NII Shonan Meeting Report
Meeting No. 194

Software Developer Diversity and Inclusion Workshop

https://shonan.nii.ac.jp/seminars/194/

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June 26 - 29, 2023

National Institute of Informatics
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Abstract

Software systems are responsible for all aspects of modern life. They help humans make critical short-term and long-term societal and personal decisions, and yet the diversity and values of the people designing software systems do not remotely represent the diversity and values of people on our planet. According to Stack Overflow's 2020 survey of more than 65,000 developers, 91.7 percent identify as male and 70.7 percent as white or of European descent. Research indicates that racially diverse groups make better decisions, open source projects with diverse contributors are more productive, developer communities with different physical abilities can be more welcoming to novices, and that working on gender diverse teams improves attitudes towards women. This is only a short list of some of the impacts that being intentional about the backgrounds of software developers can produce.

There is a significant amount of work to be done to create inclusive environments that can lead to a more diverse community building the software that is the foundation for our digital society. And this is the main goal of this workshop. We aim to discuss developer diversity and inclusion challenges faced by industry today. Our intent is to understand these challenges more clearly, to propose concrete goals to address them, and to gather recommendations as well as best practices to share with practitioners. We want to drive essential and rigorous research towards understanding barriers to diversity, equity, and inclusion while also discovering and promoting best practices that will increase diversity. We also aim to build a community of researchers and practitioners that share a passion to improve software developer diversity, equity, and inclusion.

Meeting format, expected outcomes and impact
The format was consistent with prior years: several talks, with at least half of the officially sanctioned time dedicated to small group breakout sessions. We had a mix of talks by the attendees, followed by breakout group sessions on common topics of interest. The talks addressed the current state of the art on Software Developer Diversity and Inclusion reviewing the main challenges and opportunities for improving diversity. In the breakout sessions we discussed each of the challenges and opportunities in depth and proposed concrete actions. We involved the participants in the design of the agenda and the definition of the desired meeting outcomes (e.g., community infrastructures, collaborations, books, publications, special issues, follow-up meetings, etc.).

This was the fourth annual meeting of this series. In 2019, this workshop was held in San Francisco (27 attendees). In both 2020 (70 attendees) and 2021 (56 attendees), it was held virtually, due to the global pandemic. We had a total of 23 attendees. We also allowed remote participation following a hybrid model, where virtual attendees attended part of the workshop as well. Outcomes from prior iterations of this workshop include the formation of a Linux Foundation project of the same name and a special issue of IEEE Software on the topic. We expect outcomes from this workshop to be both concrete actions to the challenges identified and future directions and plans for collaborative and rigorous research.

Meeting Schedule

Check-in Day: June 25, 2023 (Sunday)

- Welcome Reception

Day 1: June 26, 2023 (Monday)

- ❖ Morning
    - Opening
    - Introduction & Ice Breaking I
    - Group Session
- ❖ Afternoon
    - Talks #1 Gema Rodriguez-Perez, University of British Columbia
    - Talks #2 Rafael Prikladnicki, Pontifical Catholic University of Rio Grande do Sul (PUCRS), Brazil
    - Group Session

Day 2: June 27, 2023 (Tuesday)

- ❖ Morning
    - Ice Breaking II
    - Talks #3 Alexander Serebrenik, Eindhoven University of Technology
    - Talks #4 Yi Wang, Beijing University of Posts and Telecommunications
    - Group Session
    - Group Photo Shoot
- ❖ Afternoon
    - Excursion and Main Banquet

Day 3: June 28, 2023 (Wednesday)

- ❖ Morning
    - Talks #5 Grischa Liebel, Reykjavik University
    - Talks #6 Emerson Murphy-Hill, Google
    - Group Session
- ❖ Afternoon
    - Group Session

Day 4: June 29, 2023 (Thursday)

- ❖ Morning
    - Group Session (Working on Deliverables)
    - Wrap Up and Plan Follow-up Activities

Summary of Talks

#1. Diversity in Online Software Development Groups

Gema Rodriguez-Perez, University of British Columbia

Focusing on the question that what has been studied and discovered related to perceived diversity aspects in SE, Dr. Rodriguez-Perez first reported a systematic literature review (SLR) summarizing the existing evidence concerning perceived diversity in SE literature. The SLR reveals there is a lot of room for improvement in perceived diversity research. Three types of perceived diversity research were identified in SE literature, including: differences within the perceived diversity aspects, relationships between diversity and SE metrics, and SE practitioners' perceptions. For, differences within the perceived diversity aspects, various gender differences in multiple SE activities were identified, for example, how developers use debugging strategies, as well as national differences in performance of teams. For relationships between diversity and SE metrics, the evidence of diversity's positive effects were reported in both online communities and industrial workplaces. For SE practitioners' perceptions, various biases and discriminations related to gender, age, race, and sexual orientation were found.

Dr. Rodriguez-Perez then presented a large-scale empirical study which had two goals: (1) to examine the distribution of contributions from homogeneous and heterogeneous groups, and (2) whether racial and ethnic diversity is correlated to groups' contributions. The study identified 4,570 collaborative groups by detecting cliques from 1,413 GitHub projects' data. The results showed that 75% members were perceived as white and 79% members were perceived as men. Also, collaborative groups also had different racial and ethnic distribution of members. The study also found that racial and ethnic diversity may increase collaborative contributions.

Related Publications:

Rodríguez-Pérez, G., Nadri, R., & Nagappan, M. (2021). Perceived diversity in software engineering: a systematic literature review. *Empirical Software Engineering*, 26:102,1-38.

