

Dimensions of Diversity, Equity, and Inclusion

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ABSTRACT

This paper reports on the ACM SPLASH 2022 conference panel on the Software Profession Dimensions of DEI [Diversity, Equity, and Inclusion]. The panelists observed that increased awareness for the dimensions of DEI will help reduce inequity in systems and technologies. The panel further observed that there are dimensions of diversity to consider beyond age, color, gender, and physical ability. As technologists, we need to leverage diverse talents and perspectives, including by those who may not have in-depth domain knowledge or a university education specific to computer science or engineering. Panelists included academic researchers and industry practitioners: experts in human-computer interaction, teamwork, AI applications, systems design, and gender diversity issues. The hybrid organization of the panel enabled participants from Taiwan and North America to join the in-room Australian and New Zealand panelists. Panelists explored a variety of related topics, ranging from how software can cause harm to the risks of “unconscious bias” in R&D and the challenges of building diverse teams. Panelists shared observations that AI and ML systems can be negatively impacted by the bias inherent with inadequate or incomplete training data used to tune algorithms. The panel discussed and summarized questions to foster increased DEI awareness by software professionals, researchers, and community leaders.

Categories and Subject Descriptors

•Software and its engineering~Software creation and management~Collaboration in software development •Social and professional topics~User characteristics •Social and professional topics~Professional topics~Computing education

General Terms

Management, Economics, Human Factors

Keywords

Diversity, equity, inclusion

1. DIMENSIONS OF DEI

The panel chair, Steve Fraser (Innoxec), was inspired to organize the panel after a comment made by a professor of computer science. “*Regarding that ‘diversity’ and ‘inclusion’ stuff, I confirm my opinion that in the academy and in the society we should have much more important things to take care of*” – a spring 2022 comment which suggested that there was an urgent need to better understand the dimensions of DEI.

Steve began the panel by sharing the following DEI definitions based on a blog post by Heidi Musser, Chair of the Agile Alliance Board [1]: *Accessibility* is being able to get in the building. *Diversity* is getting

invited to the table. *Equity* is having fair and just practices and policies to ensure that all can thrive at the table. *Inclusion* is having a voice at the table. *Belonging* is having your voice heard at the table.

Software development puts a special focus on collaboration and teamwork. Across business and academia, an inclusive work environment can help to make product development and research programs more effective. The NASA “Challenger Launch Decision” is an example of how business managers might discriminate against input from engineers with disastrous consequences [2].

To improve communication, team members and leaders need to better understand the dimensions of DEI. Some dimensions are more obvious because they have visible characteristics – age, color, gender, and physical ability. But others are less visible – education, ethnicity, experience, gender identity, occupation, political beliefs. None of these characteristics should become obstacles to communication. Teams and organizations that embrace diversity have been shown [3] to be more productive.

The panelists introduced themselves – Kelly Blincoe (University of Auckland, New Zealand), Stéphanie Camaréna (Source Transitions, Australia), Tanya Johnson (Auror, New Zealand), Geoff Kaufman (Carnegie Mellon University, USA), Mahsa McCauley (Auckland University of Technology, New Zealand), Sheng-Ying Pao (National Tsing Hua University, Taiwan – and shared their perspectives on the dimensions of DEI. The panel’s in-room discussion was facilitated by Alex Sloley (Agile Twist, an Australia-based agile coaching consultancy) and Sally Sloley (an Australian-based agile coach specializing in visual agile management). Dennis Mancl was introduced as the panel’s Raconteur. Heidi Musser (Chair of the Agile Alliance and executive consultant) contributed to the pre/post panel discussion but sent her regrets at being unable to attend live.

2. TECHNOLOGIES MAY DISCRIMINATE

One of the panelists posed a central question about inclusion in the software field: “What needs to change in software practices and tools to make the way we develop software more inclusive?”

For example, software developers might be blind to important user requirements – designing systems that are easy for the developers to use but that have poor usability for a significant fraction of end users. Unnecessarily complex interfaces may also pose obstacles to users when a simpler one might suffice.

Geoff, as a professor of Social Computing, studies the consequences of “harm” to users when using systems that may have a hidden bias. For example, he explained how voice recognition systems may work better for some users than others, and how computer software may discriminate with measurable impact on a user’s sense of identity and sense of self-worth (particularly when their colleagues are unaffected). Researchers and product designers need to consider ways to mitigate those harms.

Tanya, a VP at a New Zealand software company specializing in Loss Prevention, has investigated software-related “harms.” She explained that software systems may have a discriminatory effect, for example, by increasing the rate at which people of color find themselves “in the judicial system” (possibly questioned or arrested based on a faulty face image match). Tanya explained that risk assessment is important and requires an understanding of both system users and those impacted.

