

Diverse Teams Are Essential for Quality Software

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Abstract

It has been shown that having diverse teams lead to increased problem-solving abilities. Solving complex problems is pivotal to software engineering and producing high quality software. It is natural to conclude that creating diverse software teams is a key element on the road to software quality. Rather than only thinking of quality in terms of testing by quality assurance engineers, Team composition is critical to quality software output. This paper will challenge you to consider the broader aspects of the other factors that play into creating quality software discuss ways you can create a diverse software team. It will also highlight examples of what Future Ada, a Spokane based non-profit, is doing to help build a strong diverse workforce.

Biography

Rebecca Long is a software engineer with 15 years experience focusing on quality assurance and DevOps. She is currently working at RiskLens, a cyber-risk quantification software company in Spokane as their Lead DevOps Engineer, Washington. She holds undergraduate and master's degrees in computer science with her thesis on social engineering and phishing within a financial institution. As a leader in the Spokane tech community for most of the last decade, she finally launched her dream of a non-profit called Future Ada in 2018 which supports and advocates for women and non-binaries in STEAM (science, technology, engineering, art, and mathematics). She lives with two cats, who are the true masters of the household.

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1 Introduction

As software professionals, we are driven by the desire to problem solve and create innovative solutions for the world. We care about what we produce and want it to be of the highest quality we can manage. It's common practice to include various types of testing in our software development lifecycle (SDLC). This could include unit tests, integration tests, end-to-end tests, UI tests, etc. We know testing helps to find bugs and other missed items during development or planning and results in higher quality output when found earlier than later.

Quality is more than just a low bug count though. It involves creating the right product, the right way, at the right time, for the right audience. Quality needs to be injected throughout the SDLC not just when it's time for testing. As early as the initial planning and brainstorming phase, quality needs to be on the forefront of everyone's mind. Is the problem being solved the right problem to tackle? Are we thinking of the problem from every angle? Who is our audience and what pros/cons would they have in using our product? This problem-solving phase is critical to the success of a project.

The makeup of the team at the problem-solving table is a critical element to the process and resulting quality product produced. Each team member has their own technical background to bring to the table, but they also have their own personal experience, upbringing, perspectives, and cultural background to share as well. Each of these different aspects contribute to the problem-solving process that takes place during software development. When the team members are all from similar backgrounds and experience, their perspectives will also be similar and thus only provide a limited view on the world. When the team members are of a diverse set of people, their perspectives will be wide and varied which ultimately helps the problem-solving process and can improve the quality of the software being developed.

2 The Lack of Diversity in Tech

The tech industry struggles with a lack of diversity. There aren't enough underrepresented people coming into the industry and there are too many who leave early. While the tech industry is still booming, the solutions being developed and the distance we could go could still be improved through a more diverse workforce at the wheel.

2.1 Historical Diversity



Figure 1: Augusta Ada Byron Lovelace (Sydell 2014)

The computing industry owes a lot to women for their multitudes of major contributions. Famous mathematician Augusta Ada Byron Lovelace (commonly known as just Ada Lovelace) is credited with inventing the first computer programming language (Gürer 2002). The ENIAC programming team had six women on it. Admiral Grace Hopper coined the term “computer bug” and invented the first computer compiler (Sanders 2009). Women math majors were common in the 1930's and those same women jumped at the chance to contribute more during World War II by working on computers (Sydell 2014).