Shameer, S., Rodríguez-Pérez, G., & Nagappan, M. (2023). Relationship between diversity of collaborative group members' race and ethnicity and the frequency of their collaborative contributions in GitHub. *Empirical Software Engineering*, 28:4, 1-31.

#2. The Inclusive Agile Accelerator: How to Improve Learning and Inclusion in the IT Industry

Rafael Prikladnicki, Pontifical Catholic University of Rio Grande do Sul - PUCRS, Brazil

In this talk, Prof. Prikladnicki introduced their over a decade field efforts in working with the local tech sector in Porto Alegre's Tecnopuc, the capital city of Rio Grande do Sul state, Brazil. Starting from the collaboration between ThoughtWorks and PUCRS on agile education, the collaboration led to several educational initiatives emphasizing inclusive issues such as gender

balance and embraced other industry partners such as Globo and Sicredi. Such programs included the Agile Accelerator starting from 2011, and its later version–Inclusive Accelerator program. These programs did not only improve students' professional skills and job market preparations, but also raised the awareness of inclusiveness. Particularly, the Inclusive Accelerator program enabled teenagers in conditions of social and economic vulnerability to have a first contact with technology and software development. Prof. Prikladnicki provided Maria Mariana's personal growth as an example of the program. 87% participants believed that the program completely met or exceeded its initial expectations, and their experiences in the program had high or very high importance in achieving their current professional position in the 2019 alumni survey. Prof. Prikladnicki concluded the talk by summarizing some critical challenges faced by the global software engineering community in improving the industry's diversity and inclusion.

Related Publications:
Heck, Nelice, Knebel, Patricia, Prikladnicki, Rafael. Agile Inclusive Accelerator: Bringing knowledge, projects and people together to build an equitable tech future. 2020. https://www.amazon.com.br/Agile-Inclusive-Accelerator-knowledge-equitable-ebook/dp/B08PDQLQPK

Program website: https://www.thoughtworks.com/en-br/about-us/diversity-and-inclusion/aceleradora.

#3. Gender and Age in SE

Alexander Serebrenik, Eindhoven University of Technology

In this talk, Prof. Serebrenik provided an overview of the results they have obtained when studying gender and age in software engineering. Prof. Serebrenik first introduced their early efforts on communication in software development teams with the focus on “community smells,” which motivated the later work aiming at improving gender diversities in software development. Two projects were introduced. Their first one was a coding education program organized in the Netherlands while another was a Hackthon in Brazil. These activities brought insights about opportunities and constraints of women's participation in software development. Then, Prof. Serebrenik discussed another diversity aspect--age. They studied online public discussions of age in software development. Through analyzing 24 online articles, the theme “employability” emerged with a number of employability strategies for older software developers identified for both companies and individuals. Then, the gender and age perspectives were combined. Prof. Serebrenik discussed experiences of veteran women in software engineering and their “survival” strategies from an interview study with 14 participants from Twitter users. The study revealed that individuals belonging to the intersection of multiple diversities often could not attribute their experiences to either particular diversity. Compared with positive experiences, negative experiences were much more common. A number of categories of strategies were identified. Prof. Serebrenik discussed the implications for organizations and veteran women software engineers. At the end of the talk, Prof. Serebrenik introduced a study focusing on the benefit of being WAHM (white able-bodied heterosexual men) compared with other 31 intersectional groups of diversity statuses, and urged researchers to put more attention in intersectional groups.

Related Publications:
van Breukelen, S., Barcomb, A., Baltes, S., & Serebrenik, A. (2023). " STILL AROUND": Experiences and Survival Strategies of Veteran Women Software Developers. In *2023 IEEE/ACM 45rd International Conference on Software Engineering (ICSE).*

#4. Gender Biases in US & China—Some Previews of A Comparative Study

Yi Wang, Beijing University of Posts and Telecommunications

In this talk, Prof. Wang presented a series of studies aiming at quantifying and comparing gender biases in the US and China. The talk started from a brief introduction of the motivation behind these efforts. Then, Wang briefly introduced two studies they conducted before the COVID-19 pandemic, which captured explicit and implicit gender biases of professional software engineers and the corresponding local public in upstate New York, United States. The measurement systems for both biases were introduced. Then, Wang presented their recent efforts in measuring explicit and implicit gender biases of professional software engineers and the corresponding local public in China. The differences in the demographics between the two countries made the research team take different strategies in collecting data. The data analysis showed some confusing results. First, in both countries, the public's gender biases towards software development profession are lower than the professional software engineers. Second, in the population of professional software engineers, China sample recorded higher explicit biases and implicit biases on SE-technical, but lower biases in general gender-career. Third, in the population of the public, China sample has higher explicit biases, but lower biases in general gender-career and SE-technical. Then, both populations, countries, and implicit/explicit biases were brought together. The results were: (1) The potential explanations for the results were also discussed.

Related Publications:
Wang, Y., & Redmiles, D. (2019). Implicit gender biases in professional software development: An empirical study. *In 2019 IEEE/ACM 41st International Conference on Software Engineering: Software Engineering in Society (ICSE-SEIS)* (pp. 1-10). IEEE.

