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Breaking the Glass Floor for Women in Tech

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Women¹ face many challenges in the tech industry. Implicit gender biases significantly impact hiring decisions, women disengage with technology faster than men, women are often less likely to get their code accepted, and tools, processes, and even education are not inclusive[1]. A direct outcome of these biases is that women represent less than 24% of the employees in the software development industry, with an even further imbalance in participation in Open Source Software (OSS) projects (around 10%). The software industry lacks equitable participation conditions, exacerbating the gender imbalance of those who shape technology.

Reducing the gender gap requires not only attracting but also retaining women in tech. Implicit biases, including sexist behavior, pervade the software industry and create a “glass floor”—a persistent barrier to enter the tech world. Even when women break through this barrier, they face socio-cultural challenges due to the hostile social dynamics in their daily work. Instances of women needing to hide their gender in their profile, stopping their contribution

¹In this chapter, we use the term “gender” as a socially constructed concept, where gender identification, display, and performance might or might not align with a person’s sex assigned at birth. To reflect this social concept of gender, we use the term “women” and “men” as a shorthand for people who self-identify as such.

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to an OSS project, leaving their jobs in the software industry, or altogether giving up on the technology area are unfortunately frequent occurrences. Even in companies and communities that care about diversity and inclusion, sociocultural problems are prevalent.

Through a systematic literature survey of 51 studies [14, 15], we identified seven types (Figure 1.1) of challenges that women face and eleven actions that companies and communities implement to overcome them. In the following, we present some findings reported in this literature.

Challenges

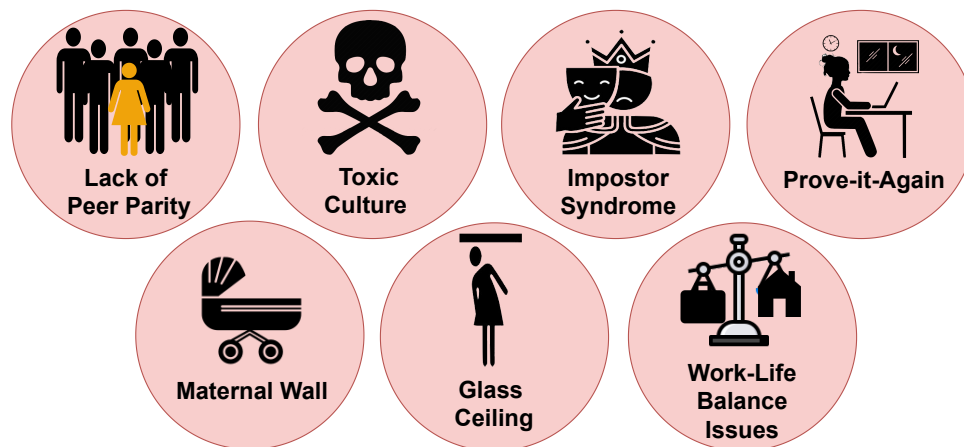


Figure 1.1: Challenges reported by women in companies [14] and OSS projects [15]

Lack of peer parity. An imbalance in gender diversity makes it difficult for women to succeed. Women report frustration at being outnumbered and invisible in men-dominated groups. As men and women have different norms for socialization, the lack of peer parity, role models, and role stereotyping further degrades their self-confidence [14]. On the other side, the literature says that women who experience peer parity engage faster with the project or community [6].

Toxic Culture. Microaggressions and sexist behavior are not uncommon in tech. Besides having their voices suppressed in technical discussions, women are subjected to various diminishing comments, such as that their inclusion in the team is a result of diversity initia-

tives and not a reflection of their skills or capacity [14]. Despite proving their competency in their code/project areas, women are rarely asked their opinion [16]. In a recent survey [4], about one-third of the women contributors reported experiencing written or spoken language that made them feel unwelcome in OSS interactions. Discriminatory expletives, swear words, and negative critiques often used in code reviews and mailing lists are particularly insulting to women. Even finding mentors can be a challenge, since upon discovering their mentee's gender, men mentors can treat the relationship as a dating opportunity.

