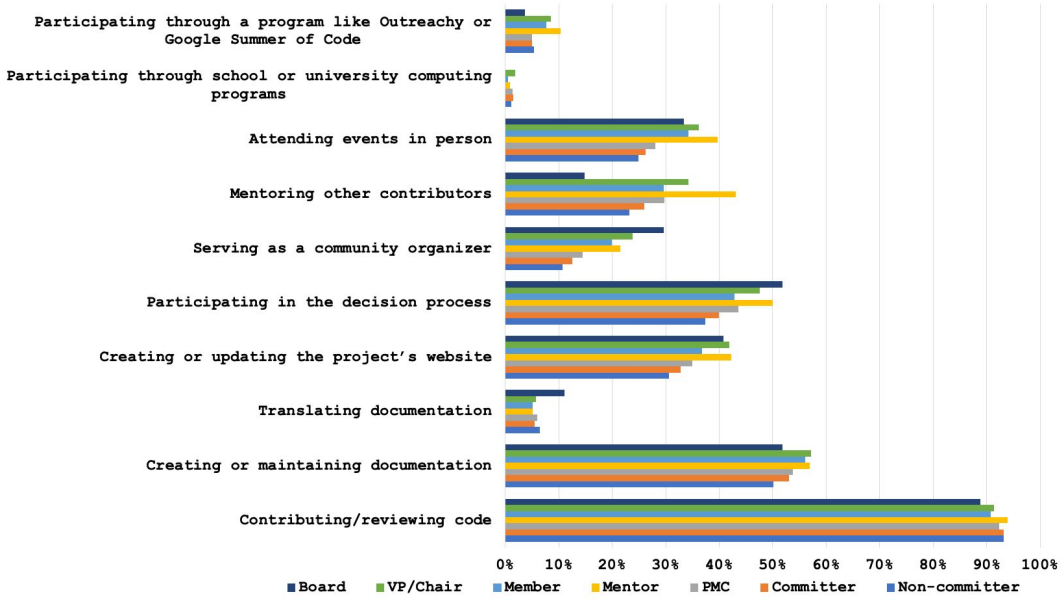
Total sample Size = 432; Board (n=27); VP/Chair (n=105); Member (n=196); Mentor (n=116); PMC-project management committee(n=303); Committer (n=400); Non-committer (n=353)

Next we analyzed the starter tasks of contributors disaggregated by their current roles. Contributing or reviewing code was the most common for all roles, followed by creating and updating documentation. This holds true also for contributors currently in leadership roles such as Board/VP/Chair.

Participating in decision making was a starter task for many, especially for those who are currently in leadership roles or mentors. Unsurprisingly, the largest segment of respondents who started as mentoring others are also mentors.

Attending events in person is also an essential task for mentors as it allows them to build relationships with other community members and share their knowledge and experience. **This suggests that these community events in ASF are able to draw a large variety of talent who remain dedicated to the community.** Those in leadership roles more frequently identified starting as community organizers as compared to other roles. This suggests that community organizers stay dedicated to the community and are recognized for it.

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 Page 17]



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 and updating the project website, no significant variations were observed among the different roles within ASF projects.

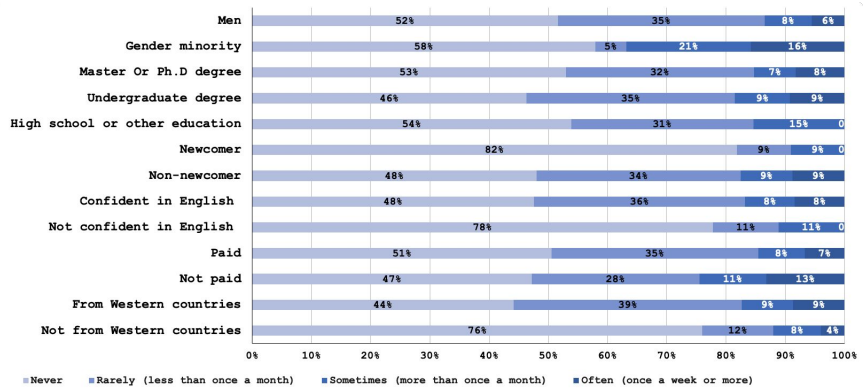
The rest of the three starting tasks, translating documentation, taking part in a program like Outreachy, and taking part in a school or university computing program, received the fewest votes among the respondents of the ASF community. We saw that over 10% of the Board members claimed they started by translating documents, with the remaining tasks making up about 5%. More than 10% of mentors claimed that Outreachy was the starting task they started to contribute to ASF.

Unwelcoming environment for underrepresented groups

A toxic work environment where contributors are unpleasant, unhelpful, or behave in an elitist manner is not new to OSS [1, 2]. The ASF and other OSS communities rely heavily on volunteer efforts and toxic/unwelcome environments can result in high turnover rates [3]. Our study shows that respondents from underrepresented groups (gender minority, not from western countries, not confident in English) face fewer social challenges (see Figure 2.3). **This indicates the ASF community is making significant strides towards developing an inclusive community**

When project organizers/core developers do not welcome contributions and resist new members' participation it can become a significant issue. Our survey results indicate that newcomers face fewer challenges because of a toxic environment as compared to experienced contributors. More non-English speakers reported having a welcoming environments as compared to contributors from western countries or those who are confident in English. **This indicates that stereotypes caused by region, culture,**

FIGURE 2.3. Frequency of Social Challenges and Toxic Environment Faced by ASF Contributors



Sample size: Not from Western countries = 25; from western countries=127; Not Paid = 53; Paid=89; Unconfident in English=9; Confident in English=143; Not newcomer=148, Newcomer=11; High school and other education=13; Undergraduate degree=54; Master and Ph.D. degree=85; Minority gender=19; Men=126

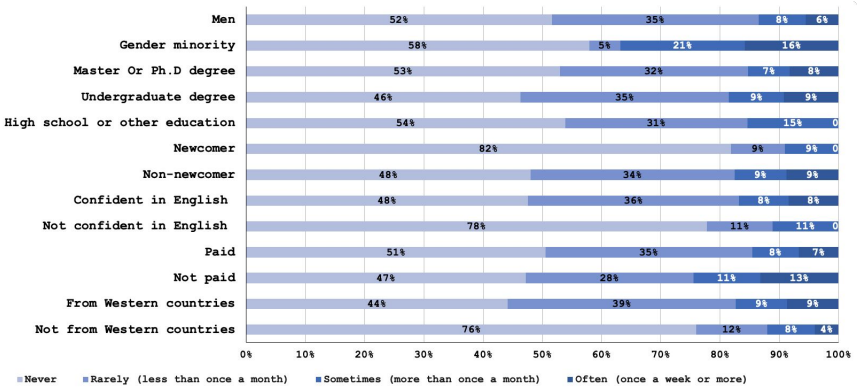
[1] Amiangshu Bosu and Kazi Zakia Sultana. 2019. Diversity and inclusion in open source software (OSS) projects: Where do we stand?. In 2019 ACM/IEEE International Symposium on Empirical Software Engineering and Measurement (ESEM). IEEE, 1–11
[2] Rajshakhar Paul, Amiangshu Bosu, and Kazi Zakia Sultana. 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.