#5. Neurodiversities in Software Engineering: Ongoing research and early results

Grischa Liebel, Reykjavik University

In this talk, Dr. Liebel introduced neurodiversity as an emerging topic in research into software development diversity and inclusion. Dr. Liebel first introduced his institution Reykjavik University and the CRESS center at the university. After introducing the concept of neurodiversity, Dr. Liebel pointed out that there is very little research on neurodiversity in SE, analyzed the reasons for the lack of work in this stream, and provided a few general

suggestions. Then, Dr. Liebel presented their efforts in designing economical accommodations for neurodivergent students in SE education. Their intervention included several simple design features, such as non-white, non-transparent background color, special font, and Increased line and letter spacing. Such an intervention had been applied in three courses, and received positive feedback in general. Since neurodiversity is not rare but often neglected, increasing its awareness in higher education is important. A few hypothetical challenges and strengths of neurodiverse people may face in software engineering was summarized. These challenges may be difficult when facing: (1) constant communication with the team, (2)code review meetings and (3) lots of changes, little structure in agile development. However, neurodiverse people may have advantages in various tasks such as, Debugging/Testing, Creative tasks, focused programming sessions, and visual thinking.

Related Publications:
Liebel, G., & Sigurðardóttir, S. G. (2023). Economical Accommodations for Neurodivergent Students in Software Engineering Education: Experiences from an Intervention in Four Undergraduate Courses. *arXiv preprint arXiv:2306.07643*.

#6. Systemic Gender Inequities in Who Reviews Code

Emerson Murphy-Hill, Google

In this talk, Dr. Murphy-Hill presented a study about systemic gender inequities in code review at Google. They found that there is a 25% difference (16.8% when adjusting for confounding factors) between men's and women's code review loads. The talk dove into 'why', such as the tendency of authors to manually choose male reviewers; the tendency of women to be less likely to have credentials useful for reviewing, such as ownership of a codebase; and the tendency for automated reviewer recommenders to perpetuate mens' relatively heavy review load. The talk also highlighted practical steps for teams and toolsmiths to take to improve review load equity.

Related Publications:
Murphy-Hill, E., Dicker, J., Horvath, A., Hodges, M. M., Egelman, C. D., Weingart, L. R., ... & Chen, N. (2023). Systemic Gender Inequities in Who Reviews Code. *Proceedings of the ACM on Human-Computer Interaction*, 7(CSCW1), 1-59.

Identifying Goals, Outcomes, and Topics

During Monday morning, a liberating structure (1-2-4 ALL) was used to identify goals, outcomes and topics. The participants were broken into 3 groups that came up with one goal, 2 outcomes and 4 topics per group.

Goals

- Set a research agenda for practical impact
- Articulating a research program
- Establish an active community with a common understanding of SDDI and corresponding methods

Outcomes

- Newsletter or something similar to inform the community
- Collaboration working groups
- Coordinated effort
- Open research questions
- Commitment to the topic
- Propose some kind of manifesto / opinion paper

Topics

- Methodologies for SDDI
- Teaching DEI
- AI + Future of work + SDDI
- US biases
- Intersectionality
- Intentions and best practices
- Measurements
- Future of research
- Knowledge transfer
- Terminology

Write-Ups Summarizing Group Sessions

With the goals, outcomes, and topics identified on Monday morning, multiple group sessions were held. After intensive discussions around the topics, each group developed a write-up to summarize the discussions that happened during group sessions. The write-ups include:

Table 1. The list of write-ups.

Write-up	Topic	Contributors
1	AI + SDDI: Expected Harms and Benefits of AI on Professional Software Developer Diversity and Inclusion	Emerson Murphy-Hill, Gema Rodriguez-Perez, Grischa Liebel, Bogdan Vasilescu, Yi Wang, and Rafael Prikladnicki
2	AI and CS Education	Magaret-Anne Storey, Cornelia Connolly, Alannah Oleson, Jocelyn Simmonds
3	Knowledge Transfer and SDDI	Rafael Prikladnicki, Grischa Liebel, Chris Brown, Sonja Hyrynsalmi, Jocelyn Simmonds, Stefan Stanciulescu, Yi Wang
4	Connecting Large Scale Social Economic Understandings with Data in Software Engineering	Yi Wang
5	Methodologies and Metrics	Raula Gaikovina Kula, Bianca Trinkenreich, Chris Brown, Sonja Hyrynsalmi, Kelly Blincoe, Bodgan Vasilescu, Stefan Stanciulescu, Gema Rodriguez-Perez
6	Intersectionality and SES	Alannah Oleson, Alexander Serebrenik, Bianca Trinkenreich, Denae Ford, Magaret-Anne Storey, Ray Harvey

1. AI + SDDI: Expected Harms and Benefits of AI on Professional Software Developer Diversity and Inclusion

Contributors: Emerson Murphy-Hill, Gema Rodriguez-Perez, Grischa Liebel, Bogdan Vasilescu, Yi Wang, and Rafael Prikladnicki

Based on recent practical advances in large language models, artificial intelligence (AI) is likely to have an increasingly large impact on the practice of software engineering. Considering the significant gaps in how software developers from different demographic groups experience the profession, AI has potential to widen or shrink those gaps. In what follows, we articulate what we anticipate some of the potential benefits and harms may be.

Potential Benefits

Lower-Stakes Questions. For fear of experiencing disrespectful feedback [Hodges23], discrimination, or other negative consequences, marginalized people can be reluctant to ask for feedback or help from colleagues. AIs provide an opportunity for these people to obtain initial feedback, e.g., to judge whether their questions go in the right direction. As such, AI tools can be a safe tool for asking questions and learning without fear of discrimination.

