



Diversity of SE Conferences

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ABSTRACT

Software Engineering Conferences have established themselves over the years as a pivotal venue for presenting research studies in the field of SE. The task assigned to Program Committee members is notably challenging, involving the analysis, review, and acceptance of submitted papers for inclusion in the conference. Recognizing the value brought by diverse perspectives, the formation of a diverse Program Committee is commonly recommended for each Software Engineering conference. This paper undertakes an analysis of the diversity among Program Committee members in three of the most prominent Software Engineering conferences: ASE, ESEC/FSE, and ICSE, spanning between years 2019 to 2023. The analysis of diversity includes factors such as gender, geography, seniority, continuity in participation, and affiliation with industry/academia. The data analysis reveals variations in representation across different communities, with some consistently showing lower levels of representation. However, it is noteworthy that in certain scenarios, measures implemented to enhance diversity demonstrate a positive impact.

CCS CONCEPTS

• **Social and professional topics** → **Men; Women; Geographic characteristics; Cultural characteristics.**

KEYWORDS

Software Engineering, Conferences, Empirical Research, Diversity

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1 INTRODUCTION

Publish or perish is a slogan for all researchers around the world, and today's context of rapid progresses in science puts even more pressure. As a consequence there exists a large population of researchers, academic staff and PhD students which submit papers for publication. On the other side, the success of publication venues,

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such as scientific journals and conferences, is determined by the quality of accepted contribution. In the field of Computer Science, conferences have established themselves as critical in the scientific community, at least for the following two reasons: faster reviewing and publication (given the dynamics of the Computer Science domain) and creating a community for discussion and constructive feedback. Thus, Program Committees are given, every year, an essential role in deciding the relevant scientific contribution in the specific domain of the conference.

The Program Committee(PC) of a conference is formed from leading experts in the domain, that have the openness to write useful, knowledgeable reviews in the given period of time. The PC must also satisfy the criteria related to diversity in terms of gender, geographic distribution, rank level ([3, 5, 8, 13]). A balance between experienced members (from previous years) and newcomers should also be considered. The diversity is desirable for different key reasons, such as:

- Broad comprehension of the field, which can be achieved from diverse background, experience and perspective. PC members coming from academic or industry, being on a senior or on a junior level, spread in terms of geographic location of their institution may contribute to this goal.
- Avoid bias and stereotypes, in which case a fair gender distribution should be taken into consideration.
- Increase audience and relevance, in other words try to target needs and interests of a diverse audience. A Program Committee diverse in terms of gender, seniority and geographic distribution could have a positive impact.
- Good practices - recommended by different associations and conference organizers ([1, 7]).

Our study aims to address the most important conferences in Software Engineering (according to https://www.openresearch.org/wiki/Category:Software_engineering, considering the average acceptance rate for the last 5 years), namely:

- ACM/IEEE International Conference on Software Engineering (ICSE), acceptance rate 16.9%;
- IEEE/ACM International Conference on Automated Software Engineering (ASE) acceptance rate 17.9%;
- ACM Joint European Software Engineering Conference and Symposium on the Foundations of Software Engineering (ESEC/FSE), acceptance rate 22.6%;

and to investigate the diversity of the PC in regards to gender, geographic distribution, seniority or rank (junior vs. senior), expertise (academic vs. industry), and time, namely from one edition to the next one, we analyzed the percentages of new PC members. All three conferences are ranked A* by CORE (https://www.openresearch.org/wiki/Category:Software_engineering).

//www.core.edu.au/conference-portal). We collected the data corresponding to PC chairs and members for the last 5 years for all these 3 conferences, annotated the data with gender, location, seniority, affiliation to academia/industry and analyse it. Our findings offer a clear synthesis of the current situation and can be used as guidelines for future conference organization.

The paper is organized as follows: Section 2 outlines the related work, Section 3 presents the method of investigation while the findings of this analysis are presented in Section 4. Section 5 contains the discussion derived from the obtained results while Section 6 expounds the potential threats to validity. Finally, the conclusions and future work directions are presented in Section 7.

2 RELATED WORK

Software Engineering conferences represent an important aspect of informing the SE community about the latest research findings. Increasing the diversity in SE conferences, might ensure a more complete overview on the domain. Since they are a significant part of presenting research papers, the improvement of SE conferences has been the subject of considerable discussion. In order to encourage the studies done on this subject, Vasilescu et al. [15], proposed a historical dataset containing information about the accepted papers, number of submissions and composition of the Programme Committees from 11 well-known SE conferences. The period for which data was recorded for each conference exceeds 10 years, with the earliest conference that was considered being FSE(ACM SIGSOFT Symposium on the Foundations of Software Engineering) from 1993 until 2013. Based on this dataset, in [16] Vasilescu et al. presented an analytical study on the health of SE conferences. The investigation was undertaken by examining 15 metrics referring to the stability of each conference, its introversion, its receptiveness to new authors, its prestige, and the alignment of Program Committee (PC) members with the authorship pool. The analysis of these metrics, conducted on the historical dataset outlined in [15], revealed that the conferences exhibit relative robustness, displaying a pronounced openness to new authors and a moderate incidence of papers co-authored by PC members.