Unwelcoming environment for underrepresented groups

and English proficiency are not faced by our survey respondents. There are no significant differences among responses from paid or volunteer contributors. **This is a positive sign that contributors are recognized for their individual contributions and not based on their employment.**

Women contributors have been a minority in OSS [1, 2]. This imbalance can also lead to biases where women receive unfavorable reviews containing language degrading to women and delayed feedback during code reviews [3]. Our study found that survey respondents who identified as gender minority encountered fewer instances of unfriendly or toxic environment as contributors. **This indicates that the efforts invested by the ASF community in promoting diversity and inclusivity is helping.**

FIGURE 2.3. Frequency of Social Challenges and Toxic Environment Faced by ASF Contributors [repeat from Page 19]



Sample size: Not from Western countries = 25; from western countries=127; Not Paid = 53; Paid=89; Unconfident in English=9; Confident in English=143; Not newcomer=148, Newcomer=11; High school and other education=13; Undergraduate degree=54; Master and Ph.D. degree=85; Minority gender=19; Men=126

[1] 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.
[2] Terrell, Josh, et al. "Gender differences and bias in open source: Pull request acceptance of women versus men." PeerJ Computer Science 3 (2017): e111.
[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.

Chapter 3

Obstacles and Challenges to DEI

“Immigration restrictions for folks from certain countries … are generally unknown to a majority of people. Acknowledging that and knowing that something as simple as speaking at a conference in a certain country for some people involves months of visa processing, etc. is a valuable thing yet is not well known or understood.” --- [ASF-55]

“Equality of outcome is a self-destructive ideology, particularly for a meritocratic institution like the ASF. The goal should be equality of opportunity. 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! ” --- [ASF-33]

OSS communities often have a large number of contributors with different backgrounds, varying levels of experience, skills, and perspectives, which can make it difficult to create an inclusive and welcoming environment for all members [1]. Additionally, OSS communities are often distributed, with contributors working remotely from different parts of the world, making it difficult to build strong relationships and maintain effective communication among team members [2].

The lack of diversity in engineering teams in the tech field is a serious concern. OSS projects are no different [4 - 5]. This lack of diversity is not good for the the society since a significant portion of the population is then left behind, nor for projects, as research has shown that teams with a more diverse (gender) composition perform better [4].

To improve DEI in the OSS community, it is important to understand the challenges faced by contributors in a large, diverse OSS organization. In this section, we focus on analyzing the difficulties faced by ASF contributors. Additionally, to gain a deeper understanding of the difficulties faced by underrepresented groups, we investigate the variety of demographic characteristics, we investigate

[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.
[3] See https://www.aboutamazon.com/working-at-amazon/diversity-and-inclusion/ourworkforce-data, https://www.apple.com/diversity/, https://diversity.fb.com/readreport/, https://diversity.google/annual-report/, and https://www.microsoft.com/enus/diversity/
[4] Ortu, Marco, et al. "How diverse is your team? Investigating gender and nationality diversity in GitHub teams." Journal of Software Engineering Research and Development 5.1 (2017): 1-18.
[5] 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.

"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]

the challenges that contributors encounter when participating in ASF activities, categorized as social, process, and project challenges. By understanding who faces what challenges, we can work towards creating a more inclusive and welcoming environment for all contributors and improve the overall effectiveness and sustainability of the ASF community.