Support for New Ways of Working. AI tools offer opportunities for people with disabilities or with alternative preferred ways of working, as these tools can enable them to use their preferred workflow while still ensuring that the outcomes are as required by the organization. Additionally, organizations can then allow their engineers to work in various ways, without limiting them to a single required modality or workflow. A few concrete examples are as follows.

A common characteristic of several conditions included under the umbrella of neurodiversity is the ability for excellent visual thinking. With future developments in AI, it might become easier for visual thinkers to express their thoughts in images, e.g., as sketches, and use AI tools to convert them into code or other software-related artifacts.

Similar to neurodivergent software engineers, those with visual impairments can benefit from using different modalities, e.g., through AI tools that can generate software artifacts based on speech input.

For dyslexic software engineers, i.e., with difficulties in reading and writing texts, AI tools might be particularly useful because they can easily convert incomplete or syntactically incorrect text into the expected format. Early work has already appeared that studies this kind of support in general-purpose tasks, such as writing emails [Goodman22].

Automation Yields Better Preparation for Peer Feedback. Professional software engineers often provide feedback to their peers about software engineering artifacts, such as code changes during code review. Folks from historically marginalized groups often receive harsher or more critical feedback than their peers [Kreitzer21, Murphy-Hill22]. When AI provides automated feedback prior to peer review, it's possible – though by no means guaranteed – that the total surface area available for especially harsh or critical feedback goes down, thereby limiting the excessive feedback received by historically marginalized engineers.

Potential Harms

English as the Dominant Language. Natural language is particularly difficult for non-English speakers, so LLMs could be especially hard to use for non-native speakers [Weidinger et al. 2021]. Meanwhile, prompt engineering for LLMs may also inherit these limitations, thus restricting non-native speakers' effective use of LLMs.

Diversity and Inclusion in LLMs Are Handled Implicitly. Currently, diversity and inclusion (and some other ethical issues) in LLMs were implicitly approached with certain human alignment techniques [Boggust et al. 2022]. However, since training data is largely from majority groups and many other restrictions, these human alignment techniques shall be used in caution and evaluated for D&I purposes.

Widening Gap between Novices and Experts. The research emerging so far suggests that while most developers seem to benefit from LLM code suggestions and that the tools generally seem productivity enhancing, there is an implicit assumption that this programming model takes for granted – that users are able to fully comprehend and meaningfully review the LLM's suggestions. One could imagine this not always being the case. For example, for novices it may become harder, not easier, to program assisted by an LLM. This may be further exacerbated by an additional need to be able to translate thoughts accurately into prompts, widening the gap still. See also this CACM blog post. .

Double Standards. At present, the use of AI tooling is a gray area for many software development organizations – such tooling can provide significant productivity benefits, but come with correctness and privacy risks. In such organizations, a software engineer who uses AI tooling may be viewed differently by their peers, depending on their demographics. For instance, a man who uses ChatGPT to write code could be considered forward-thinking, but a woman who does so may be considered not sufficiently competent to do the work herself.

Polarizing the Workforce of Software Engineering. LLMs, especially used for SE purposes, often need people with certain SE knowledge to do some simple and repetitive work such as labeling. They might be locked in those low-level tasks and have limited opportunity to develop their career, which has happened many times in our modern history [Autor et al. 2006, Autor & Dorn 2013].

Given these potential harms and benefits, the challenge for researchers in the area is to answer the following questions:

- How do we maximize the benefits and minimize the harms that AI in software development will do in the future?
- What behaviors or best practices should professionals be aware of to decrease harm and increase benefits?
- How can AI tools support new and different ways of working?

Reference

[Autor et al., 2006] Autor, D. H., Katz, L. F., & Kearney, M. S. (2006). The polarization of the US labor market. American Economic Review, 96(2), 189-194.

[Autor & Dorn, 2013] Autor, D. H., & Dorn, D. (2013). The growth of low-skill service jobs and the polarization of the US labor market. American Economic Review, 103(5), 1553-1597.

[Boggust et al., 2022] Boggust, A., Hoover, B., Satyanarayan, A., & Strobelt, H.(2022). Shared Interest: Measuring Human-AI Alignment to Identify Recurring Patterns in Model Behavior. In Proceedings of the 2022 CHI Conference on Human Factors in Computing Systems (CHI '22). Association for Computing Machinery, New York, NY, USA, Article 10, 1–17. https://doi.org/10.1145/3491102.3501965

[Goodman22] Goodman, Steven M., et al. "LaMPost: Design and Evaluation of an AI-assisted Email Writing Prototype for Adults with Dyslexia." Proceedings of the 24th International ACM SIGACCESS Conference on Computers and Accessibility.

[Hodges23] Maggie Hodges and Emerson Murphy-Hill. Perceptions of Software Developer Inclusion: a Survey at Google. In Equity, Diversity, and Inclusion in Software Engineering: Best Practices and Insights, to appear.

[Kreitzer21] Kreitzer, R. J., & Sweet-Cushman, J. (2021). Evaluating student evaluations of teaching: A review of measurement and equity bias in SETs and recommendations for ethical reform. Journal of Academic Ethics, 1-12.

[Murphy-Hill22] Murphy-Hill, Emerson, Ciera Jaspan, Carolyn Egelman, and Lan Cheng. "The pushback effects of race, ethnicity, gender, and age in code review." Communications of the ACM 65, no. 3 (2022): 52-57.