Another study, [13] discussed different contradictory topics about methods to better handle minorities inclusion and hybrid SE conferences.

In [10], Narayanan et al. analyse the diversity of three SE conferences and two journals with respect to gender, ethnicity and geographical area of both authors and governance of the conference. Gender and ethnicity data was obtained using the NamSor tool, while the geographical areas data was obtained using the GeoPy library. The findings derived from this study indicate a notable disparity in the distribution of authors and governance concerning gender, ethnicity, and geographical origin. While ethnic diversity has exhibited a positive trajectory over the past decade, suggesting the efficacy of implemented measures to enhance such diversity, analogous upward trends have not been observed for gender or geographical representation. No statistically significant correlations were identified between the diversity of authorship and governance. Furthermore, no considerable biases were detected in the frequency of paper citations based on the ethnicity, gender, or geographical origin of the first author.

The current study shares similarities with the research presented in the aforementioned research works. Nevertheless, the study outlined in this paper reveals a few distinctions when contrasted with the earlier related work. Firstly, our examination includes an exploration of the roles (Senior or Junior) and the affiliation with the industry/academia of the Program Committee (PC) members, along with an analysis of time diversity. Secondly, the attribution of gender and geographical location to each PC member is manually performed to enhance accuracy, as opposed to relying on designated tools. This manual approach proves beneficial in cases where certain names could be interpreted as both male and female.

3 METHOD OF INVESTIGATION

The dataset used in this study is formed by Program Committees board and members from the top three most prestigious conferences in Software Engineering, namely ICSE, ASE and ESEC/FSE from the last 5 years. We have considered the period of 5 years as being relevant enough, since the average acceptance rate of the conferences is also computed based on the last 5 years. We restricted our dataset to the Research Track of these conferences, as it is known as being the most prestigious track, and also we observe significant variation in terms of number of tracks and structure of PCs for the rest of the tracks. The data was collected using a web scraper tool (as a browser extension¹ and then annotating the data manually with the following information based on individual profiles from conference webpages:

- gender: based on the picture or public acknowledge of the person on their websites; the divide into *female/male* was straightforward, however in case of *non-binary* persons, we had only a couple of publicly declared cases;
- based on the country affiliation we completed the information regarding the *continent*. One remark should be made here: we considered Israel as part of Asia, even if Israeli institutions are sometimes accepted as European in some professional organizations;
- we tagged each entry rank with *senior* or *junior*. Taking into account the diverse professional systems across the globe, we decided that full professors or senior researchers should belong to the category senior, and all the rest will be tagged with junior, even if in some countries associate professors are considered tenure positions;
- we tagged each entry expertise with *academic* or *industry*. In some cases of double affiliation, we prioritise industry over academic, considering that the majority of PC members comes from universities or research institutions.

The dataset previously described is available at [9], being able to be used for replication studies and comparative analyses.

Based on this data, various graphics were generated to provide a more comprehensive representation of several factors related to gender, geographical distribution, roles, and affiliation within the three examined conferences. Utilizing the pandas² library in Python, data from the Excel files (xlsx) was imported and processed to extract information, including but not limited to: the gender distribution across all conferences and within each individual conference, the

¹<https://chromewebstore.google.com/detail/ofaokhiedipichpaobibbnaahkdoiiah>

²<https://pandas.pydata.org/>

ratio of chairs and committee members from academic backgrounds compared to those from the industry, gender distribution across geographical areas, role distribution based on gender, and other statistical measures intended to offer a meaningful perspective on diversity within the three software engineering conferences under study. We chose various graphical representations, including bar graphs, line graphs, and pie charts, to enhance the presentation of the diversity landscape within the analyzed conferences.

4 FINDINGS

We opted for a simple longitudinal quantitative investigation, since our study involves repeated observations of the same attributes of the conferences over a period of time of 5 years. We considered the period to be relevant since it includes pre-pandemic, pandemic and post-pandemic conference editions. Analyzing the data from a quantitative perspective served our objectives and provided insights from the different diversity views under investigation.

4.1 Gender Diversity

As the field of software engineering continues to progress, a natural trajectory involves fostering greater accessibility for a broader demographic. This holds significance, particularly considering the historical context wherein gender distribution within the domain has exhibited marked disparities. Within the realm of software engineering conferences, adherence to this historical pattern has been noticeable.

A more equitable gender distribution in the domain of software engineering could yield numerous advantages. Extensive studies on this subject [17], [11] have been conducted, with their outcomes suggesting that a more gender-diverse community could introduce varied perspectives, enhance the global relevance of conferences, and contribute to creativity and problem-solving capabilities.