Process Challenges related to

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

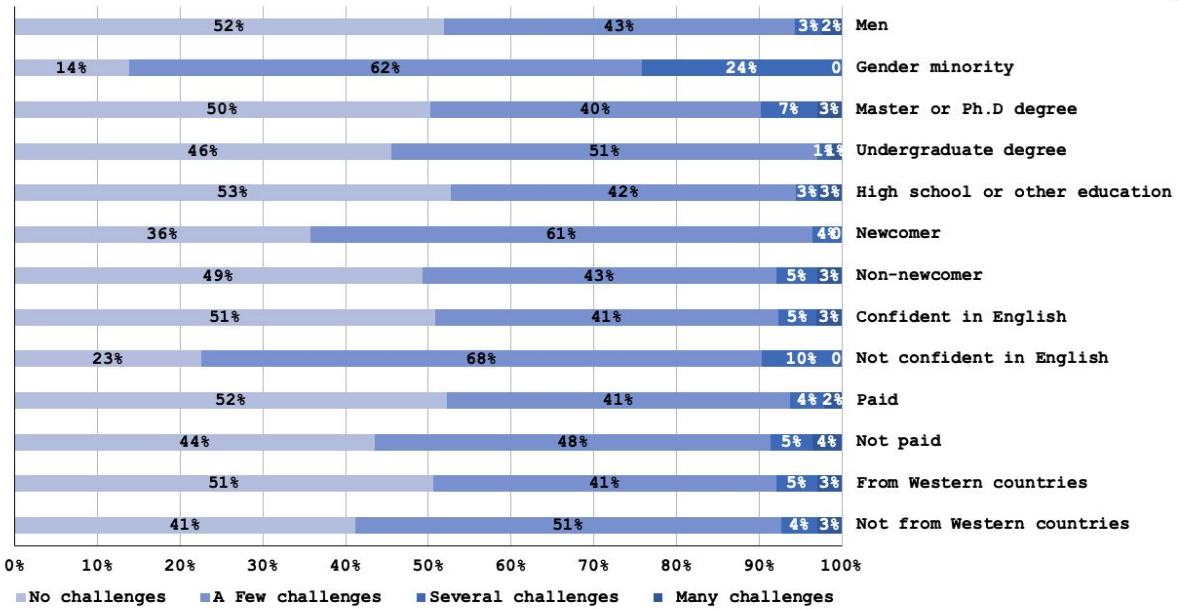
Social Challenges related to

- 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

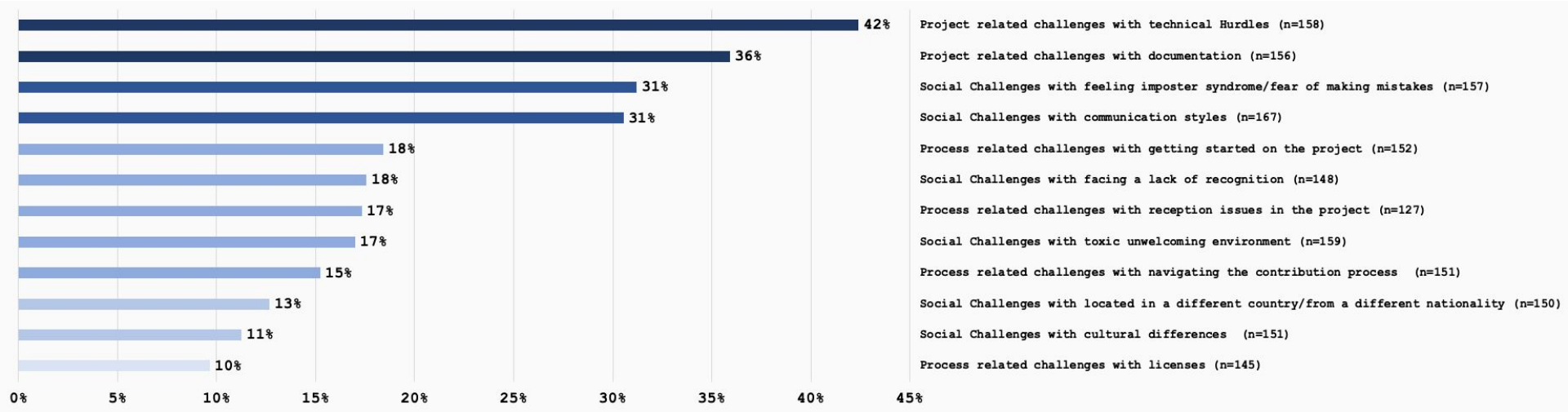
- Documentation
- Technical Hurdles

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



We found over half of respondents from Western countries did not experience significant difficulties in ASF projects, while 41% of non-Western countries reported no challenges. A similar trend was observed among those who were unpaid for their contributions (44%) compared to those who were paid (52%). Respondents who lacked confidence in English (23%) and the ones who identified as a minority gender (14%) reported no challenges. More than half of respondents who were confident in English or identified as men reported no challenges. Newcomers to ASF faced more challenges than those who were not newcomers, and those with undergraduate degrees faced fewer challenges compared to those without higher education background.

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



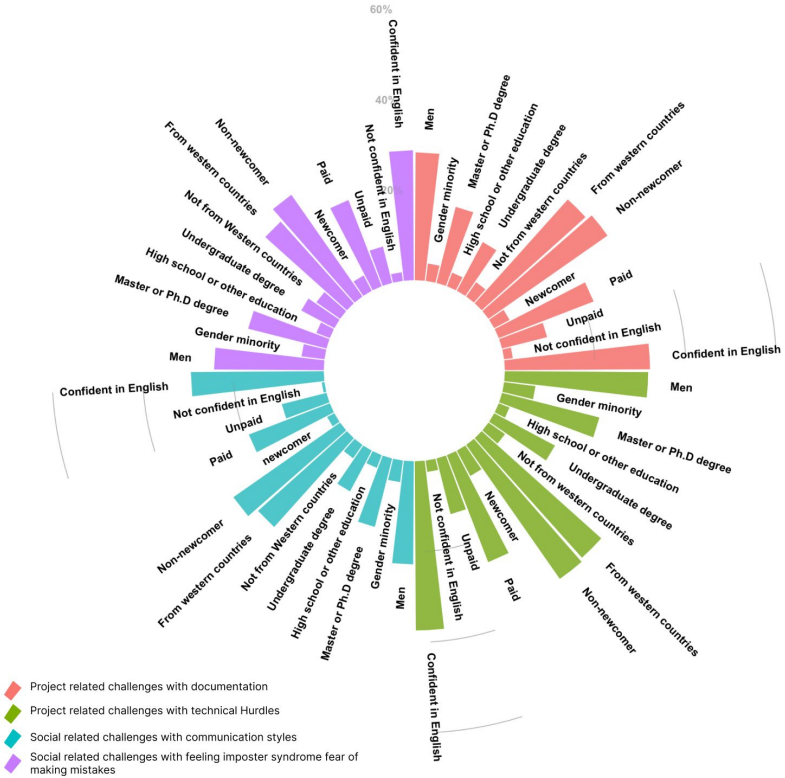
The survey found that the most commonly reported challenges among respondents were project-related challenges with technical hurdles, with 42% of respondents reporting this type of challenge. The second most reported type of challenge was project-related challenges with documentation, with 36% of respondents reporting this. Social challenges were also a significant issue, with 31% of respondents reporting social challenges with feeling imposter syndrome or fear of making mistakes and 31% reporting social challenges with communication styles. Additionally, 18% of respondents reported process-related challenges with getting started on the project, and 17% reported process-related challenges with reception issues. Process-related challenges with navigating the contribution process and with licenses were also reported by 15% and 10% of respondents, respectively. Social challenges with facing a lack of recognition and social challenges with a toxic or unwelcoming environment were reported by 18% and 17%, respectively. Respondents also reported social challenges with being located in a different country from different nationalities and cultural differences, at a rate of 13% and 11%, respectively.

In depth-look at highly voted challenges

Project related challenges with **technical hurdles** were most reported among men, those with Masters or Ph.D., from western countries, who are not newcomers, are paid, and are confident in English. Similarly, project related challenges with **documentation** were reported more by men, those with Masters or Ph.D., from western country, non-newcomers, and who are confident in English than their counterparts.

When it comes to social related challenges related to **communication styles**, respondents who are confident in English, paid, Non-newcomers, those from western countries, Master and Ph.D, and men reported them more frequently. **Social related challenges** with **feeling imposter syndrome fear of making mistakes more than their counterparts** were reported more by those confident in English, Paid, Not Newcomer, From western countries, Man, and other education background.