2. AI and CS Education

Contributors: Magaret-Anne Storey, Cornelia Connolly, Alannah Oleson, Jocelyn Simmonds

Motivation

With advances in AI technologies, we aim to investigate the impact of these tools when supporting learning and teaching tasks in CS/SE courses. The use of AI may replace the teacher roles or some of the tasks teachers do. We need to investigate how this may benefit students and teachers, but also how it may impact retention, dropout rate, or create barriers to entry to CS education.

Proposed benefits of using AI technologies in CS/SE education:

- Scaling our courses to larger cohorts may be easier
- Targeting help by giving help (using AI) to those that can use if effectively, while freeing up educators effort to spend more time working with students who may benefit more from in-person help, or would give additional time to preparing new materials
- Faster feedback to students (grading) improving the immediacy of that feedback but also more encourage tinkering and exploration [GenderMag Studies by Burnett et al., 2016]
- Faster feedback to instructors on student progression and comprehension, insights on problem learning/understanding areas
- Feedback on pedagogical approaches and strategies with more insights into what questions are asked, and to inform material improvements
- More insights into biases/accessibility of concepts across different demographics
- Psychological safety -- students can ask questions (of the AI supportive tools) and troubleshoot in a safe environment where they won't feel embarrassed to ask for help -- supplement and provide a new modality for e.g. office hours using AI
- Building community around asked questions (e.g. "you've asked the same question as three other people! Say hi!")
- Helping instructors share with other instructors and give back time, recommending collaboration and consequently building a community of instructors.
- Personalized coding coach (to support computational thinking and problem based learning - how to use abstractions and decomposition and pattern recognition)
- Impact on teacher efficacy, self-concept

Potential risks of using AI technologies in CS/SE education:

- a lack of ability to adapt to students' individual circumstances, or a lack of empathy for difficult events that students might be going through external to the course.
- If AI agents are used to impart content knowledge, that students from different demographic/identity might interact with educational AI agents differently, or that they might benefit differently from AI-based help.
- Replacing human helpers (such as TAs) with technology may remove some of the social elements that contribute to a sense of belonging in computing, which is a strong predictor of retention in the field, especially for students from diverse genders, ethnicities, and other marginalized identities.

- Negative impact on social integration. The retention literature focuses on academic and social integration (e.g., the Tinto model), we may need to inquire how AI will facilitate or create a barrier to social integration.

Proposed Studies

Social and emotional learning (SEL).
Using social learning theories as a lens - we should study diversity facets, demographic facets, and identity and experience facets on social and emotional learning.

Impact of lack of empathy.
Will the AI be able to adapt to human needs and fake empathy in the AI agent. What is the impact of this lack or faked empathy?

Proposed approach:
Conduct an ethnographic inspired multiple case study approach and action research methods to develop a narrative dialogue from multiple perspectives. We may (the authors of this section) use AI in our local context and reflect on educator perspectives as we onboard to the use of AI in our courses. We need to know and decide on what to observe and how to observe. We should consider involving our students as co-researchers (taking an action research methods approach.) Another potential method to explore is the Dialogue between researchers [see Shah & Yadav, 2023].

Concrete Next Steps

- Submit a position paper/ACM communications article discussing the benefits and risks of using AI in education and which are most timely and impactful in the short term – but from an EDI point of view and educator.
- Design and run a study exploring the impacts of AI on different aspects of education in each of our courses as described above.

References

[Shah & Yadav, 2023] Shah, N., Yadav, A. Racial Justice Amidst the Dangers of Computing Creep: A Dialogue. TechTrends 67, 467–474 (2023). https://doi.org/10.1007/s11528-023-00835-z

[Rodríguez-Pérez et al., 2021] Rodríguez-Pérez, Gema, Reza Nadri, and Meiyappan Nagappan. "Perceived diversity in software engineering: a systematic literature review." Empirical Software Engineering 26 (2021): 1-38.

[Burnett et al., 2016] Burnett, Margaret, et al. "GenderMag: A method for evaluating software's gender inclusiveness." Interacting with Computers 28.6 (2016): 760-787.

3. Knowledge Transfer and SDDI

Contributors: Rafael Prikladnicki, Grischa Liebel, Chris Brown, Sonja Hyrynsalmi, Jocelyn Simmonds, Stefan Stanciulescu, Yi Wang

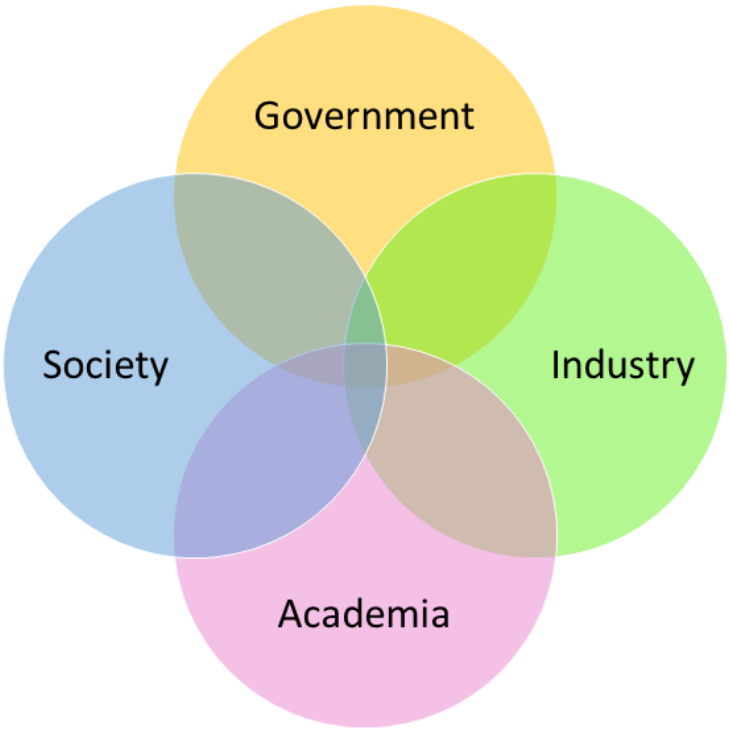
Description of the Problem:

Software Developer Diversity and Inclusion (SDDI) is vital for improving the quality and usability of software. SDDI efforts usually involve actions developed by representatives of the quadruple helix, but the work is currently very fragmented, siloed, and sometimes overlapped. There are no common forums to make knowledge transfer effective. Governments have their own agenda while academia has their own research problems and inaccessible publication processes. Industry, although recognizing the importance of the SDDI agenda, sometimes prioritize other initiatives. We believe that the agenda is needed and urgent to impact the society as the main driver.

The actors in the different quadruples seek to improve software developer diversity in different ways. Academic researchers in the Academia actors like SDDI community, publishing in venues like GE@ ICSE. In industry, there are trailblazer companies such as Google and Microsoft and tech companies seeking to diversify their workforce. In society, there are active communities such as Women in Tech (Global and locals) and local communities (such as Czechitas, Black in Tech, or Mimmit Koodaa) and several local initiatives that are not much visible. At the Government level there are national ministries, EU level actions and regulations, or other governmental actors, especially in employment, and different kinds of support mechanisms (depending on the welfare state system).

Different quadruple helix actors impact each other, but that is not always acknowledged or made visible. For example, the Government can provide funding to the academic SDDI project, support by recruiting underrepresented groups to land to the SE job markets, or provide support or possibilities for communities in the society. Another example is when industry brings real problems that can be connected to government initiatives and collaboration with academia.

Right now there is a lack of effort to allow different actors to work together, are visible for each other, and can create new possibilities together. Every actor has an important role in supporting SDDI goals and actions. With increased visibility with each other, we can gain a better understanding of what other actors are doing and their pain points, aiming to produce more efficient and impactful SDDI actions together.



Challenges:

- SDDI knowledge and initiatives are fragmented and each helix has different views and goals and actions, so the transfer is difficult.
- Some of the actions overlap.
- Some actions are not visible to the others.
- Our own work is not always visible within our community.

Goal: To work on SDDI knowledge transfer among the quadruple helix (industry, academia, government, and society)

Outcomes:

- Create a shared collectively owned online platform where the representatives of the quadruple helix can share their initiatives, find what is happening within the broader community and connect to each other (e.g. GitHub repository or wiki / wordpress)
- Find ways to meet regularly, both online and in person
- Intentionally bring people from different domains to get different perspectives
- Always have an interdisciplinary perspective as the main driver
- We need to work multi-directionally

Sources:

Carayannis, Elias G.; Barth, Thorsten D.; Campbell, David F. J. (2012-08-08). "The Quintuple Helix innovation model: global warming as a challenge and driver for innovation". *Journal of Innovation and Entrepreneurship*. **1** (1): 2. doi:10.1186/2192-5372-1-2. ISSN 2192-5372.

Gorschek, T., Garre, P., Larsson, S., & Wohlin, C. (2006). A model for technology transfer in practice. *IEEE Software*, *23*(6), 88-95. https://ieeexplore.ieee.org/document/4012630.

What's next?

- Videos
- Quarterly online meetings? Two per year, being one online?
- Post survey of the topics - create working groups on the most voted topics
- Take a look at the Linux Foundation initiative and find ways to collaborate more?
- Shared repository?
- Vision paper / manifesto with a research agenda?
- Communication platform?
- Shonan Seminar report
- Columns with twitter and linkedIn profile pages, create hashtag for our community
- 1. Opinion piece
- 2. Shared repository
- 3. Joint research

Keywords

Friends, Welcoming, Community, Energizing, Moisture, Peace, Inspired, Networking, Fun, Happiness, Refreshing, Collaborative, Insightful, Belonging, Rewarding, Enlightening, Inclusive

4. Connecting Large Scale Social Economic Understandings with Data in Software Engineering

Contributors: Yi Wang

Sociologists have already created multiple large scale surveys, for example:

- General Social Survey: https://gss.norc.org/
- World Value Survey: https://www.worldvaluessurvey.org/wvs.jsp
- Bureau of Labor Statistics: https://www.bls.gov/cps/lfcharacteristics.htm

All surveys have been administered for more than 40 years in multiple waves. Therefore, those surveys provide quite good understandings to the general social, economic, and cultural dynamics over the last several decades.

We have some social-economic data about software engineers, a special population, to some degree.

Although these data may be rough, e.g., the collection of them may be not as rigorous as the above ones, they still often have some insightful understanding to us. Some of them include GitHub's annual report, stackoverflow, openstack's survey, etc.

So, how about bring those two streams of data together, to explore if there are any new insights address some important issues, for example,

- Are we as progressive as the society or left-behind, or more progressive (particularly, relative to our soci0-technical status)?
- Could we have enough resistance to the social/cultural setbacks?
- Where are we in the whole spectrum of the people living in the country or the world?
- How do the different value systems shape the industry practices of DEI around the world?
- And many others.