In the examination of the three conferences under consideration, a noticeable gender disparity becomes evident as presented in Figure 1. Specifically, within ASE from 2019 to 2023, a substantial majority, constituting 75.3% of chairs and committee members, is identified as male, whereas 24.3% are female, and 0.4% identify as non-binary. The discernible discrepancy in these percentages suggests a potential limitation of the conference, diminishing the diversity of perspectives—an essential aspect in the context of conference paper evaluations.

In the case of ESEC/FSE, the gender differential is less pronounced, with male representation at 65.2%, female representation at 33.6%, and non-binary representation at 1.2%. Notably, the variance between male and female proportions is smaller compared to ASE.

Concerning ICSE, the gender distinction is even more modest, with male representation at 61.7%, female representation at 37.6%, and non-binary representation at 0.7%. This indicates a progressively smaller gender gap, reflecting a more balanced distribution across male and female participants within the conference.

As depicted in Figure 1, a positive trend is discernible across all three conferences under consideration. The percentages corresponding to each gender exhibit a converging pattern, indicating that initiatives implemented to enhance gender diversity among conference members are yielding positive outcomes. However, the

trajectory of evolution over the years for the ASE conference does not uniformly display an ascending trend, in contrast to the other two conferences. For instance, in 2021, the count of female members was lower than that in 2020 or 2019, despite an overall increase in the total number of members across all genders. This pattern, however, was not observed in 2022 and 2023, wherein the number of female members experienced growth. As a summary, a discernible ascending trend is observable for female members.

The gender diversity analysis presented earlier did not incorporate the non-binary category due to insufficient available data. While it is conceivable that some PC members identify as non-binary, the absence of documentation on this aspect in the primary channels for extracting gender information limits inclusion in the analysis. Consequently, the comparisons conducted above exclusively considered the female and male categories.

4.2 Geographic Diversity

Several studies have demonstrated the impact of individuals' geographical regions on their mentality and cognitive processes [12]. Consequently, having a greater diversity among committee members in a software engineering conference, particularly in terms of geographical representation, has the potential to introduce novel perspectives and varied approaches to problem-solving. Such diversity may contribute to an enriched review process inherent in every software engineering conference, offering insights from different geographic contexts and emphasizing diverse aspects of consideration. However, any analysis in regards to geographic distribution must be adjusted taken into consideration the software development industry and the educational and research capabilities of the region. In this light, on one hand, it is understandable why Africa is almost missing, while, on the other hand, we cannot ignore the high representation in India and China ([4, 6]).

In the examination of the three scrutinized conferences, an observable disparity emerges in the representation of various geographical areas. North America and Europe notably dominate the distribution of chairs and committee members, establishing a pronounced imbalance. Conversely, Australia, and South America exhibit comparatively lower representation across all three analyzed software engineering conferences. Asia, while positioned between the extremes, demonstrates a more substantial representation than Australia, and South America but falls short of the representation levels observed in Europe or North America. This pattern persists consistently across all three conferences, as illustrated in Figure 2.

Regarding the trends observed across these geographical areas, no consistent pattern is evident across all three examined conferences. Figure 3 illustrates that the singular region displaying a consistent upward trend over the five-year period in all three conferences is North America. In contrast, the remaining regions exhibit varied trajectories. For instance, Europe demonstrates an ascending direction over the years for ASE, but experiences a decrease in 2020 compared to 2019 in ESEC. Subsequently, it increases in 2021, decreases again in 2022, and shows a marginal increase once more in 2023. The irregular nature of these fluctuations does not allow for definitive conclusions. In contrast, South America exhibit relatively stable patterns over the years, demonstrating neither significant increases nor decreases.