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



Locating information for contributing to OSS Projects

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

The ease with which contributors can locate this information can have a substantial bearing on how much satisfaction they receive from being a part of the project. If contributors can quickly and easily locate the information they require, not only will they be able to contribute to the project in a more timely and effective manner, but they will also have a greater chance of producing high-quality contributions that will be accepted by the project maintainers [1, 2, 5].

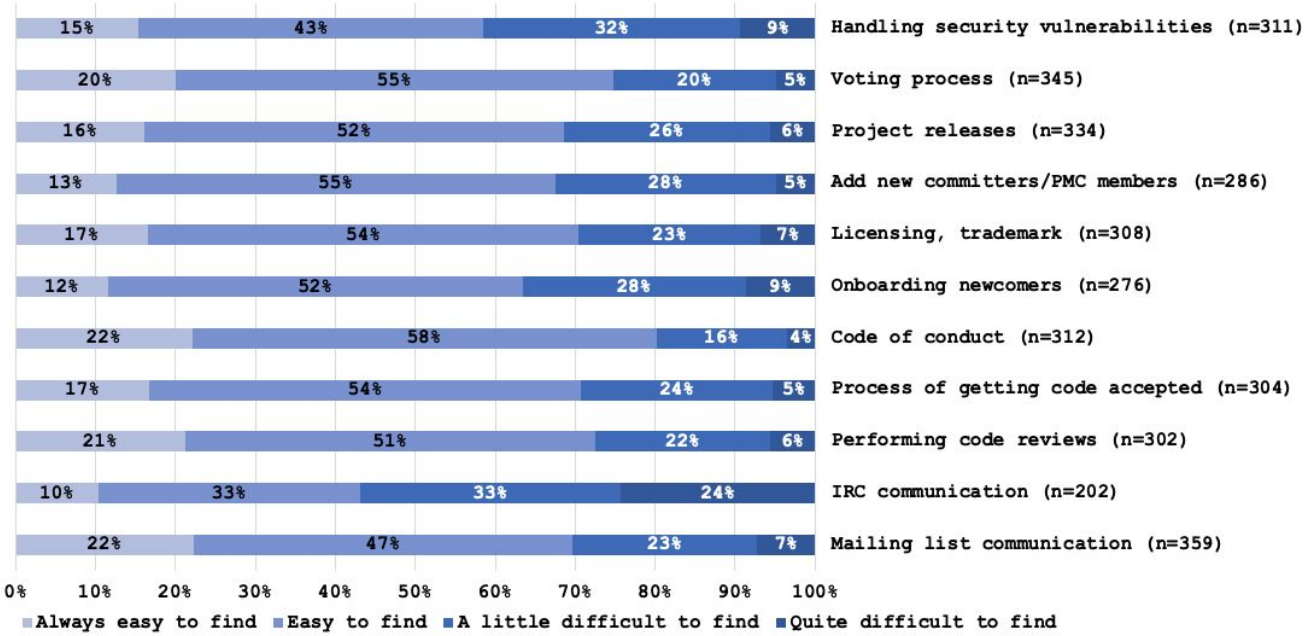
In addition, information such as a code of conduct has the potential to be a useful instrument in OSS communities to create a social environment that is encouraging and welcoming. A code of conduct is a collection of guidelines that members of a community are expected to follow regarding their interactions with one another. Such guidelines can be helpful in preventing harassment, discrimination, and other undesirable behaviors that can cause people to leave a community [4, 5].

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

In contrast, if contributors have difficulty locating the information they require, they may experience frustration and delays in contributions, and their contributions may not satisfy the project's standards or be rejected 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.

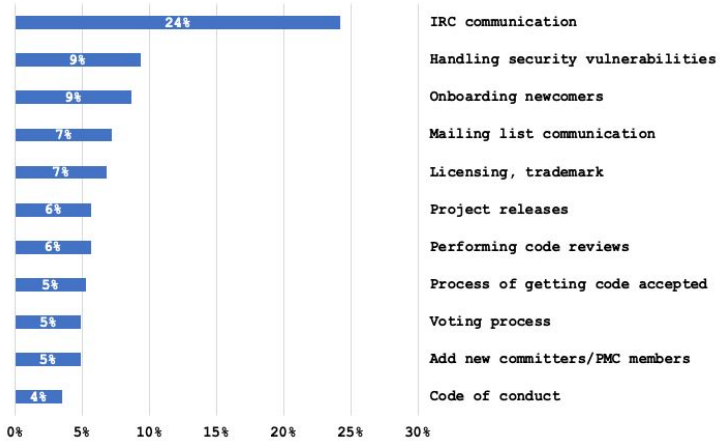
[1] Steinmacher, Igor, et al. "Overcoming open source project entry barriers with a portal for newcomers." Proceedings of the 38th International Conference on Software Engineering. 2016.
[2] Simmons, Andrew J., et al. "A large-scale comparative analysis of coding standard conformance in open-source data 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?



n refers to the total number of respondents of the question.

FIGURE.3.5 Difficulty in Locating Information: Proportion of Respondents Reporting Challenges



We evaluated the ease of accessing different documents and guidelines from ASF. The results, as shown in Figure 3.4 and Figure 3.5, indicate that IRC (Internet Relay Chat) communication was the most commonly reported type of information that was difficult to find, with 24% of respondents indicating this. Handling security vulnerabilities and onboarding newcomers were the second most commonly reported types of information that were difficult to find, with 9% of respondents indicating difficulty with these topics. Mailing list communication, licensing, and trademark were also frequently reported as difficult to find, with 7% of respondents indicating difficulty with these topics.

FIGURE.3.6 In depth-look at the most voted challenges (IRC communication n=49)

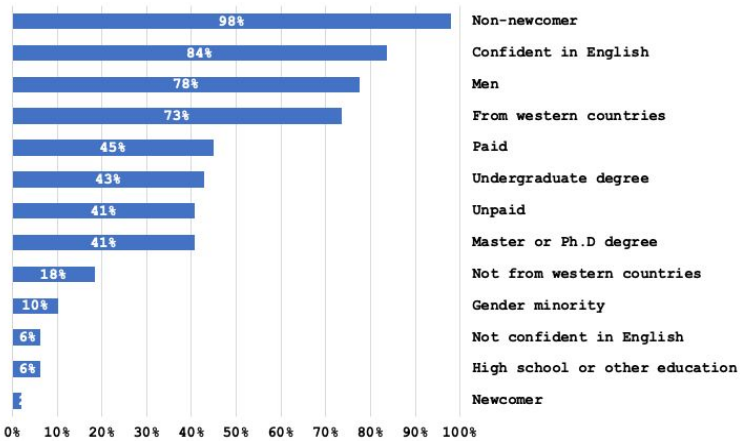


Figure 3.6, indicates which demographics found it difficult to find information in IRC communications (49 respondents). Notably, among this group, the highest rate of difficulty was reported by respondents who were not newcomers (98%). Additionally, respondents who lacked confidence in English reported difficulties at a rate of 84%, while men and contributors from western countries reported difficulties at rates of 78% and 73%, respectively. Furthermore, respondents with an undergraduate degree, those who were unpaid, or those from non-western countries also experienced difficulties in finding information about IRC communication.