And, make some contribution beyond our domain by publishing on general interdisciplinary venues, e.g., NC. SA. PNAS, PRS, etc.

Plan: Understanding those surveys (their structure,…)->figuring out a way for synthesizing.

5. Methodologies and Metrics

Contributors: Raula Gaikovina Kula, Bianca Trinkenreich, Chris Brown, Sonja Hyrynsalmi, Kelly Blincoe, Bodgan Vasilescu, Stefan Stanciulescu, Gema Rodriguez-Perez

Problem: No methodologies and metrics to effectively analyze diversity and inclusion in software engineering. Although there are high level discussions of Inclusiveness [2,3], an underlying theory of how they are all connected is missing.
Motivation: The goal of this chapter is to define metrics for Inclusion in online communities.
Method: We did a very simple search in multiple domains (i.e. software engineering, educational psychology, and management) to understand how these perspectives are related to each other.

We aim to put together a resource to understand how inclusion, belonging, toxicity, etc. are connected and can be merged together in a resource for future researchers to use. (paraphrased from Raula's explanation)

Case 1: A Sense of Belonging to a Virtual Community

Most recent work investigated and developed a theoretical model that seeks to understand the link between OSS developer motives and a Sense of Virtual Community (SVC) [1]. The study adapted an instrument from the psychology domain [8] to measure feelings of belonging to an OSS community. Data was collected through a survey answered by Linux Kernel contributors and quantitatively analyzed using structural equation modeling.

Case 2: Toxicity in GitHub

This work investigates the role of online toxicity and its negative impact on online communities negative impact on the people and that online communities that it effects has been well documented. The study takes a look at understanding the characteristics of open source toxicity to better inform future work on designing effective intervention and detection methods. Authors curated a sample of 100 toxic GitHub issue discussions to combine multiple search and sampling strategies, finding that f the most prevalent forms of toxicity are entitled, demanding, and arrogant comments.

Case 3: An Educational Psychology Perspective of Inclusion

Belonging has been shown to be a vital need for humans, specifically for improving student experiences. Educational psychologists have characterized belonging as four components: Competencies (skills and abilities needed for connection), Opportunities (the availability for belonging to occur), Motivations (need for acceptance and social interaction), and Perceptions (person's subjective feelings concerning their experiences) [5]. Future work in SE research involves investigating these components in software development contexts. For example, measuring opportunities for acceptance for developers among their SE team and organizations.

Case 4: Optimal Distinctiveness Theory - A Management Perspective

Employee inclusion in the work group was theorized as the fulfillment of dual needs for belongingness and uniqueness. Employee inclusion can be characterized as creating an environment where individuals feel both a sense of belonging and recognition for their distinct contributions within the work group. It involves fostering a balance between being part of a cohesive team and allowing individuals to express their unique identities and talents [7]. Future research can investigate how belongingness and uniqueness are associated and their importance for feelings of inclusion in SE teams.

Research Agenda

Although we understand that these cases are related to inclusion, we are yet to understand how these are all connected. Therefore, we look back to other domains and try to identify gaps, and theories that could crossover into software engineering. Hence we develop this agenda that can be used for future directions of research.

1. What are the gaps in our inclusion definitions and concepts that can be carried over into software engineering?
2. Although we have qualitative evidence of Inclusion, we are yet to find out quantitative and tools that can measure this phenomena?
3. How to create new theories and test other theories from other fields?
4. How can information from online communities be utilized to measure inclusiveness?
5. A key outcome is to prepare a vision paper that would contain this research agenda that researchers can use as motivation for future work in Inclusive metrics.

Related Work and Links

1. Bianca Belonging paper from ICSE (https://arxiv.org/pdf/2301.06437.pdf)
2. https://chaoss.community/kb/metric-inclusive-leadership/
3. https://chaoss.community/kb/metric-new-contributors/
4. https://www.rockymountainresearch.us/Homepage/How%20to%20Measure%20Inclusion%20in%20the%20Workplace.pdf
5. Belonging: a review of conceptual issues, an integrative framework, and directions for future research Kelly-Ann Allen, Margaret L. Kern, Christopher S. Rozek, Dennis M. McInerney & George M. Slavich
6. https://journals.sagepub.com/doi/pdf/10.1177/0149206310385943?casa_token=YmJucDJpARkAAA[…]XfHbvTYU8ghZLFM3NK3xk-xqy9gz0Ws8PoYciBBH9GokTFPzzv8BVdsRPQ
7. Shore, L. M., Randel, A. E., Chung, B. G., Dean, M. A., Holcombe Ehrhart, K., & Singh, G. (2011). Inclusion and diversity in work groups: A review and model for future research. *Journal of management*, *37*(4), 1262-1289.
8. Blanchard, A., Askay, D. A., & Frear, K. A. (2011). Sense of community in professional virtual communities. In *Virtual communities: Concepts, methodologies, tools and applications* (pp. 1805-1820). IGI Global.