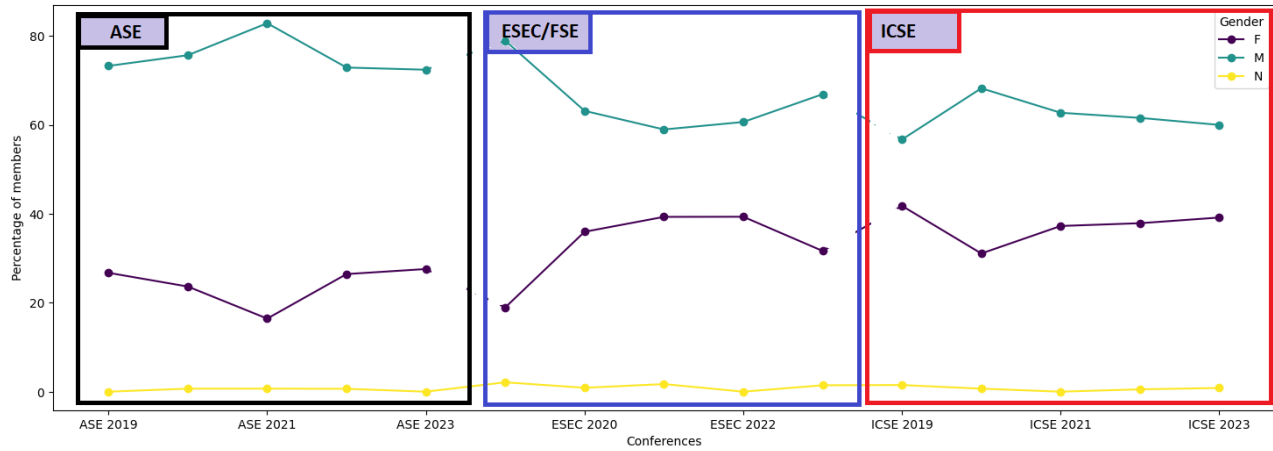


Figure 1: Gender Distribution of PCs over 2019-2023

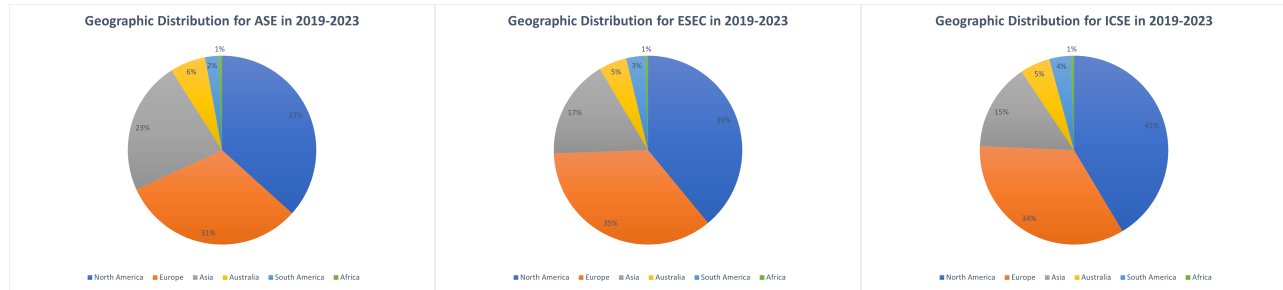


Figure 2: Geographic Distribution of PCs over 2019-2023

One notable observation from Figure 3 is the substantial increase in the number of PC members from Asia in 2023 across all three conferences, in contrast to the figures from the preceding four years. Yet, in scrutinizing the acquired data, the conference's location was not factored in, as it could indeed impact geographic diversity.

Gender Diversity on Different Geographical Areas. Analyzing gender distribution in various geographical areas is valuable for examination as it contributes to a more comprehensive understanding of the extent to which gender diversity is dispersed across different regions. As shown in Figure 4, the distribution of gender across geographical regions is uneven. Across all conferences and regions, the prevalence of male chairs and committee members in the discussed conferences significantly outweighs that of female or non-binary counterparts. It is noteworthy to mention the ratio between male and female PC members. Across all three conferences, the difference in proportions between male and female members was less pronounced in Europe and North America, indicating an improvement in gender diversity within these two geographical areas. In ESEC/FSE and ICSE, Asia similarly demonstrated this behavior too. However, in the case of ASE, this difference between male and female PCs was more substantial. Australia and South America exhibit a smaller participant pool, making conclusions about their gender diversity less certain.

4.3 Seniority Diversity

The main task of the Program Committee is to review the submitted papers and decide which should be accepted to be presented at the conference. Thus, PC members must have a scientific expertise in the field of the conference, which will recommend senior professionals, having a considerable experience in such processes. On the other hand, PC members should also be willing to write useful and explainable reviews in time, which will recommend juniors, with more available time and eager to accumulate experience. A trade off between senior and junior members should be found, as some recommendations suggests [8]. Considering the explanation of tagging the rank from Section 3, our analysis summarized in Figure 5 revealed the following:

The most consistent in terms of number of senior PC members exceeding the number of junior PC members is ASE, with a higher number of senior members in 2023 (135 seniors compared to 68 juniors). ESEC/FSE exposes oscillating situations of senior/junior ratios, as both extreme cases are reached for this conference: in 2019 the highest percentage of seniors is achieved (68.42%), respectively in 2023 (68.42%) the lowest percentage of seniors is observed (28%). ICSE assures, in general at least 60% of the PC as seniors, with the exception of 2021 and 2022 when equal number of junior and senior PC members existed.