Impostor Syndrome. The hostile toxic culture that often pervades tech communities leads to those in the minority doubting their abilities. Impostor syndrome, wherein individuals struggle to internalize their accomplishments, results not from an individual's inadequacy, but from systemic oppression [5]. Despite being knowledgeable and professionally well-settled, women may be more reluctant to publicly display their work and speak out in meetings, and may create fake accounts to hide their gender when they are new to an online community.

Prove-it-again. Women report the need to repeatedly show competence and expend extra effort to be heard when competing with men. Despite accomplishing exceptional work, women feel they need to prove themselves once again when receiving a task that is considered more important or risky and when there is someone else overseeing their work to guarantee that it will be done. Women in tech also feel they have *"no room to slip [up]"* [14]. Prove-it-again involves constantly providing more evidence to demonstrate competence.

Maternity wall. The maternity wall is a common stereotype faced by women, and describes the experience of mothers whose coworkers perceive and judge them as having made one of two choices: to continue to work and neglect their family, or to prioritize family over work, making them less reliable in the workplace. Thus, when women in tech have children, they tend to receive fewer responsibilities. Given the common belief (stereotype) that mothers are not capable of handling much work, women sometimes *"surprise colleagues that they are able to handle it all"*. This is clear in cases when women are asked to step down from their roles after returning from maternity leave [14].

Glass Ceiling. The glass ceiling describes a corporate world phenomenon in which minorities' access to top-management positions is blocked by tradition or culture [9]. It is an invisible structural barrier that prevents minorities from career advancement [11]. In addition to the gender wage gap, women often report feeling that they have nowhere left to climb in the ladder, working harder to achieve the same positions as men, while having their ambition

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discouraged. Moreover, women report they are disproportionately unsupported to reach higher positions because corporate politics are played by men and men lift only their counterparts to the top [14]. The barriers to future career opportunities discourage women from continuing in the tech industry. For example, studies have found women's participation to drop from 14.2% (participants of Google Summer of Code) to about 4.3% as core developers in OSS; i.e., they are better represented earlier in the joining process than in core roles.

Work-life Balance. Societal role expectations, women's career ambitions, and the nature of the IT industry challenge the way women manage their professional and personal lives. When working extra and long hours, women feel more stressed and have trouble disconnecting from work, which impacts their household tasks and well-being. Women often are the primary caregiver for a family and perform a larger share of the household labor. Many people believe that working from home is easier for caregivers. However, even when working remotely, women in tech face pressure to work extra hours and face consequences for not giving in to this pressure: if they miss after-hours meetings, they are excluded from decisions made during them, and are perceived by others as *"lacking in teamwork"*.

Most challenges women face in the software industry have a parallel in OSS. However, some of them manifest differently. In OSS, women face bias when they explicitly identify themselves as women; in the software industry women report a lack of recognition and face the maternity wall. In OSS, women report difficulties in finding a mentor, but onboarding is usually not as challenging in the industry.

Actions to mitigate the challenges

The aforementioned challenges that push women away from the tech industry are, to some extent, known. However, it is important to take action to increase women's participation and create a more diverse and welcoming environment. In the following, we will focus on actions reported in the literature, illustrated in Figure 1.2, and how they help reduce the current challenges.