6. Intersectionality and SES

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Intersectionality considers the simultaneous and mutually constitutive effects of the multiple social categories of identity, difference, and disadvantage [2], paying close attention to racism, sexism, and classism as they operate simultaneously. The concept of intersectionality describes the ways in which systems of inequality based on gender, race, ethnicity, sexual orientation, gender identity, disability, class, age, and other forms of discrimination "intersect" to create unique dynamics and effects. It is well known that different diversity aspects do not operate in isolation. In fact, Kimberlé Crenshaw introduced the concept of intersectionality, arguing that diversity aspects are not mutually exclusive but intersecting, implying that one should be acutely aware of different challenges experienced by people at the intersection of multiple diversity aspects. For example, the experiences of Black women differ from those of Black men and of non-Black women: for example, "a smaller percentage of Black women reported being introduced to CS by a family member or a friend (17% and 3%, respectively) than was the case for non-Black women (24% and 10%, respectively) and Black men (21% and 9%, respectively)."[1] Moreover, Black women do not necessarily know whether their negative experiences should be attributed to their gender or their race. Recently, similar observations have been made for older women, who are sometimes unsure of whether the negative experiences were because of their gender or their age. Sometimes their experiences should be contributed to the combination of gender and age as witnessed by the following quote from one of veteran women recently interviewed by Breukelen et al. "As I approached menopause, there was another shift of just this contempt, because you're not even a sexually available female. And there's 'No, I don't even have an interest in having sex with you and so why would I ever listen to you?' You're going to try and tell me I'm wrong and you're unattractive.' So it got worse.." [4] It should be stressed that while negative experiences have been mentioned more frequently, sometimes combination of gender and age open new opportunities to veteran women: "A company approached me. . . They were like 'our ideal candidate would be a Woman of Color [who has] also survived a stroke'."

Black women and veteran women are merely two of the possible intersections that one might consider when studying software developers' diversity and inclusion from the intersectional perspective. Further examples might include, e.g., older adults with vision impairments. Moreover, many individuals find themselves on the intersection of more than two diversity axes:

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[1] Ross et al. The Intersection of Being Black and Being a Woman: Examining the Effect of Social Computing Relationships on Computer Science Career Choice. ACM Transactions on Computing Education Volume 20 Issue 2 Article No.: 9 pp 1–15 https://doi.org/10.1145/3377426

[2] Cole, E. R. (2009). Intersectionality and research in psychology. *American psychologist*, *64*(3), 170.

[3] Haynes, C., Joseph, N. M., Patton, L. D., Stewart, S., & Allen, E. L. (2020). Toward an understanding of intersectionality methodology: A 30-year literature synthesis of Black women's experiences in higher education. *Review of Educational Research*, *90*(6), 751-787.

[4] Sterre van Breukelen, Ann Barcomb, Sebastian Baltes, Alexander Serebrenik "STILL AROUND": Experiences and Survival Strategies of Veteran Women Software Developers. 45th International Conference on Software Engineering, 2023, pp. 1152-1164

previous study of 25,324 U.S. STEM professionals by Erin Cech has shown that white able-bodied heterosexual men experience better treatment and rewards compared with members of all 31 other intersectional gender, race, sexual identity, and disability status categories. The more intersections an individual finds themselves on the less social inclusion they are likely to experience, lower professional respect, career opportunities, salaries and persistence intentions. However, this study did not consider software developers specifically, and it was limited to U.S.-based individuals.

Future Opportunities and Research Questions To Explore

- ***Methodology***
- ***How to select the diversity aspects for interaction? A two-stage approach***
    - *The first stage involves qualitative investigation to explore how the population of interest self-identifies in terms of diversity. This stage aims to gather in-depth insights and understanding of how individuals within the population define and perceive their own identities. Once the qualitative stage is complete and a comprehensive understanding of identity within the population is obtained, the second stage involves quantitative data collection. This stage aims to quantify the demographic aspects associated with the identities identified in the qualitative stage. Researchers can design surveys or questionnaires that include demographic variables relevant to the diversity aspects discussed during the qualitative investigation.*
    - *The quantitative data collection process can involve administering the survey to a larger sample from the population of interest. The collected data can then be analyzed using statistical methods to examine the relationships, patterns, and interactions between the demographic aspects and the self-identified identities.*
    - *By employing this two-stage approach, researchers can first gain a qualitative understanding of how individuals self-identify within the population, and then proceed to quantitatively explore the demographic aspects related to those identities. This comprehensive methodology allows for a more nuanced and holistic examination of diversity within the population of interest.*
- ***Gaining further knowledge***
    - What are the experiences of individuals on intersections of diversity axes not considered in the literature so far? In particular, given the U.S.-focus or the assumed universality in many of the SDDI studies, it is imperative to understand the impact of the national culture on the previous findings.
    - How can we quantitatively expand our investigations of intersectional perspectives to ensure a clear output for impact?
- ***Impacting the software development practice***
    - How to design interventions supporting individuals on the intersection of multiple diversity axes, and in particular, their self-perception, and self-efficacy? What are the new methodological techniques we should use to adapt to continue studying intersectionality in the new world of AI-powered software development?
    - How can we ensure we as researchers build AI-powered interventions that empower these combination experiences of marginalized developers?

Resources

- Upcoming Book on EDI in Software Engineering features chapters on: First Drafts - Google Drive
- Kimberlé Crenshaw's breakdown of Intersectionality : Intersectionality Part One: Intersectionality Defined | Office of Equity, Diversity, and Inclusion (nih.gov)
- Sasha Costanza-Chock's description of intersectionality as it relates to design justice, which builds on Crenshaw's work

Outcomes (In an ideal world)

- Community events that gather perspectives from developers who identify with multiple marginalized groups (e.g., Black in Tech conference in Atlanta) - both to get feedback from developers of the marginalized groups and to conduct studies during the event itself.
- Magazine. ACM Queue/CACM (something similar to IEEE Software) - popularizing article about our work? An opinion piece? A great way of getting our work in the hands of developers

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