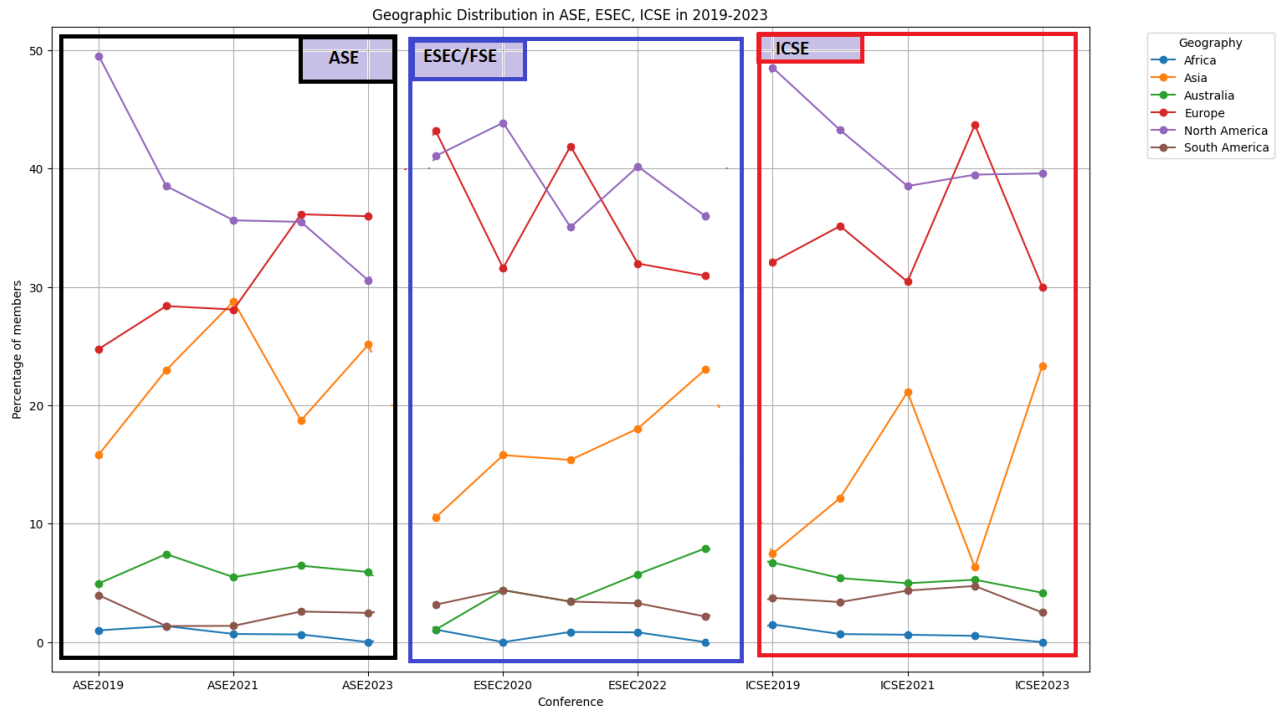


Figure 3: Geographic Distribution Trend of PCs over 2019-2023

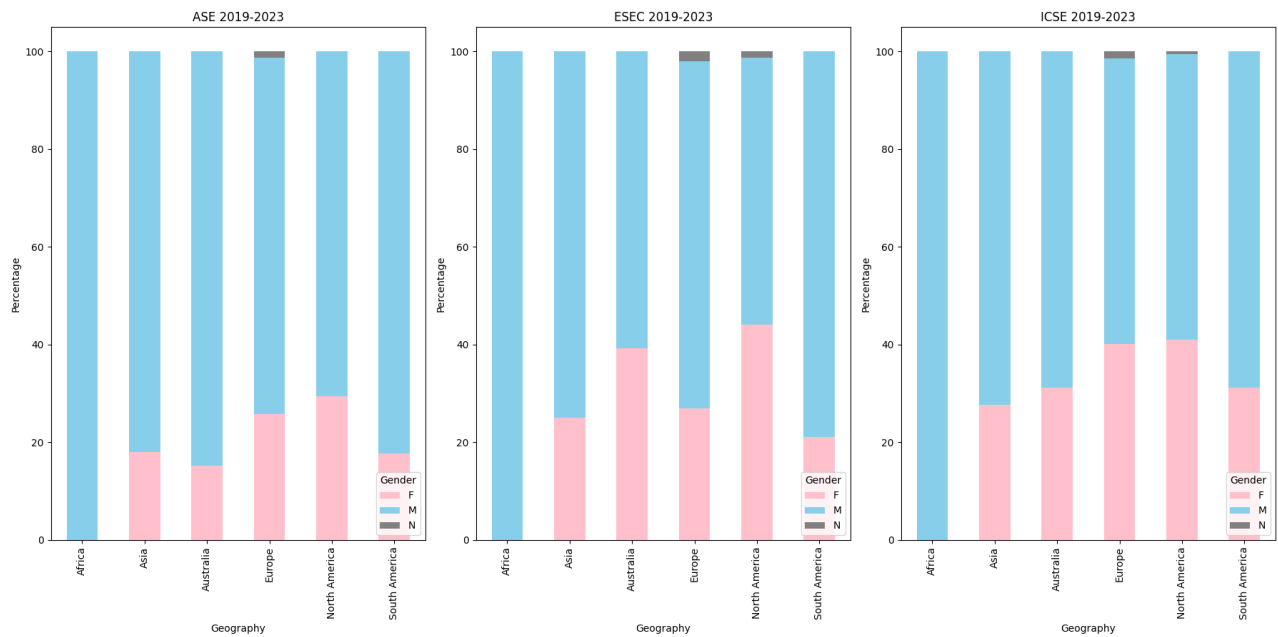


Figure 4: Gender Distribution of PCs on Geographical Areas over 2019-2023

It is not our intention to provide optimal values for senior/junior representation in Program Committees. We only provide an assessment for the last five years for the three conferences, as an indicator to be considered for future PC structure, and also as a

characteristic to be addressed in the process of review assignment. The previous studies that addressed different aspects related to Program Committees ([10, 16]) did not address this aspect.