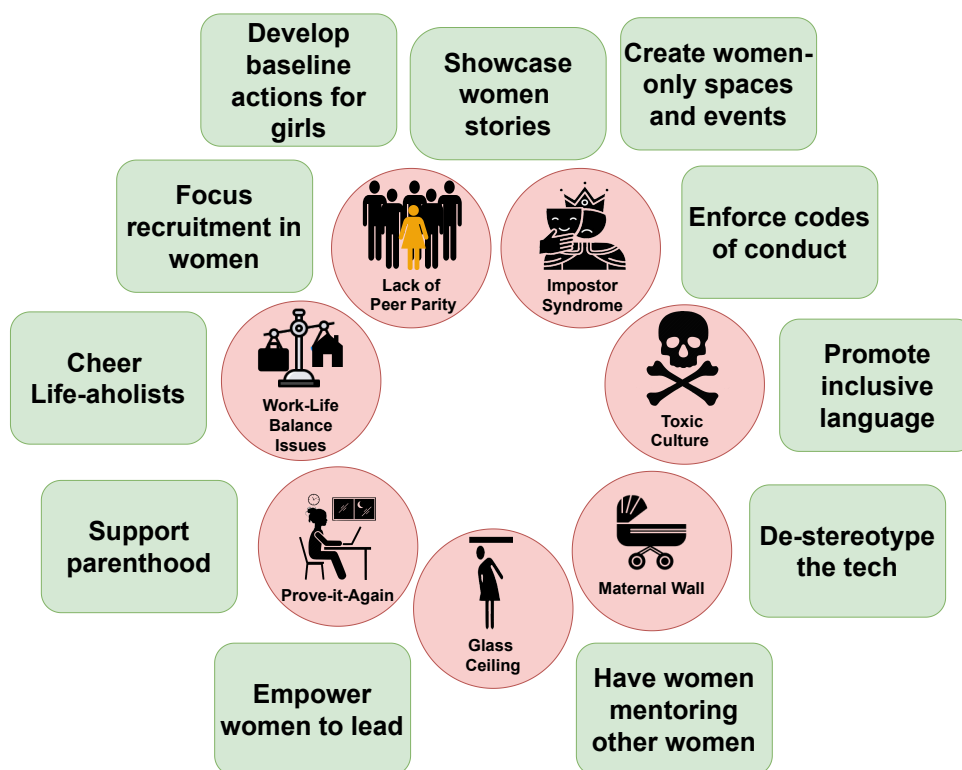


Figure 1.2: Actions to mitigate challenges faced by women [14, 15]

Women are more inclined to join companies or projects that have more women involved. This strengthens their belonging to the project. It is important to **promote awareness about the presence of women** in the project or company to help attract more women and reduce the feeling of alienation. For example, an online dashboard can be used to present the number of women participating, showing what kinds of roles they play, how long they have been involved, and information about their pathway in the project or company.

This can highlight not only that women are welcome at the project or company, but that there are role models to be followed there. For example, companies can **promote women to leadership roles** as a way to empower a larger cohort. First, this sends a clear message that women belong there and that they are respected. Second, having women in decision-making positions can ensure that their voices will be heard. This would, for example, make it easier to communicate the needs and problems faced by women, since the interlocutor also experiences them. Promoting more women to leadership is important, but it is essential to **empower** women by giving them the necessary authority to play the leadership role. Serving

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in a high position can be even more challenging for women, as they often lack the support or power to accomplish their strategic goals. As a result, women leaders often experience shorter tenures than their peers who are men. When recognizing women's achievements, projects and companies should provide the social attraction women seek to overcome their competence-confidence gap.

Inspiring actions can include **showcasing** by publicly celebrating women's accomplishments in blogs, project homepages, and social media, and organizing events with women speakers. These actions can attract more women, and retain women who are already employees or contributors. Considering that this media exposure can include women's posts and pictures, it can also help to de-stereotype the software developer, which is usually associated with images of men. Two examples of this strategy are the "Women that Build Award"² in "Women Who Code"³, and "Women in Tech"⁴, which highlights a woman who has excelled in her work in the STEAM industry. Women can nominate themselves or be nominated by other people.

Having women recruiting women may help to **focus the recruitment process on women**. Moreover, making job opportunities attractive to women's needs, creating more part-time positions, reserving positions prioritized for women, and advertising job openings to women's groups are actions that help to focus the opportunities on women. If no women is involved in the recruitment process, the pipeline may be easily broken, which would affect the recruitment.

A girl should enter the tech pipeline when she is at school by taking preparatory courses, becoming experienced in the use of computers, and otherwise preparing for undergraduate college degrees in STEM. Further along the pipeline—and depending on the educational system—a young woman majors in computer science, and after that she graduates from a computing discipline and, then, enters the job market to be recruited. **Promoting baseline actions**, like schoolgirls' events for girls in STEM, can inspire vocation in girls and raise awareness about how the organization supports women's growth. The baseline actions should be active on girls'/young women's social media (e.g., Snapchat/Instagram).