Kelly, whose research focuses on human aspects of software engineering, noted that not all users are identical. Some software systems can put an extra burden on certain kinds of users because of their differences. Even if it isn’t a case of racial or gender discrimination, it might be discrimination based on

“preferred method of working.” Kelly explained that systems are sometimes initially configured such that users are expected to “play around” or “try things out” instead of following a fixed and documented process. It’s a valid “way of working,” but it doesn’t work for everyone. She said, “There is research that shows there are different kinds of cognitive factors that influence how you interact with software systems, and that there are some gender differences in this.” Kelly noted that although some users are more likely to “tinker” with new software, others are more cautious.

All of the panelists discussed the potential for “discrimination” within the software profession. For example, software development organizations may adopt specific tools and practices with unanticipated consequences – impacting individuals with visual or other physical impairments. Panelists were eager to promote a more diverse and inclusive development community as a way to address unconscious bias in software system design. Diversity issues may become even more important as artificial intelligence (AI) becomes more widely integrated into system design.

3. BIAS AND AI/ML PITFALLS

The discussion turned to another central question for the panel: “What are the implications of not including underrepresented groups in the development of AI technology, and why is diversity so crucial to the development of AI?”

Sheng-Ying saw diversity, equity, and inclusion as essential because most of our interesting problems are about more than just writing software: our problems require interdisciplinary and cross-disciplinary efforts to solve them. Sheng-Ying has used her talents and connections in medical technology, computer science, and art design to educate a new generation of software designers. She envisioned more effective university-industry collaborations: teamwork that brings together experts in many technologies to build new and more usable products in the healthcare field.

Stéphanie shared her experiences using AI to increase sustainability in food systems by partnering with small farmers, schools, and food rescue organizations. Stéphanie emphasized the importance of having “everyone at the table” in the design process. Brilliant scientific experts may build a brilliant software system, but the system might not meet the needs of some stakeholders who were not included in the design process. Stakeholders focus on their narrow area of expertise, such as soil quality, nutrient level, or setting standards for the skin color and texture of fruits and vegetables. However, “experts” might ignore the market knowledge of farmers who understand the preferences of their customers.

Stéphanie shared a personal story on training an AI system to recognize bananas in the crate for rescue organizations. They trained the system by using images of bananas found on the Internet. Could the data on the Internet be biased? An Internet search generally returns images of perfect bananas: beautiful, yellow, and most of them will be of the Cavendish type. However, unlike ideal bananas, crates contained a mix of half-rotten bananas, some with spots, some green, individual, in small or large bunches, multiple banana varieties – much more chaotic than the training data. “You cannot expect developers and engineers in front of a computer having to think about all of these different possibilities,” Stéphanie lamented. The application of an effective scanning system required a team with diverse knowledge: people who could imagine the real-world range of bananas.

Stéphanie generalized from the banana example: There is a parallel between “catering for a large variety of bananas” and “catering for the diversity of people.” In any domain, it is discrimination if there are individuals who have lost the opportunity to be heard or to contribute.

Mahsa works in the field of natural language processing, and she echoed the call for more team diversity to avoid “unconscious bias” scenarios. “If we have a diverse team in the first place, we can hope our product it is really covering a wider perspective and a bigger population, and hopefully it will be well-suited for the users who are going to use it.” Mahsa told the story of the initial version of the YouTube app for iOS in 2013, which didn’t adapt the uploading of video files correctly for left-handed users. Many of their uploaded videos appeared upside-down – a bug that might have been connected to the developer team being almost exclusively right-handed [4].

Mahsa called for the creation of “metrics that can value and measure fairness.”

Every panelist had a perspective on the issue of bias and AI systems. Tanya believed that diverse teams of both developers and testers are essential. Tanya observed how AI amplifies our biases: “AI and Machine Learning picks up on our own biases and then it propagates it at scale.”

Kelly advocated listening to many voices when designing software products. She warned about the consequences of non-diverse product development: “When we don’t have diverse perspectives on software teams, we can accidentally create systems that exclude, frustrate, or endanger other people.” Kelly urged development teams to think about “whose voices they are hearing and whose voices are being missed.

Geoff also raised the issue of “barriers to effective communication” within a team. He observed that the best teams will have mechanisms in place to allow for a diversity of perspectives to be shared.

Psychologically safety is an important part of inclusion – a prerequisite for including multiple voices in design. Geoff cited some of the best ways to establish a safe communications environment, to help people feel safe to say what they think. Teams should establish communication norms early and on-board new team members to make them feel valued and respected.

4. BUILDING A DIVERSE TEAM

Diversity is not easy to achieve. Mahsa asked: How can we actually create a diverse and inclusive environment by encouraging (for example) gender diversity? Mahsa continued by noting that it is difficult to hire women when the number of female college graduates with computer science degrees is small. Mahsa pointed to surveys in New Zealand: 3% of 15-year-old high school student girls say they consider tech as a possible career path. “It means that they are feeling that they already know that this path is not for them.”