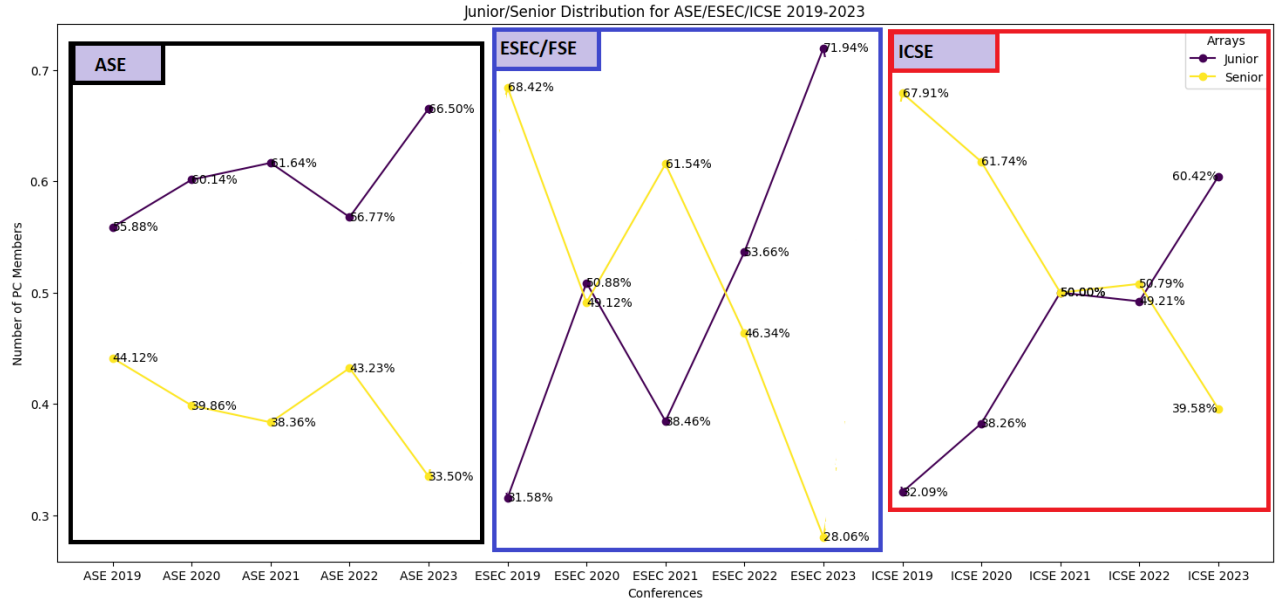


Figure 5: Seniority distribution in ICSE, ESEC/FSE and ASE for 2019-2023 period

Table 1: PC turnover for 2020-2023

	2020	2021	2022	2023
ICSE	63.09%	73.46%	69.75%	65.42%
ESEC/FSE	69.3%	64.96%	68.38%	55.17%
ASE	68.24%	34.25%	63.7%	55.17%

and 2013 the trends look very similar, and their conclusion was "Wide-scoped conferences ICSE, FSE and FASE, and narrow-scoped GPCE have consistently higher PC turnover than the other conferences. ASE (wide-scoped) appears to be an outlier with respect to the other wide-scoped conferences." This has been completely confirmed by our analysis for the period between 2019 to 2023.

4.4 Time Diversity

All three conferences under consideration are sponsored by ACM and as a consequence comply to the ACM SIGSOFT policy [2], namely to include at least 1/3 new members into the Program Committees. Table 1 shows the turnover for ICSE, ESEC/FSE and ASE for the period 2020 to 2023, namely which is the percentage of new PC members in the year Y compared to year $Y - 1$.

In case of ICSE and ESEC/FSE, we can notice that the recommended threshold is significantly exceeded, bringing new members to the Program Committees at a consistent pace. In case of ASE, the turnover is fluctuating, and in one case, year 2021, being very close to the advised margin. However, in all cases at least 25% of the members have previously served in the PC, assuring a continuation and stability in terms of tasks and expertise.