Since girls and adult women need to see themselves in tech for actions to have an effect, we need to **de-stereotype the tech** and avoid the *feminization* of specific assignments, like those relating to non-technical roles. More images of women should be used in technical ad-

²<https://womenawards.globant.com/>

³<https://www.womenwhocode.com/>

⁴<https://wearexena.com/awards/>

vertisements, and women should not be only allocated to procedural tasks. Organizations should offer women to play all kinds of roles that can challenge their skills. Inclusivity also includes adjusting communication styles and de-biasing software. Another way to de-stereotype is by de-biasing software through the GenderMag technique. GenderMag uses personas and a specialized Cognitive Walkthrough (CW) to systematically evaluate software and make them more inclusive of women's cognitive styles [3].

Some actions are essential to deter women from leaving a tech position. The first is to cultivate a welcoming and supportive environment and avoid sexism. **Women-only groups and activities** bring a safe space for women to express feelings and opinions and are helpful to foster discussions and support networking. An online women-only forum can be an easy first step, and the exchanged content can be helpful in monitoring situations when women need support. This strategy can be part of more significant efforts to encourage and welcome women, which can include mentoring or inviting women to contribute to specific activities. Since many projects still have only a few women, groups can facilitate interaction between women from different projects. Trainings and booklets can help to **promote inclusive language** and avoid gender pronouns and terms that assume that people are all one gender or one demographic (e.g., using the term "guys"). Bots can monitor written communication and proactively correct gender pronouns.

Mentorship can help women to find the assistance and support they need, particularly by having **women as mentors for other women**. Mentors need to be supportive, friendly, respectful, and encouraging. Besides joining ongoing support groups, women can also be assigned to formal mentors for regular one-on-one meetings. A mentoring program can include a plan for different women leaders to discuss their career trajectory and the benefits and challenges of holding their job. Women could share their techniques for managing time, balancing family and career demands, highlighting how they regularly learn new skills, making themselves heard by men, ignoring disruptions, and coping with criticism or insults.

Besides training and assisting women, the workplace itself needs to be safe. By assisting projects in articulating good behaviors for all members, **developing and enforcing a code of conduct** helps to mitigate Tightrope effects⁵ by assisting projects in articulating good behaviors for all members. The code of conduct comprises the collective norms of a community

⁵ The term Tightrope is usually associated with the circus, where a circus performer balances on a stretched rope. Following the analogy, the term can refer to the narrow band of socially acceptable behavior for someone, in our case, women.

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that shape the culture of collaboration and the community's expectations and values and aim to create a friendly and inclusive community. While having a code of conduct will not prevent sexism, it indicates to any men who display sexist behaviors that such actions will not be tolerated. The code of conduct needs to be enforced among the project members. Organizations should implement mechanisms to monitor communication, implement the code, and show that violations have consequences. Providing training on topics such as speaking up on behalf of women who are being disrespected in meetings, managing bias in the workplace, and raising awareness of micro-aggressions at work are some examples of standard training elements.

Work and family are often the two most important domains in a person's life, and their interface has been the object of study for researchers worldwide. As women assume the role of working professionally in addition to their traditional role of homemaker, they are under great pressure to balance their work and personal lives. The societal role expectations, women's career ambitions, and the nature of the IT industry challenge the way women manage their professional and personal lives. The COVID-19 pandemic and the need to work from home cast new light on these issues. While it brought more flexibility to many workers, it also brought new challenges. For a great share of the population, it became hard to separate personal and professional life. Women felt this more than men, given the aforementioned societal expectations.