Tanya offered a suggestion: she found that many women come into the software industry through other alternative paths – not necessarily by way of the university pipeline. They come from boot camps, they are self-taught, or they are transferring from other areas of business.

On the point of self-taught developers, the panel impresario, Steve Fraser, invited Mary Shaw (Carnegie Mellon University), who was present in the audience, to offer her thoughts. Steve noted that Mary had given HOPL and SPLASH conference keynote talks [5,6] where she mentioned the prevalence in today’s business and research environment of “vernacular programmers.” These are the people who are usually not considered “professional programmers,” because their primary work is in other areas of business, technology, or science – but they have expanded their skills to “develop software for their own means and their own ends.”

Mary was happy to join the debate. She suggested that most young people in undergraduate computer science programs are the people who want to make “software developer” the first line on their business cards. Mary suggested that many “programmers,” by an order of magnitude, are people who have never studied computer science formally. Even so, these “vernacular developers” are programming every day: from spreadsheets to sophisticated scientific applications.

Mary’s category of vernacular developers is often ignored by software researchers or the teams building commercial software tools. In her keynote talk, Mary called for vernacular developers to be included rather than ignored. In Mary’s papers and talks, she called on the software engineering community to include the needs of these unconventional programmers in the design of programming languages, tools, and software processes. In this panel discussion, she raised the hope that this population of programming talent might contribute to a more diverse software community – and if we want to grow community diversity, we need to understand what draws people into programming.

Mary proposed that we should develop a better understanding about various “routes into the software profession,” where we might find some routes that would be amenable to building a more diverse population. Mary wasn’t sure about boot camps: “I suspect it’s mostly white men.” Tanya replied with a contrary observation: “Actually not. It’s actually more women.” Tanya’s evidence was based on personal experience since her company had hired pharmacists and office managers who attended software boot camps to be re-educated as software developers.

The question of what motivates people into developing software catalyzed a few of interesting observations. Tanya talked about a recent talk by Sacha Judd (CEO of Hoku Group) about women’s pathways – and how there is often hostility about the pathways they take. Some of them create things like fanfiction and Tumblr blogs and building things around pop culture. “They are not often viewed as being serious software developers, but they are building things that they love and that they enjoy.”

Kelly referenced an article and a talk by Rebecca Batchelor (a professor in Atmospheric Sciences at University of Colorado, and originally from New Zealand). Batchelor suggested that rather than thinking about “pathways in,” that we should think about career paths as a “braided river” [7] (a river that divides into a network of small rivulets that recombine). Kelly explained that there is not just one pathway in, one route to being a software professional, but multiple different ways – and it is OK to go out to do something else and then come back.

5. TEAMWORK AND COLLABORATION

Teamwork and collaboration do not come easily to some. There is a special challenge when team members need to discuss a multitude of perspectives. The panel addressed an important question about inclusion: “How can we get people to share diverse points of view?”

Sheng-Ying explained that it is essential to bring together many perspectives and connect experts from different backgrounds, cultures, and disciplines to collaborate and work together.

Sheng-Ying mentioned an interesting book about the dynamics of children’s play groups, and how they sometimes struggle to play together: “You Can’t Stay You Can’t Play” by Vivian Gussin Paley [8]. When they play together, some kids will exclude other some of the other kids. This behavior of forming an exclusive group starts at a very young age. Sheng-Ying outlined some experiments with improving collaboration: “A few years ago, we leveraged technologies for design interfaces for very young kids... to get groups of young kids to learn and experience how beautiful it may be to collaborate with others, to

include others... instead of always saying ‘oh, you cannot play with us.’” We need to apply similar ideas to get people from different academic or technology backgrounds to work together.

Geoff advocated more participatory design methods, where members of specific populations are brought in as collaborators in the design process.

Geoff also explained some teamwork-focused research being done with one of his grad students. They designed an online chat interface to be used by members of a new team – people who haven’t met each other yet. This chat application added occasional extra prompts to each team member: the application would ask questions that made them stop and consider the emotional experience or thoughts of the other team members, to reflect on how other people might be feeling. Geoff’s team has found that just the simple action of pausing to reflect on “how your experience might be different from somebody else’s” could go a long way toward creating a climate where people are more likely to share diverse viewpoints.

Geoff and his team have also explored the problem of “defensiveness.” He explained that we can feel threatened by diverse perspectives, or we may have a defensive reaction when privilege or status is challenged. To mitigate this defensiveness, Geoff’s researchers have set up some exercises where people in a group reflect on their core values – a technique known as self-affirmation. The process of reviewing individual and group core values “buffers your psyche against threats.”