Chapter 4

A Pulse Check of 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]

The ASF community is diverse and consists of different organizations as well as paid and unpaid contributors. Here we compare the results of two surveys on the experiences of contributing to the ASF conducted in 2020 and 2022 with the aim to monitor changes in the perspectives and engagement of contributors in ASF projects. This pulse check focuses on the engagement of contributors in ASF activities, perception of DEI, ease of locating information, and the frequency with which contributors consult policies in the ASF.

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% (See Figure 4.1).

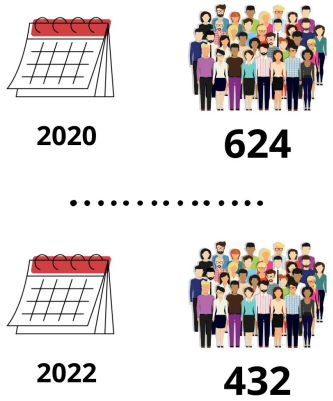
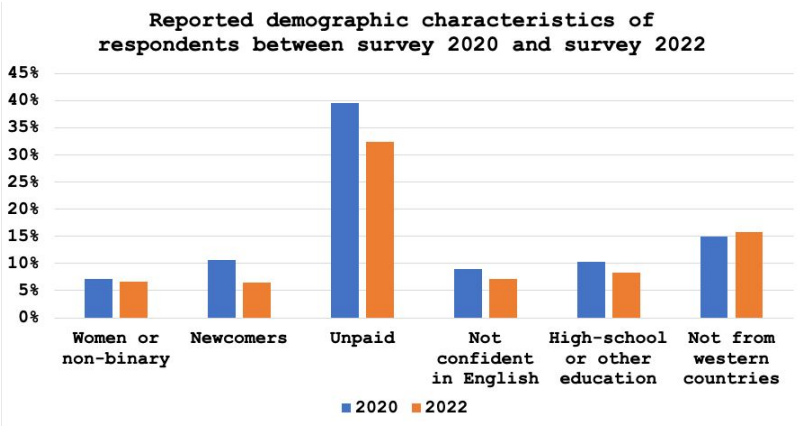


FIGURE.4.1 Demographics of the survey responses (2020 & 2022)



Section 4.1. Comparing Proportional Activity Engagement through Diversity Lens

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

Gender minority: The comparisons highlight the impact of role incongruity[1] when contributors think about participation from minority gender contributors. The data analysis of the two surveys conducted in 2020 and 2022 shows an **increase in participation from those who are in minority gender group**. For example, “contributing reviewing code” had a 31% increase in 2022 compared to 2020. Additionally, there is a 20% increase in respondents from gender minority participating through “outreach programs”, and a 4% increase in “helping with the operations” of in ASF projects. **This suggests that the community awareness and efforts to promote inclusive participation appears to be working.**

Newcomer: There has been a 20% increase in the proportion of newcomers participating in code-related activities within the ASF. Furthermore, 22% more newcomers joined the organization through programs. Despite this, it appears that newcomers are more engaged in “mentoring” or “decision-making”, both in code-related and non-code related activities. **The data suggest that the ASF community is effectively attracting newcomers and helping them to become successful in their contributions.**

Language and region: English is the primary language used among ASF projects. Despite this, contributors who do not consider themselves confident in English demonstrated a higher level of engagement across all activities – with the exception of “serving as community organizers” – similar to respondents from non-western countries. **These trends indicate that the community is becoming more 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 [1]

Compensation and Education Background: There is a slight decrease in engagement in activities such as “translating documentation”, “attending events in person”, or “serving as a community organizer” (<3%) among those who are not paid. However, other activities show an increase in involvement from this group and contributors who do not have undergraduate or higher education degree, particularly in the area of “mentoring” other contributors, with an improvement of more than 10%. **This suggests that the ASF community is fostering a culture of knowledge sharing and collaboration among its contributors, even among those who may not have traditional credentials or financial incentives to do so.**

Section 4.2 Comparing Changes in Perceptions of DEI through a Diversity Lens:

It's important for individuals to feel like they are being represented and valued by the community in order for them to be productive and satisfied. Table 4.2 shows results that reflect contributors' perceptions of their ability to contribute to projects in the ASF.

Role stereotyping: The data shows an increase in the percentage of respondents who felt that they were being seen as a "parental figure" and that they were "expected to take care of others…more so than is usual" across all demographic groups, with the exception of those who identify as a gender minority for the latter question (“I feel some members of the community are patronizing to me”).

There was also a increase in mentoring activity across all demographic groups, which may be a reflection of **contributors in ASF projects who feel that others look up to them as parental figures also feeling like they are expected to take care of and look after them**. However, it's notable that respondents who identified as belonging to a gender minority had a decline in feeling that they were required to care for others more than is customary. **The data indicates a positive trend in the ASF community creating a welcoming environment.** The percentage of respondents who felt that members were "patronizing" them decreased for all demographics. The decline was particularly notable for those who are not comfortable using English or identify as a gender minority, with a decrease in more than 10%.