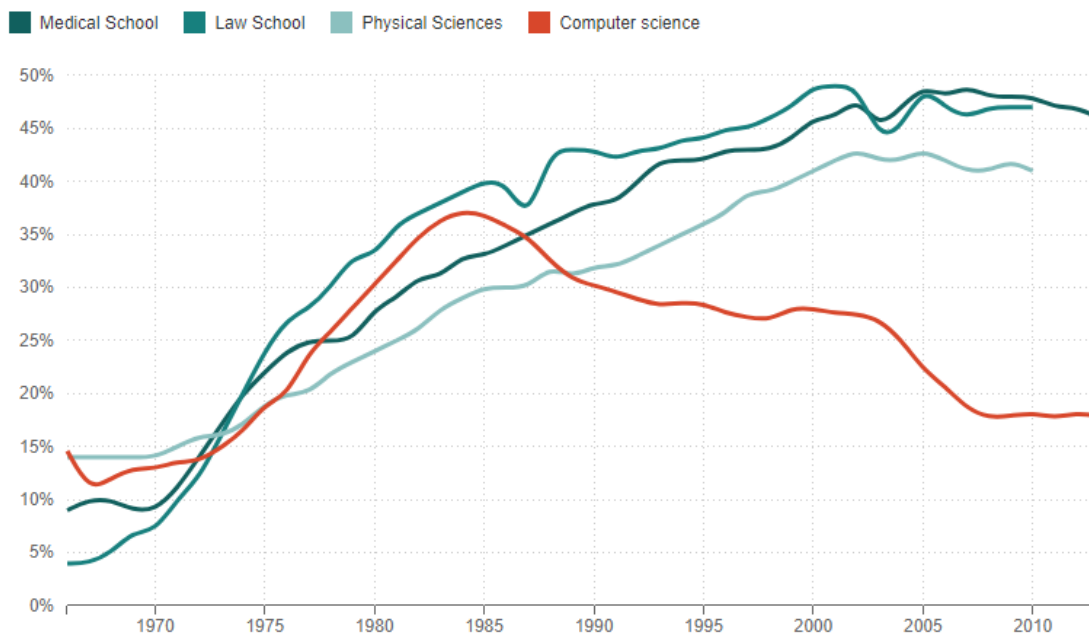
Despite women's major accomplishments in this field they rarely were credited or acknowledged. Programming was still seen “as menial labor, like factory work, and it was feminized, a kind of “women's work” that wasn't considered intellectual” (Mims 2017). It wasn't until the 1960's that the industry was professionalized and recognized as an intellectual career. This shift began attracting men and pushing women out of the field. Women earning computer science degrees peaked in 1984 at a mere 37% and has only been declining ever since (Mims 2017).

2.2 Modern Demographics

Since the peak in the mid-1980's, the industry has become filled with an increasing number of white men. Despite recent efforts to counter this trend, we are still seeing the number of underrepresented groups diminish.

2.2.1 Gender

Multiple studies have shown that the number of women in the tech industry has been steadily dropping since the 1980's with the more current numbers showing we are down to only 15-20% (Gardner 2014, Henn 2014). In 2008, Harvard Business Review published "The Athena Factor" which found that women's careers often stall at the mid-point and that "after 10 years of work experience ... 41% of women in tech leave the industry, compared with 17% of men" (Gardner 2014). Most of the women who leave are not leaving the workforce but instead switching industries which could imply that part of the diversity problem lies with the industry culture.



Source: National Science Foundation, American Bar Association, American Association of Medical Colleges
Credit: Quoc Trung Bui/NPR

Figure 2: Number of women in computer science over time (Henn 2014).

2.2.2 Race

Representation of minorities in tech is even worse than the gender gap. According to the U.S. Equal Employment Opportunity Commission (EEOC), "high-tech sector in 2014 employed a larger share of whites (68.5% tech vs. 63.5% private sector), Asian Americans (14% tech vs. 5.8% private sector) and men (64% tech vs. 52% private sector). It also employed a smaller share of African Americans (7.4% tech vs. 14.4% private sector), Hispanics (8% tech vs. 13.9% private sector), and women (36% tech vs. 48% private sector)" (Rayome 2018). Additionally, 83% of tech executives are white (Rayome 2018).