Stéphanie offered a suggestion to employ multiple collaboration modes. Her teams use a combination of synchronous live meetings and asynchronous interactions. Stéphanie observed that although the live meetings can be efficient, there is an inclusion problem: “the louder voices tend to take up the floor.” The teams understand the value of accepting asynchronous inputs, where team members have more time to think and reflect. This can make it easier for some team members to contribute outside of the live sessions.

Stéphanie admitted that when her teams try to be more inclusive, the extra effort appears inefficient: it can seem wasteful to include activities that allow multiple points of view to be expressed. But Stéphanie didn’t agree with the obsession with efficiency – her rhetorical question was whether listening to multiple points of view is a “waste of time” or an “investment in time.” Good communication is not just a way to make everyone on the team feel that their opinion has been heard: open dialog helps teams foster increased understanding and develop better solutions.

Mahsa reported on her experiences in running “unconscious bias sessions” in her work with staff members across the university. The sessions can help staff communicate better. Mahsa emphasized that many people “don’t know what they don’t know,” so bias sessions are a necessary activity to educate people, to help them understand potential bias and discrimination.

Social distancing, mandated by the Covid-19 pandemic, necessitated that many meetings and conferences became virtual. Virtual conferences foster increased diversity, equity, and inclusion by reducing cost barriers to attend – increasing global accessibility and enabling those with physical disabilities to more easily attend [9].

6. QUESTIONS TO INCREASE DEI AWARENESS

In preparing for the panel, panelists were requested to suggest questions that would foster DEI understanding. Some of these questions were discussed during the panel, but all are included here to help catalyze ongoing discussion.

DEI in the development process:

- When, in the process of designing and developing solutions, should DEI dimensions be considered?
- What needs to change in software practices and tools to make the way we engineer software more inclusive?
- How do you get meeting attendees to share diverse points of view – rather than simply going with “majority” opinions?
- If we have a small team, how can we bring in more points of view?
- How can we encourage a diverse and inclusive work environment?

DEI in building better AI and Machine Learning systems:

- What are the implications of not including underrepresented groups in the development of AI technology, and why is diversity so crucial to the development of Artificial Intelligence?
- How should we design “training data” for AI systems to minimize data bias?

DEI and “potential harm” from technologies:

- How are we evaluating any potential harm to users caused by biased or non-inclusive technology – and what steps can we take to mitigate that harm?
- How do we build diverse teams, and create inclusive work environments to make sure we’re building software we won’t regret later?
- How should we encourage the design and use of more inclusive user interfaces to avoid cultural bias?

DEI and the future of conferences:

- How can we motivate the post-pandemic use of virtual/hybrid meeting technology to improve participant accessibility and equity – particularly for international conferences?

7. LESSONS LEARNED

The panel facilitators, Alex and Sally, asked the panelists to summarize their panel takeaways. Mahsa worried that different organizations and companies have seen DEI as a “ticking a box exercise.” She insisted that we need to start taking actions that have a meaningful impact on DEI. Tanya agreed and indicated that although we won’t achieve immediate success, it is important to start. Kelly was heartened – “to hear so many people coming from so many different perspectives sharing very similar thoughts around psychological safety and diversity and inclusion and belonging.” Stéphanie learned through the panel dialog that there are many “pathways” into practicing software, which will hopefully lead to more opportunities for increased diversity.

Sheng-Ying expressed gratitude for the opportunity to collaborate with people from around the globe – expressing the importance of geographical diversity and inclusion. She specifically praised the diverse and collaborative nature of the panel session – which was possible only because both SPLASH 2022 and the panel were organized as a “hybrid” combination of in-person and virtual participation. Virtual and hybrid conferences can contribute to a more diverse and inclusive collaboration environment. Geoff found that the panel discussion highlighted the importance of increased awareness for the different ways that bias or equity issues affect the software profession. He suggested that we need to increase our personal awareness – and the awareness of our organizations – for DEI issues.

Throughout the 90-minute session, the panelists wrangled with two core questions:

- How can we build more diversity and equity into the “software profession?”

- How can increased awareness for diversity and inclusion address unconscious bias?

There are no easy answers. To build a diverse community, the panelists advocated increasing diversity of the talent pipeline that encourages early career talent to join the software field. Panelists shared ideas to provide multiple “pathways” into the software profession to challenge the dominant “hacker” cultural stereotype. Effective collaboration goes hand-in-hand with inclusive teams – and panelists promoted the values of better team communication, group dynamics, participatory design methods, and inclusive modes of collaboration.

Unconscious bias will continue to plague software product development and research if diversity, equity, and inclusion principles are not embraced. The panelists illustrated this point with several examples, particularly within the emergent domain of AI/ML. Teams benefit from talented individuals with experience in multiple domains, to foster inclusive system design and decrease the impact of biased training data on AI/ML systems.

Steve thanked all panelists and the audience for their participation and looked forward to continuing conversations at SPLASH 2023 in Lisbon!

8. REFERENCES

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