Ability to contribute: Our findings suggest that barriers have been lowered for the demographic groups studied, with a greater number of contributors reporting that they believe they have an "equal chance" of getting their contributions accepted. This is particularly true for those who identify as a gender minority (9%) or are not comfortable using English (19%). Additionally, a higher percentage of newcomers (10%) have a positive perspective on having an "equal opportunity." There is also an uptick in positivity when it comes to the statement "nothing keeps me from contributing," with 39% of gender minorities and 14% of respondents who are not confident in English expressing this opinion. **This indicates positive trend in ASF projects, which might be from efforts to promote DEI in the ASF community.**

When looking at "network of peers" or "finding a mentor they are comfortable with", the data shows mixed results. **Overall, a greater proportion of survey respondents who identify as belonging to a gender minority feel they have access to a supportive peer network and mentors with whom they are comfortable.**

However, the data shows a negative trend for contributors who are not compensated for their contributions and those who do not have a formal education degree. They do not perceive that they have an equal chance to contribute to ASF projects. This is particularly true for 22% of respondents who do not have a formal education degree and disagree with the statement: "nothing keeps me from contributing to ASF." These unpaid and non-formal education degree respondents also increasingly disagree that it is easy to find a desired mentor, which may be related to their decreasing perception of “having a solid network”. There has been some improvement for newcomers (3%) in understanding technical talks, which could indicate that **newcomers in our survey are more familiar with technical jargon or that project discussions are using less jargon and becoming more inclusive.**

Being represented: The data shows that a higher number of respondents from underrepresented groups felt that the Project Management Committee (PMC) did not accurately represent society among members of gender minorities (22%) and newcomers (8%). The percentage of people from underrepresented groups who believe they are included in the decision-making process has decreased. However, it is encouraging to note that people who live outside of the West or who are not fluent in English have a greater sense

of belonging in decision-making bodies. Uncompensated contributors and those without a college degree are less likely to feel represented by PMC and take part in decision making.

Code of conduct: A majority of ASF projects heavily rely on English-language content, thus, cultural and geographical differences can also lead to misunderstandings of regulations and procedures, which can create additional communication barriers. The code of conduct is a key document of expected behavior and decorum in a project. Our findings reveal that the awareness of the code of conduct has increased by 9% among non-native English speakers and 15% among non-Western respondents**.**

However, the data also shows that the proportion of newcomers who were aware of the code of conduct fell (13%). The reduced frequency of community events where members from these groups engage informally and discuss action plans might be a reason for this decrease in awareness. This along with the sentiment of feeling patronized could mean that respondents from these minority groups may not have the agency to fix a problematic situation.

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, particularly when they were aware of the code of conduct. This may be due to the fact that **code of conduct guidelines are increasingly being created with specific procedures for addressing violations rather than just being seen as "aspirational" documents.** Additionally, respondents who lacked formal education and were not compensated for their contribution were less likely to feel that the code of conduct empowered them, even though they were made aware of the code of conduct.

Section 4.3 Comparing Easy to locate information regarding policies/information by Diversity Lens

Table 4.3 presents the data showing the differences in responses from the 2020 and 2022 surveys regarding the ease of locating information about policies and other information, broken down by diversity attributes. The arrow in the table indicates a percentage increase or decrease in responses between the 2020 and 2022 survey.

Gender minority: According to the data, for respondents who identified as a gender minority, there was a 18% decrease in the ease of locating information about the "mailing list communication". A similar decrease was also observed in the ease of locating information about "voting process", with a 14% difference in the survey results from 2020 to 2022. Despite these decreases in the ease of locating information about most policies and information, there was a 6% increase over these two years in the ease of locating information about "Onboarding newcomers". **This suggests that additional efforts are needed in improving the accessibility and clarity of information in the ASF projects and governance.**

Newcomer: When it comes to newcomers, there was a 9% increase from 2020 to 2022 in the ease of locating information about "adding new committers PMC members". However, there was a significant decrease of 16% among newcomers when it came to locating information about "onboarding newcomer". **This suggests that ASF may have improved the accessibility and clarity of certain types of information for newcomers, but more effort is needed in onboarding newcomers.**

Language and region: There is an improvement in the ease of locating information about policies for respondents who are not confident in English or those not from Western countries. There is a 20% increase in the ease of locating information about "Code of conduct" for those not confident in English and another 18% increase in the ease of locating information about "performing code reviews". Respondents not from Western countries also show a 6% increase in the ease of locating information about "Code of conduct". As previously mentioned, these numbers suggest that ASF projects have improved the **accessibility of information related to policies, Code of conduct, Process of getting code accepted, and add new committers PMC members which have resulted in positive outcomes for those who are not confident in English or not from Western countries.**

Compensation and Education Background: When it comes to the ease of locating information about ”onboarding newcomers”, “project releases”, and “the voting process”, the results show a decrease for unpaid contributors, with the decrease being less than or equal to 5%. Additionally, those with an informal education background also reported a 12% decrease in the ease of locating information about “project releases”. However, there is a positive trend when it comes to locating information about the “code of conduct”, with an improvement of 20% among those who do not have a formal education background. **This may suggest that ASF is making an effort to make information about the code of conduct more accessible.**

Section 4.4 Comparing frequency to locate information regarding policies/information by Diversity Lens

Table 4.4 presents the data showing the differences in responses from the 2020 and 2022 surveys regarding how often contributors consult information, broken down by diversity attributes

Gender minority: There is a decrease in the frequency of consultation for most types of information among contributors. For example, there is a 13% decrease in consulting about the process of getting code accepted and the “voting process”. However, seeking information about “performing code reviews” , “adding new committers”, and “PMC members” has remained consistent. There is a 2% increase in the frequency of consulting information about “licensing trademarks”. This reduction in consulting information may be because of difficulties in finding the right information or because individuals in this category are already aware of the information and have no need to consult it.

Newcomer: The frequency of newcomers consulting the process of "getting code accepted" and "onboarding newcomers" has remained consistent. However, there has been a 7% decrease among newcomers when it comes to consulting the voting process and code of conduct. In contrast, the data shows a 15% increase in newcomers often consulting about “performing code reviews” and a 14% increase in often consulting about “project releases”. This is inline with the data that shows an increase in number of newcomers contributing to code or code reviewing activities.

Language and region: Respondents who are not confident in English reported two significant increases in the frequency of consulting information. There was a 22% increase in consulting information about “adding new committers PMC members”, and a 20% increase in consulting information about “project releases”.

Those not from Western countries reported a 5% increase in consulting information about “onboarding newcomers”, “adding new committers PMC members”. These results suggest that respondents who are not confident in English and those not from Western countries are staying informed about aspects such as, onboarding newcomers and adding new committers and PMC members.

Compensation and education background: Our study shows an 11% increase in consulting information about "adding new committers as PMC members" for contributors with high school or other educational background. However, there is also a noticeable decrease of 19% among these contributors when it comes to how often they consult information about "mailing list communication".

Unpaid contributors showed no significant change between the surveys regarding how often they consult information about "performing code reviews". There was an increase ranging from 3% to 4% in how often they consult information about "adding new committers as PMC members" or "project release".

TABLE.4.1 Comparison of proportional activity engagement between 2020 and 2022 disaggregated by diversity lens.