INDUSTRY PARTICIPATION BY GENDER SEX AND RACE GROUPS HIGH TECH VS. ALL PRIVATE INDUSTRIES

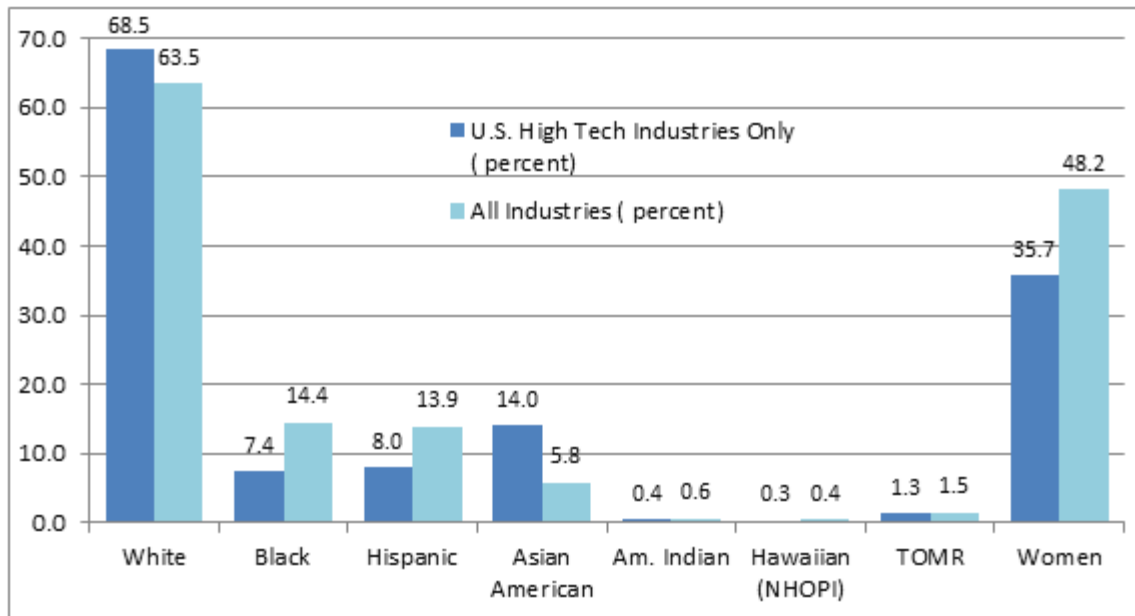


Figure 3: Equal Employment Opportunity Commission stats on race and gender in high tech (EEOC 2014)

2.3 Impact on Software Development

A great example of what a lack of diversity can do on an engineering team is to look at the airbag industry. The team who developed airbags was all-male and thus designed airbags to work for the average height and weight of a man. Unfortunately, the “tragic consequence was that women and children were killed when those early airbags were deployed” (Catlin 2014). Without women at the table during the design and testing phase, it wasn’t until after many accidents happened that finally in 2011 a female-crash-test-dummy was required to be used (Shaver 2012).

Another excellent and less tragic example is when Google initially launched the YouTube app for Apple. They noticed that:

“... approximately 10 percent of the uploaded videos were upside down: “Were people shooting videos incorrectly? No. Our early design was the problem. It was designed for right-handed users, but phones are usually rotated 180 degrees when held in left hands. Without realizing it, we’d created an app that worked best for our almost exclusively right-handed developer team.” (Brown 2016).

We need to ensure everyone is at the table for solving the world’s problems. When we have a homogeneous team doing the work, the perspectives available are limited which ultimately leave holes in the solutions developed as seen with the airbags. Missing something as big as “the impact of airbags on women” can result in costly errors. The quality of the product is lowered and worse yet the perception of your product and company is reduced as well.

3 Benefits of Diversity

There are many direct and indirect benefits to have diversity on your teams and in your leadership. Diversity leads to broader perspectives for problem solving which ultimately leads to greater innovation and better bottom lines.