Supporting parenthood is crucial for women who are caregivers. Maternity leaves usually relate to each country's law. Some countries mandate a longer maternity leave, while others mandate a shorter one. Besides sponsoring childcare and children's education, organizations and projects can adjust the duration of the maternity leave beyond the relevant country's laws by offering additional paid leave. Moreover, projects can provide psychological safety with a policy to guarantee the same position for women who return from maternity leave, while adding flexibility in work hours. Extra hours should be discouraged, and, instead, projects should **cheer those who are centered on their well-being**. Still, projects with global teams face difficulty finding suitable group meeting times, as people live in different places and time zones. Cultivating a culture of mutual respect can help to avoid the "invisible punishment" for those who cannot stretch when scheduling meetings. Sabbaticals promote well-being and increase future productivity through fostering fresh ideas. Implementing sabbaticals allows for paid leaves for personal and professional development.

Not a Conclusion: The road ahead

In this chapter, we provide a snapshot of the challenges faced by women in tech and, more importantly, the actions that may alleviate these challenges. However, there is still a long road ahead at the research, practice, and societal levels to make the tech industry more diverse and welcoming.

The literature reports a diverse set of challenges faced by women, but there is still a big gap regarding how it connects to the reasons why women leave (or avoid) the tech industry. Theoretical understandings can help create more effective, longer-term solutions. [10], one of the few studies that have used theory to explain these phenomena, found that social capital can support the long-term engagement of both men and women in OSS projects and that when team members have more diverse programming language backgrounds, women are less likely to leave the project. More broadly, we need more research about why a large portion of women who study STEM do not join the tech industry so we can create more effective, longer-term solutions based on these phenomena. Being aware of the challenges that women face, educators can address the underlying issues causing these challenges to improve students' (all gender) awareness of biases and discuss possible mitigation actions.

Historically, the social differences influenced by gender roles (i.e., the roles that men and women are expected to occupy based on their sex) may be amplified because of the gendered division of housework and childcare tasks, especially for mothers of young children. Impostor syndrome, sexism, lack of peer parity, prove-it-again, glass ceiling, and work-life balance issues were challenges reported by women in different software development contexts, including in large companies and Open Source projects [15, 14]. Some challenges surpass the organization and relate to the local, regional, or company/community culture. These challenges bump into society and often contribute to this cultural legacy. One example is the “trailing spouse”—when a person follows his or her life partner to another city because of a work assignment. Moreover, during the COVID-19 pandemic, a longer “double-shift” in the context of lockdown and limited availability of child-care services contributed to stress, anxiety, job insecurity, and difficulty in maintaining work-life balance among women with children [7]. It means that all of us as a society have to do our share to evolve and change this cultural legacy that hurts women more than men.

Although several actions to increase women's participation have been proposed in the lit-

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erature, few works present scientific evidence about their effectiveness. For instance, few studies evaluate the effectiveness of the “code of conduct” [13, 12], even though it is one of the most-cited actions to promote women’s participation. Evaluating the effectiveness of actions can be challenging, as communities need to have consistent measurements before (baseline), during, and after their implementation [8]. For example, although OpenStack created the Women of OpenStack Working Group (which included educational sessions, professional networking, mentorship, social inclusion, and enhanced resource access), the OpenStack Foundation lacked baseline information about the involvement of women [8].

Future work can also understand the intersectionalities of contributors to shift the focus away from individual-level conceptualizations of gender in tech and toward structural examinations that take into account the power dimensions of race, class, culture, sexuality, caregiving responsibilities, disabilities, and other demographics, and how different systems of oppression are mutually constituted and work together to influence women’s participation. Sensitivity to intersections enhances insight into the issues of inequality, thus maximizing the chance of social change [2].

Another open avenue for researchers is investigating why women do not join the tech industry. The perspective of women who are outsiders (and possible future insiders) and understanding what would entice them to join tech can bring new insights to attract women to the field.

Finally, “untying the mooring ropes” of socio-cultural problems is difficult. The cultural structural sexism present in society is mirrored in the professional environment. There is still a long work ahead for the software industry, and for us, as a society, to create a more diverse and inclusive environment. We hope our results will enlighten actions toward reducing the perceived challenges and increasing awareness about the structural and cultural hurdles imposed on women that negatively influence diversity in the software industry.

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