	Gender minority	Newcomer	Not confident in English	Not from western countries	Unpaid	High school or other education
Contributing reviewing code	↑ 31%	↑ 20%	↑ 3%	↑ 7%	↑ 6%	↑ 6%
Creating or maintaining documentation	↑ 6%	↓ -5%	↑ 11%	↑ 18%	↑ 7%	↑ 4%
Translating documentation	* 0%	↓ -5%	↑ 3%	↑ 4%	↓ -2%	↑ 1%
Participating in decision making about the project development	↓ -2%	↑ 8%	↑ 2%	↑ 20%	↑ 6%	↑ 9%
Serving as a community organizer	↓ -11%	↓ -9%	↓ -2%	↑ 18%	↑ 2%	↓ -1%
Mentoring other contributors	↑ 4%	↑ 13%	↑ 26%	↑ 24%	↑ 10%	↑ 11%
Attending events in person	↓ -12%	↓ -1%	↑ 3%	↑ 3%	↓ -1%	* 0%
Participating through school/university computing programs	↑ 5%	↑ 3%	↑ 8%	* 0%	↑ 1%	↑ 5%
Participating through a program	↑ 20%	↑ 22%	↑ 4%	↑ 15%	↑ 2%	* 0%
Helping with the ASF operations	↑ 4%	↓ -1%	↑ 2%	↑ 10%	* 0%	↑ 2%

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

	Question	Gender minority	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	↑ 14%	↑ 11%	↑ 9%	↑ 11%	↑ 11%	↑ 9%
	I am expected to take care of other members of the project more so than is usual	↓ -16%	↑ 8%	↑ 8%	↓ -1%	↑ 3%	↑ 2%
	I feel some members of the community are patronizing to me	↓ -12%	↓ -4%	↓ -14%	↓ -5%	↓ -4%	↑ 2%
Ability to contribute	I have an equal chance to get contributions accepted	↑ 9%	↑ 10%	↑ 19%	↑ 5%	↑ 4%	↓ -8%
	Nothing keeps me from contributing to the project	↑ 39%	↑ 10%	↑ 14%	↑ 2%	↓ -2%	↓ -22%
	I have a solid network of open source peers	↑ 18%	↑ 2%	↑ 12%	↑ 13%	↓ -3%	↓ -2%
	It was easy to find a mentor with whom I felt comfortable	↑ 12%	↓ -7%	↓ -8%	↓ -2%	↓ -6%	↓ -6%
	I have a hard time following discussions because of technical jargon	↓ -2%	↑ 3%	* 0%	* 0%	↓ -4%	↓ -2%
Being represented	The PMC represents a diverse set of people	↓ -22%	↓ -8%	↑ 14%	↑ 14%	↓ -6%	↓ -13%
	I feel represented in the decision making group	↓ -16%	↑ 7%	↑ 9%	↑ 14%	↑ 1%	↑ 8%
The code of conduct	I was made aware of the code of conduct and how to report violations	↑ 8%	↓ -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%	↑ 3%	↓ -1%	↑ 6%	↓ -4%	↓ -5%

TABLE 4.3 Easy to locate information regarding policies/information

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

TABLE.4.4 Comparison of proportional policy consultation between 2020 and 2022 disaggregated by diversity lens.

	Gender minority	Newcomer	Not confident in English	Not from western countries	Unpaid	High school or other education
Mailing list communication	↓ -2%	↑ 4%	↓ -6%	↓ -1%	↓ -2%	↓ -19%
IRC communication	↓ -1%	↑ 2%	↓ -17%	↓ -5%	* 0%	↑ 19%
Performing code reviews	* 0%	↑ 15%	↓ -10%	↑ 1%	* 0%	↑ 5%
Process of getting code accepted	↓ -13%	* 0%	↓ -11%	↓ -6%	↓ -4%	↓ -15%
Code of conduct	↓ -7%	↓ -7%	↓ -6%	↓ -3%	↓ -3%	↑ 5%
Onboarding newcomers	↓ -12%	* 0%	↑ 5%	↑ 5%	↓ -2%	↓ -5%
Licensing trademark	↑ 2%	↓ -2%	* 0%	* 0%	↓ -4%	↓ -6%
Add new committers PMC members	* 0%	↑ 1%	↑ 22%	↑ 5%	↑ 4%	↑ 11%
Project releases	↓ -6%	↑ 14%	↑ 20%	↑ 3%	↑ 3%	↑ 1%
Voting process	↓ -13%	↓ -7%	↑ 5%	↑ 2%	↓ -2%	↓ -11%

Chapter 5

The State of DEI & Recommendations

“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 show that biases, and stereotypes are becoming less of an obstacle, particularly for underrepresented groups such as contributors who identify as gender minorities and those who are newcomers. The improvement can be attributed to a growing awareness of the need for DEI, as well as the steps taken by the ASF to make the community more inclusive, such as Apache mentoring programme.

Gender minority: Lack of representation, discrimination, and harassment have historically been obstacles for gender-minority 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 ASF projects**. There is a significant improvement among gender minority respondents in their ability to make both code and non-code contributions and their perception of their ability to contribute. Specifically, we saw a notable improvement in their agreement with the statement, "nothing keeps me from contributing" in our study.

Language and region: Our studies suggest non-Western contributors and those who are not native English speakers are more engaged in all activities including decision making, mentoring, code-reviewing activities among others. In addition, there has been a rise 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 make projects more inclusive and welcoming.

However, we observed a decrease in the frequency of consulting information such as, how to get code accepted, or communication policies, among respondents from non-Western countries or those not confident in English

This maybe a result of **ASF project efforts in developing a welcoming environment for contributions and perhaps these individuals have fewer friction points that warrants a need to consult additional information.**