3.1 Greater Innovation

Research shows that “socially diverse groups (those with a diversity of race, ethnicity, gender and sexual orientation) are more innovative than homogeneous groups” (Seiter 2017). A Harvard Business Review research study has highlighted how diversity does play a critical role in innovation. In the study diversity was broken into two categories: inherent and acquired. Inherent diversity representing the traits you are born with such as gender, ethnicity, and sexual orientation. Acquired diversity being what you gain from experience such as working in another country. They considered companies who had leaders exhibiting at least three of each type of diversity as having two-dimensional diversity (2-D). In these environments, the ideas and values of diverse employees are heard and promoted up the chain. The study found that “Employees of firms with 2-D diversity are 45% likelier to report a growth in market share over the previous year and 70% likelier to report that the firm captured a new market” (Hewlett 2013).

Another study, this time by the Boston Consulting Group (BCG), showed that teams with diverse leadership have a direct positive impact on innovation resulting in higher revenue from new products and services (Lorenzo 2017). This same study also showed that “innovation performance only increased significantly when the workforce included a nontrivial percentage of women (more than 20%) in management positions” and that “having a high percentage of female employees doesn’t do anything for innovation ... if only a small number of women are managers” (Lorenzo 2017).

3.2 Better Financial Bottom Line

As the Kapor Center for Social Impact’s 2017 study calls out:

“Diversity in tech matters—for innovation, for product development, for profits, for meeting future workforce demands, and for closing economic and wealth gaps. But unfairness, in the form of everyday behavior (stereotyping, harassment, bullying, etc.) is a real and destructive part of the tech work environment, particularly affecting underrepresented groups and driving talent out the door. With a concentrated focus on building inclusive workplace cultures, tech can save billions of dollars in financial and reputational costs, keep great talent, and finally make progress on its diversity numbers” (Kapor Center for Social Impact 2017).

As called out in the book *Inclusion*, a 2015 McKinsey report states:

“In the United States, there is a linear relationship between racial and ethnic diversity and better financial performance: for every 10 percent increase in racial and ethnic diversity on the senior-executive team, earnings before interest and taxes (EBIT) rise 0.8 percent” (Brown 2016).

4 Increasing Diversity on Software Teams

Here are industry and research backed methods to help increase diversity on your team. There are many levels needed to effectively approach this problem. Only doing one or two things will be a good starting point but try to be mindful of each of the areas listed.

4.1 Educate Staff

Diversity can be a tricky subject for many. It is important to educate your leadership and team members on the importance of it. Developing an annual or semiannual mandatory training on diversity, inclusion, and equal employment opportunities can help with this understanding and reduce the “chances of unfavorable situations” (Forbes Coaches Council 2018).

4.2 Create an Inclusive Culture

It is important to create a culture of inclusion on your teams. This will naturally draw in diverse members as everyone will feel safe and included regardless of age, race, gender, or background. Even if you don’t

have a diverse team today building this culture will allow different folks to feel welcome as soon as they walk through the door (Forbes Coaches Council 2018).

4.2.1 Inclusive Language

A powerful way to start building an inclusive culture is to start with the language you and your team use. While you may not purposefully mean to be excluding anyone, much of the common language used in day to day conversations are microaggressions and can be harmful to an inclusive culture. Microaggressions are “the tiny, casual, almost imperceptible insults and degradation often felt by any marginalized group” (Seiter 2017).

Inclusive language is defined as:

“Language that avoids the use of certain expressions or words that might be considered to exclude particular groups of people, esp gender-specific words, such as "man", "mankind", and masculine pronouns, the use of which might be considered to exclude women” (Dictionary.com 2012).

Incorporating inclusive language in conversations can include the following (Seiter 2017):

- Don't use “guys” to refer to men and women
- Use gender-neutral terms
- Avoid statements that perpetuate stereotypes
- Respect the language people call themselves
- Be thoughtful about the imagery you use
- Avoid negative or demeaning language around different groups of people

Swapping out commonly used words for more inclusive ones can help a lot at creating an environment where everyone feels welcome.