In [16], a detailed analysis to stability of Software Engineering conferences included also an investigation of the PC turnover, using a metrics for ratio of new PC members for conferences with regards to several years. One of their findings refer to the fact that the turnover shows similar behavior for one year compared to several years, thus we consider that our approach (comparison with previous year) is relevant for this purpose. Their analysis found a huge variation for PC turnover, ranging from 8.8% to 93%, but for two conferences out of our scope. For the three conferences under investigation, ASE, ESEC/FSE and ICSE, for the period between 1994

4.5 Academic vs. Industry Diversity

Even if a dedicated track for industry exists in the conferences under discussion, given the applicability of scientific results (in forms of contributions submitted to the research/main track) in Software Engineering, the practitioners' opinions are important and should be considered in the acceptance of papers. While a majority of industry-affiliated Program Committee (PC) members typically consist of researchers affiliated with research divisions of large companies, and therefore serve as proxies for practitioners rather than practitioners themselves, they maintain a closer proximity to practitioners compared to researchers from the academic realm. Consequently, their perspectives and opinions may offer valuable insights from the practitioners' standpoint. In order to assure a representativeness of the practitioners community, a diverse Program Committee should ensure representatives with industrial affiliation.

Some conferences recommend a minimal representation of industry, such as 10% in case of FASE (International Conference on Fundamental Approaches to Software Engineering), as stated in [16]. The situation revealed by our analysis is shown in Figure 6.

For the 5 years under consideration, the average percentage between academics and industry are: 9.97% for ASE, 9.88% for ESEC/FSE, respectively 9.2% for ICSE. While all conferences tend to be close to the suggested threshold of 10%, none of them manages to exceed this threshold.

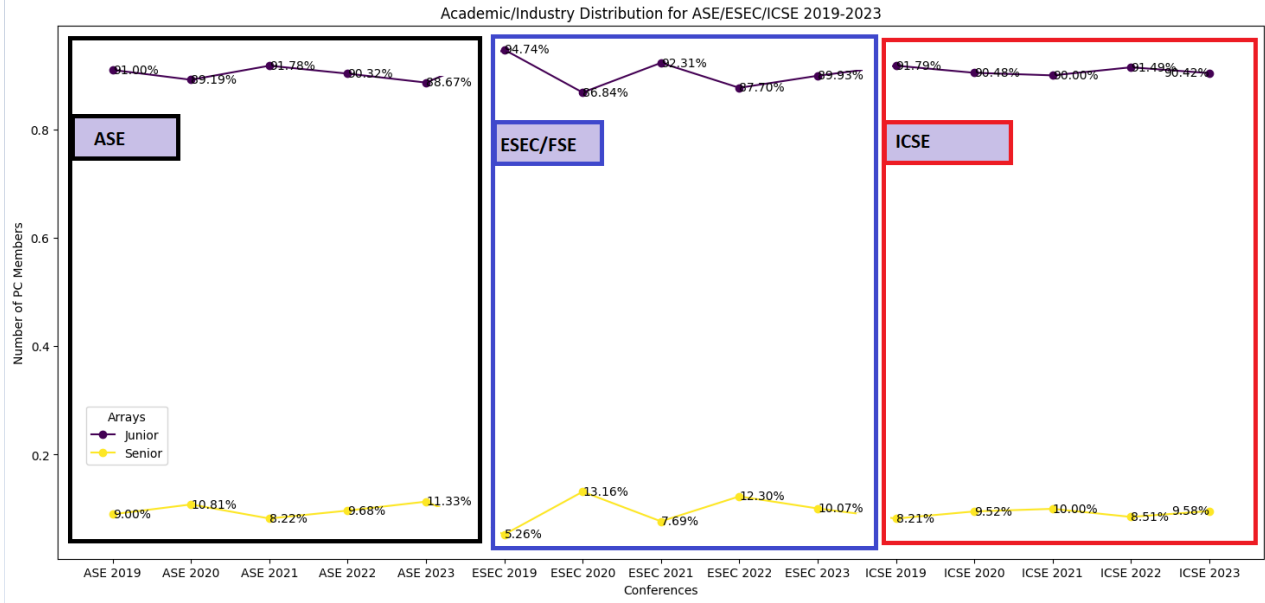


Figure 6: Academics vs Industry representation in PCs

5 DISCUSSION

In this section we propose to interpret our findings for each conference to highlight how they implement diversity. Our discussion has no intention to criticise or to propose thresholds, rather to underline good practices and to endorse all aspects of diversity.

ASE seems to be narrower than the other two conferences, since its focus consists of automated Software Engineering. This might have an impact on the diversity of PC as its pool of experts is limited. It is the most balanced in terms of geographic distribution and constant in relation to rank of the PC members. It can improve in terms of gender diversity, as only approximately one quarter of PC members are females. Both from the perspective of diversity in time and attracting industry representatives is very close to the recommended margins and can aim for a more diverse representation.