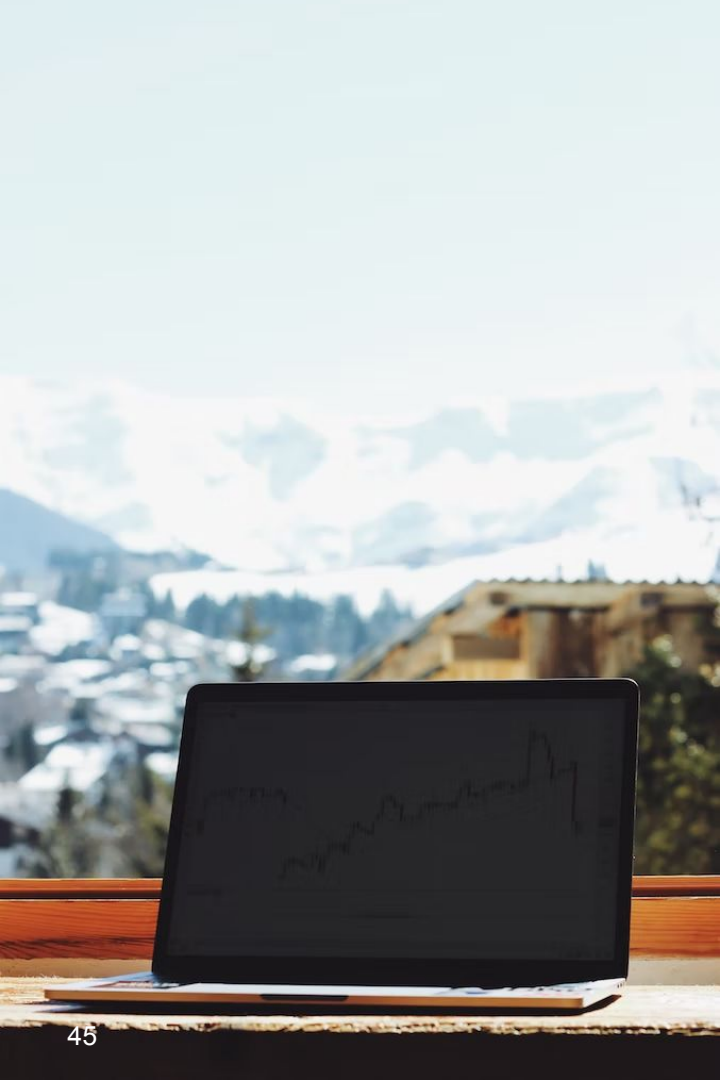
Employment and Education background: We have noticed an increase in the level of activity engagement among contributors who do not have a higher education degree or compensation, particularly in the area of mentoring other contributors. This indicates that ASF projects are progressing in inclusivity for these groups. However, it is important to note that contributors who are not compensated or do not have a higher education degree are increasingly disagreeing with the notion of having equal chance to contribute and share the same social connections. A potential concern could be that unpaid contributors' contributions may be eclipsed by those who are paid to contribute, and in turn impact their standing in the community.

Progress is still needed

Gender Minority: The gap between the number of contributors who identify as men and those who identify as gender minority remains large. In OSS community, biases and obstacles based on gender are firmly embedded, as men have historically dominated and continue to do so [1]. There is still work to be done to make the ASF community more gender-inclusive, despite the progress that has been accomplished. The ASF should keep engaging in outreach and mentoring programs to increase the number of contributions from gender minority groups. Specifically, the ASF projects could focus on **promoting and mentoring minority genders to leadership positions will aid in attracting and retaining underrepresented contributors in OSS** [1].

Newcomers: Onboarding new contributors is a persistent challenge in OSS communities. Many organizations are using mentoring programs to train new contributors, such as Google Summer of Code and the Apache mentoring programme. However, our findings indicate that even though respondents mentored other contributors more frequently, many found it difficult to locate a suitable mentor. Possible reasons for this could be conflicting time zones, mismatches in interests between mentor and mentee, or negative perceptions of receiving constructive criticism. It appears that newcomers are less likely to consult policies. Possible reasons for this could be a lack of mentors or orientation to guide them on the policies. Some solutions to address this issue are the

[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).



following. First, it is important to **acknowledge and highlight mentoring activities**, for example, by identifying implicit mentoring through code reviews as suggested by an existing study [1]. Second, in addition to formal mentoring programs, the ASF could consider **organizing/encouraging informal mentoring** where mentors and mentees can naturally connect and form mentorship relationships [1].

English skills: As previously stated, the use of English as the primary language in ASF operations and communication can create obstacles for non-native English speakers looking to contribute. We proposed potential strategies to overcome these language barriers for contributors.

(1) **Provide a translation tool**: The ASF can provide translation tools to assist non-native speakers in understanding rules, procedures, and recommendations, making it easier for them to contribute to the project [2].

(2) **Promote mentoring programs**: ASF projects should include mentoring programs that provide additional assistance and direction to non-native speakers, allowing them to learn the ropes and grow more confident in their contributions [3].

(3) **Encourage contributions from a diverse group of people**: Projects that actively seek out and encourage contributions from a diverse group of people, including non-native speakers, can help create a more inclusive and welcoming environment for all contributors. Such cohorts of individuals with similar demographics can foster a sense of belonging helping them remain 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 be beneficial for new contributors as it allows them to select a channel in which they are most comfortable.

Regional differences: Contributors to ASF projects hail from different countries and have diverse cultural backgrounds. Cultural disparities can results in disparities in communication and working style. There are several strategies that can be used to overcome such cultural differences:

Provide communication template: Provide communication best practices or templates that allow open and clear communication among members. This can help build trust and understanding. For example, when sending a message to a community, it is important to be polite and respectful, highlight your relevant skills and objectives, clearly state your question and present any attempts you have made to solve it before seeking assistance from the community [1].

Provide appropriate orientation: Provide orientation and training on cultural differences and best practices for communicating and collaborating with people from different cultures [1].

Create role models: Encourage leadership role participation of members from diverse cultural backgrounds and as role models for the community, such as ASF DEI committee members [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.

Create code of conduct: Have a clear and enforceable code of conduct that promotes mutual respect and prohibits discrimination or harassment based on cultural differences [1].

Compensation: Our study shows that a considerable number of respondents do not receive compensation for their contribution, particularly among those who are new to the project . When we surveyed contributors about their willingness to be compensated more, we found that the issue is complicated and cannot be resolved just by increasing financial support. Other considerations, such as policies, opportunities, and legislation, also play a role. In addition to financial compensation, ASF projects can reward contributions in various ways. This could include ways for recognizing and rewarding behaviors such as mentoring and assigning "karma" points or other non-monetary forms of recognition for code/non-code related contributions [2].

Education background: There are several strategies to increase the inclusivity for contributors without higher education, such as undergraduate degree: Provide clear documentation and guidelines for project contributions. This can aid persons without a formal education background in understanding how to engage [3].

Provide guidance and mentorship to new contributors. This can allow contributors without formal education to explore the project and comprehend its technical features. Be receptive to contributions that may not be as polished as others and be more adaptable during the code review process [2].

[1] 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.
[2] 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.\
[3] 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.

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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.