<i>Exclusive Term</i>	<i>Inclusive Term</i>
Mom & Dad	Parents, Caregivers
Boys & Girls	Children
Guys	Folks, People, Y'all
Men & Women, Ladies & Gentlemen	People of all genders
Brothers & Sisters	Siblings
Crazy, insane, nuts, psycho	Person with psychiatric disability; mental illness
Impaired, invalid, crippled, afflicted	Person with a disability
The handicapped, the disabled	People with disabilities
Retarded, slow, idiot, moron	Person with intellectual, cognitive, developmental disability

Table 1: Exclusive vs Inclusive Terms (Seiter 2017) (Unitarian Universalist Association 2018)

4.2.2 Unconscious Bias

We all have unconscious bias (also known as implicit bias) which are social stereotypes about certain groups that get formed outside our conscious awareness. These biases often are the root of much of today's discrimination which is ultimately an unconscious act stemming from our misconceptions around the belief “that the norms and experiences of our own social group— whether defined by race, class, gender, sexual orientation, disability, religion, or some other qualifier— are, or should be, the same for every other social group” (Brown 2016). While we can't help having unconscious bias, we must acknowledge this reality and then work to be mindful of it and prevent it from getting in the way of interacting with and respecting others.

4.2.3 Empathetic Leadership

It's important for everyone on a team, but especially leadership, to have emotional intelligence and empathy. This is a form of social awareness that allows being “able to assess situations from multiple

perspectives” (Harlan 2017). To relate to one-another as human beings, versus the older workplace model of checking your emotions at the office door. Life and your humanity does not stop just because you are at a desk. For employees to feel safe in bringing their full selves to work they need empathy and understanding from others. This is especially important for when major life events spill over into our work life – kids must be picked up from daycare early because they have a fever, the emotional impact from a divorce, disorganization that comes from moving, distraction that comes from pregnancy or adoption, or the toll from the death of a loved one. All these things can impact all employees, even the rock stars. Creating a safe environment where they can share what’s going on in their life to empathetic and understanding peers and leaders helps everyone, not just the underrepresented groups. Having this social awareness and empathy can help you pause before judging and improperly dealing with situations that may arise (Harlan 2017). It is becoming clearer that “higher emotional quotients have greater sensitivity and empathy, are rated as more effective, receive higher performance ratings, develop high-performing effective teams, and create a healthier ... culture” (Pinkus 2016).

4.3 Recruitment and Hiring

Outside of offering equal pay to women and minorities, there are some other tactics to keep in mind when looking for diverse job candidates.

4.3.1 Job Postings

When seeking out women and other underrepresented groups to join your team, it’s best to be mindful of recruitment strategies. Does your job ad highlight things like cold beer, ping pong, and endless video games? While it’s great to have a fun, laid back culture, these things often attract younger, predominantly male applicants and turn away folks with kids or those interested in starting a family (Geek Feminism Wiki). The phrasing of titles also can be problematic as the industry favors descriptions like “rockstar” and “ninja” which women are less likely to identify with. Additionally, listing the skills needed for the job under “required” can turn away women who believe they must meet 100% of those qualifications. Listing skills in more general terms instead of specific technologies and under a “preferred” heading will help pull in more diverse candidates (Geek Feminism Wiki). It can be helpful to have a diversity statement on your website and job posting so potential applicants can see your commitment to this issue.

4.3.2 Seek Underrepresented Candidates

Search for women and minorities to apply for your open postings. Send the job listing to community organizations advocating for diversity in tech and encourage employees, especially those of underrepresented groups, to share with their networks.

Be sure if you attend a conference or career fair for recruitment, the image you are presenting is inclusive for everyone. Do not have “booth babes” but instead bring along technical women who can also help speak to the culture of the company. Be mindful of phrasings and the jokes told in front of potential candidates.

4.3.3 Hiring Panels

Hiring panels should be made up of diverse employees to help sort the candidates. Blind resume reviews can be helpful to focus on skillsets rather than gender or age by removing names and dates before sorting. It has been shown that gender bias still exists in STEM when determining the best qualified candidate. A 2012 study showed that with two identical resumes, one with the name “John” and one with the name of “Jennifer,” employers in STEM viewed “John” as more qualified and even offered “John” a higher initial salary with mentoring opportunities (Moss-Racusin 2012).