ESEC/FSE is also one of the premier conferences in Software Engineering, where the joint between the European conference and the one for Foundation of SE allowed a broader and more diverse range of contributions and perspectives. Similar to ICSE in terms of gender, geographic and time diversity, ESEC/FSE could become more constant in terms of senior/junior composition of the Program Committee and also attract interest from industry. The geographic diversity is fluctuating, which seems to be dependant on the conference location.

ICSE is a highly prestigious conference, in terms of acceptance rate, number of accepted papers, number of participants and also co-located events. As a consequence, members of the Program Committee can be selected from a larger pool of candidates. ICSE has a relatively small gap in gender representation (considering female/male ratio). Considering geographical distribution most PC

members are affiliated to North America, then Europe, with a significant increase in 2023 for Asia (topmost affiliation). In terms of representativeness, senior/junior distribution is fluctuating, turnover is the highest (explainable by the reputation of the conference), while industry representation is close to the recommended value. Given the success of the conference, this might be a point of improvement.

Overall, our longitudinal inspection revealed differences in diversity considering the different editions under consideration, and also between conferences. The positive remarks refers to the fact that all top ranking conferences in SE obey to minimal recommended values for different perspective of diversity, while conserving high standards of expertise for Program Committees. It is our strong belief that improvements are still needed for a better representation of women at the level of PC members, PC chairs, and also in regards to geographic distribution: the dominant position of North America and western Europe is no longer justified.

Based on the investigated diversity facets, some **actionable recommendations** include: 1) *Diverse Outreach and Recruitment* - actively search and attract potential PC members from underrepresented gender and geographical groups; 2) *Conference Commitment to Diversity* to be clearly stated in call for PC members; 3) *Encourage nominations*: allow community members to nominate PC members, enabling a wider selection pool.

Our standpoint suggests the following **guidelines future conferences organization**: 1) *Diversity Statement*: clearly state all diversity aspects that the PC should have in call for PC members A diversity liaison representative would be a strong expression towards this goal; 2) *Transparency and accountability*: offer transparent information about PC selection process and establish accountability measures related to diversity. Thus, the diversity statement will not remain declarative, but be seen as an real action; 3) *Application Process*: design a nomination procedure that allows to recommend

and self-nominate members and use communication channels to assure global outreach to SE community.

The current study bring consistent benefits to both researchers and practitioners. For researchers the availability of the dataset and the mapping of diversity aspects can offer further research potential, while the guidelines for PC organization can support and stimulate the SE community. The practioners can benefit from the diversity mapping of SE research interests, but we hope can be also motivated to be more supportive of the research community.

6 THREATS TO VALIDITY

We address three types of threats in our approach:

Internal validity can be primarily affected by the data collection process. Data incompleteness from the individual profiles from conferences webpages have been addressed by manually searching for information on personal webpages, in most cases to complete the gender and seniority level. We consider that manual annotation eliminates ambiguities with similar male/female names, especially for Asian names. Threats from this category might come from incomplete information (especially in case of non-binary gender) or outdated information provided by PC members.

External validity refers to the generalization of our results and in this regard we have targeted two aspects. Firstly, we formulated our findings in terms of observations and in comparison with similar studies and we did not infer general patterns. Secondly, we discussed only three conferences (which might represent a threat regarding the size of our dataset), and considering their ranking, they might not be a complete view of SE conferences. This situation could be mitigated by including more conferences in the dataset.

In terms of *construct validity*, based on studying different recommendations, such as [3, 5, 7, 8, 13] and analysing similar contributions ([10, 14, 16]), we are confident that we have tried to cover multiple facets of diversity.

7 CONCLUSIONS AND FUTURE WORK

The significance of establishing a high-performing Program Committee is well-known when considering software engineering conferences. The composition of PCs holds a high importance, given the challenging responsibility of reviewing and accepting submitted papers for conference inclusion. Diverse perspectives within such committees have the potential to add substantial value. This paper seeks to conduct a diversity analysis of the program committee members for three of the most important software engineering conferences: ASE, ESEC/FSE, and ICSE, over a five-year span, from 2019 to 2023.

Various dimensions of diversity are explored, including gender, geography, seniority, continuity in participation, and affiliation with industry/academia. The findings reveal instances of underrepresentation in several communities, such as females and non-binary individuals in the context of gender diversity, and participants from Australia, Africa, South America, and Asia in terms of geographical diversity. Disparities are also observed between individuals affiliated with the industry and those associated with academia. While positive trends indicating an increased diversity in Program Committees are observed in certain cases, the overall results underscore the need for ongoing efforts to promote diversity.

A potential enhancement for this study could involve incorporating metrics to quantitatively measure diversity levels based on the available data, akin to the approach outlined in [10], thus a replication study might identify progress in a timeframe of a decade. Furthermore, expanding the dataset to cover an extended timeframe would be beneficial. However, this expansion is constrained by the challenges associated with the proper storage and retrieval of older data, thereby complicating the data gathering process. Another potential direction of investigation could be to compare the diversity between Program Committees and the authors who have accepted papers at these conferences.

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