4.3.4 Interviews

Standardize interview questions ahead of time before bringing in any candidate. Ensure the entire hiring panel agrees on what the questions are and why they are being asked. Be sure to discuss and secure

what hiring criteria to use prior to any interviews and then commit not to change the criteria part way through the process.

4.4 Retainment

4.4.1 Equality

Women and minority employees need be held to the same standards as other employees. This includes equal pay for salaries, raises, and bonuses. Have equal job expectations for employees. Be sure underrepresented groups have equal promotional opportunities and take note if there is a lack of diverse team members moving up the corporate ladder. If women and other underrepresented groups see only white men being rewarded for their hard work, those employees will start looking for opportunities elsewhere where they will be appreciated for their contributions.

4.4.2 Growth Opportunities

Provide mentoring opportunities to employees of underrepresented groups. Internal corporate mentor programs are great, but if your employer doesn't offer one consider informal mentoring options. Consider being a coach, mentor or sponsor for a woman or other minority member of your team. Each of these roles are different and each are important for success: "a coach talks to you, a mentor talks with you, and a sponsor talks about you" (Catalyst 2014).

Sponsor training events for women and minorities to send them to conferences or other seminars to help their career. Make sure all employees are receiving some form of sensitivity, anti-harassment, and unconscious bias training.

4.4.3 Work / Life Balance

Providing a culture that promotes a healthy work/life balance is key to drawing and retaining diverse employees. Corporate cultures that encourage 50, 60, 70+ hour work weeks are not friendly to families or those wanting to start a family and quickly lead to burnout. A company that has balanced parental leave policies that protect a parent's job following the birth or adoption of a child shows a commitment to employees and an understanding that employees also have lives outside work. Offering flexible schedules and remote options can also provide more opportunities for parents to work on your teams. This opens a large candidate pool of talent to pull from as well.

Ultimately, all employees benefit from a commitment to work/life balance. A study called *How Men Flex* found that "men respondents believed that work flexibility helped them be more productive, happier, less stressed, more motivated at work, more effective at home, and more committed to their employers" (Brown 2016). Promoting a healthy work/life balance helps not just underrepresented members of your team but all employees. Happier and healthier employees benefit the company via lower turnover rates, fewer sick days, and greater loyalty.

4.5 Executive Efforts

For those in executive leadership positions, you are in a unique position to make larger impacts on the organization's culture and stance regarding diversity and inclusion. The first recommendation is to hire a dedicated, experienced human resources person. Second is to consider hiring a Diversity and Inclusion (D&I) expert. Both roles will help guide you on setting up a safe environment that fosters inclusion.

Having clear, strong anti-harassment and anti-discrimination policies in place is key. It is critical that these policies are posted for all staff to have easy access and to ensure the policies are well understood by everyone. It is recommended to have a zero-tolerance policy for misconduct to show these issues are taken seriously. The organization must understand that a "lack of action [with sexual misconduct] implies tolerance, harming their investments in the long term and damaging that company's chances of success" (Lodico 2017).

When problems do eventually happen, it's important to have a safe reporting path for individuals to utilize. If the reporting process isn't safe, where the employee feels there will be negative repercussions for filing the report, you will only hear of problems after they are too big to remediate.

4.6 Community Involvement

As an individual, a team, or an organization who is committed to diversity and inclusion, make efforts to reach out to the community and help promote these values. Help to recruit women and minorities into the industry. Help teach tech skills to the youth to help create a diverse next generation of tech professionals. Show up at diversity events, sponsor scholarships, and offer internships to underrepresented groups. These steps can help show your community that you take the issue of diversity in tech seriously and want to make a big picture difference.

5 Community Organizations Here to Help

Thankfully there are many organizations around to help you make your team diverse and inclusive. These groups are good to connect with. Attend their meetings, volunteer, sponsor events. Learn from their examples. Supporting the work they do will ultimately help our whole industry bring in and retain underrepresented groups. Establishing good rapport with organizations like these, especially ones local to your company, will provide an avenue to learn from and to recruit from.

5.1 Future Ada



Figure 4: Future Ada logo

Future Ada (named after Ada Lovelace) is a Spokane based non-profit established in early 2018 (Future Ada 2018). Our mission is to secure space for women and non-binaries in STEAM (science, technology, engineering, art, and mathematics). We purposefully decided to go with STEAM, inserting “art” into the traditional STEM fields. We believe:

“the STEAM movement isn’t about spending 20 percent less time on science, technology, engineering, and math to make room for art. It’s about sparking students’ imagination and helping students innovate through hands-on STEM projects. And perhaps most importantly, it’s about applying creative thinking and design skills to these STEM projects so that students can imagine a variety of ways to use STEM skills into adulthood” (Feldman 2015).

We are making strides to help increase diversity and inclusion in all the STEAM fields, not just technology. Our initial focus has been on the tech industry, however, as most of our founding members are from tech. Projects we are involved with currently include bringing in other national resources to Spokane such as Django Girls, Girls Who Code, and Write/Speak/Code. We also created a scholarship for women interested in attending one of our local university computer science programs and are building a mentorship program with the same university to help prepare women and non-binary students for industry. Support from industry and our communities are critical to our success in helping advocate and encourage underrepresented groups to go into and stay in STEAM.

5.2 Other Community Opportunities

There are many other wonderful organizations and conferences who are working toward helping and supporting diversity in technology.

Women in Tech Organizations:

- Women Who Code: <https://www.womenwhocode.com>
- Girls Who Code: <https://girlswhocode.com>

- The Anita Borg Institute: <https://anitab.org>
- Black Girls Code: <http://www.blackgirlscode.com/>
- Django Girls: <https://djangogirls.org/>

Diversity and Inclusion Organizations:

- Project Include: <http://projectinclude.org>
- Compassionate Coding: <https://compassionatecoding.com>
- <div>ersity: <https://hirediversity.us/>
- Better Allies: <https://maleallies.com>

Conferences:

- Grace Hopper Celebration of Women in Computing: <https://ghc.anitab.org>
- Women in Cybersecurity (WiCyS): <https://www.wicys.net/>
- The Diana Initiative: <https://www.dianainitiative.org/>
- Write/Speak/Code: <https://www.writespeakcode.com/>

6 Conclusion

As software quality assurance professionals, we understand the creativity and innovation that goes into software engineering and software testing. We build software to solve problems, to help people, to help our communities. Software is built for people and built by people. As such, it is critically important that we have those creating the software also be representative of the world around us, the world that will be using the software. Diversity is a key element in developing high quality software as diverse team members are the best way to have broad perspectives and be maximally innovative.

There are many steps individuals, teams, and organizations can take to reach a team full of diverse employees creating high quality software. Simple steps such as using inclusive language and being mindful of unconscious bias make huge differences. Bigger steps such as fostering an inclusive environment with strong work policies, safe reporting methods, and empathetic leaders take more work but are worth the effort. All these efforts lead to a stronger, more innovative team which will ultimately produce better software and better bottom-lines.

Luckily, there are some universities that are having success increasing the number of women in their computer science programs. Harvey Mudd increased their computer science ratio to be 48% women and Carnegie Mellon increased theirs to 42% as of the year 2000 (Catlin 2014). This is good news for potential new hires to help diversify your teams.

6.1 Future Research

This paper has connected dots between research into how diversity and inclusion impact teams in general and the assumed impact that would have on software specific teams. Next steps would include doing specific research to prove the conclusions drawn here, that a diverse team produces higher quality software.

6.2 Call to Action

Every day more research comes out to show benefits to having a diverse team and an inclusive workplace. I encourage everyone to help create an inclusive environment at your office and on your team. Help create a space where diverse individuals want to be. We can all play a part in helping to create a safe space for diversity and we all will reap the rewards of creating a better workplace and producing higher quality software.

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