Software Testing Conferences and Women

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***Abstract*—The question of gender equality is an increasing concern in all aspects of life these days. ICT has its peculiarities in this respect, as it is often regarded as a “male” discipline. Among the many different subfields of ICT, in this work we concentrate on *software testing*, an area in which a significant portion of all ICT professionals is engaged. Testing is an interesting field because according to certain views more women work in this area compared to other ICT fields. Since testing itself still covers a large topic involving education, research and industry, we further limit our analysis to *software testing conferences* and the rate of women participation in important roles at these venues. We looked at keynote speakers and chairs in different roles and program committees, but not the participants themselves as reliable data was available only for the former. We investigated if gender distribution was similar to or different from the reported data for ICT as a whole. We also compared the different types of conferences, academic and industrial, from this aspect. We have found, among other things, that gender ratio at software testing conferences is similar to other fields, but in more important roles such as keynotes, equality is more significantly maintained.**

I. Introduction

The use of ICT end-user products is part our everyday life regardless of age, cultural position, and gender. However, when it comes to professional engagement in this field, we can observe a significant gap between men and women. One of the reasons for this could be the social construction perspective of ICT, which handles this area as male-dominated. Often, the individual differences between men and women are mentioned as a further root cause for this phenomenon [1]. Objective statistics support this observation, which are frequently collected and published by various organizations, such as NSF in the USA [2] or Eurostat in Europe [3]. These trends can be analyzed in other ways as well, such as looking at the number of women in leading positions in these fields (which is also very low), and the judgement of women in various areas of software engineering and computer science [4], [5].

Many national and international organizations have been formed in order to improve these differences both in quantitative and qualitative manner, and to draw the potential female employees' attention to the possibilities of the ICT sector. These include, without completeness, [6], [7], [8], [9], [10], [11], [12], [13], [14], [15]. Other organizations, such as [16], [17], [18], [19] are working for uniting and supporting female employees by focusing on a smaller topic area.

The gender (in)equality issue affects various areas of ICT differently. According to a general view, the participation of women in the field of software testing is typically higher than generally in ICT. We are not aware of a systematic analysis of this phenomemon, but a large number of informal articles, blogs and discussions state that women's ratio in software testing may be even higher than men's, which is to be compared to the very low ratio of 1-5% of female developers in open source projects [20], for instance.

In this paper, we aim at verifying if this rate can be observed from the composition of software testing conferences. We will concentrate on the structure of conference organization in most important roles, namely the organization chairs, the invited keynote speakers, and the program committees. For this purpose, we systematically analyzed a large set of software testing conferences, which represent both the academic and industrial world. In particular, we looked at 40 academic and 32 industrial events from the year 2016. The collection of the conferences is based on our prior work in the topic of academia-industry collaboration [21]. We collected the data based on publicly available information from the conference websites. Consequently, we were unable to extend the study to the participants themselves of these conferences as this information is usually not available.

The main research questions of our work can be summarized as:

RQ1 Based on the composition of software testing conferences, is the gender gap in software testing similar to what is reported in the ICT industry in general?

RQ2 How motivated are female affiliates with these conferences to take part in the other type of conference, namely to go from academic to industrial and vice versa?

RQ3 Is there any difference in the judgement of women depending on their roles and positions in these conferences?

RQ4 Can we differentiate in gender ratios based on the roles investigated, namely chairs, keynotes and committee members?

II. Related work

It is difficult to estimate the extent of the gender gap in the fields of Science, Technology, Engineering, and Mathematics (STEM) in general, and so in Information and Communications Technology (ICT) in particular. Different statistics highlight the trends in this respect, such as [22], [23]. According to the National Science Foundation (NSF) [2] and the Bureau of Labor Statistics data [24], the total ratio of female employees was 46.8% in the USA, while it was only 25.5% in the fields of "Computer and mathematical occupations."[1] The *computer system analyst* (35.7%), *web developer* (33.6%) and *database administrator* (46.2%) were outstanding areas, while the rate of women in the area of *computer network architects* was only about 9.7%. (There were no data reported in relation to software testing or quality assurance.) Similar tendencies can be observed in statistics from other regions in the world [25], [26], [3].

Differences appear not only in the raw numbers. Tartari *et al.* [27] examined the differences between male and female academics in their openness to academic engagement with industry and found that women engage less and in different ways than their male colleagues. Brooks *et al.* [28] examined how gender relates to research evaluation and found that there are differences in the quality of journals in which men and women publish. The observation of Terrel *et al.* [5] shows that the contributions of female reserachers tend to be accepted more often than that of men's.

It is hard to estimate the gender gap in the field of software testing, since no reliable statistics are available. We only found a number of informal analyses or opinions about the question such as blogs, discussions and various online articles. A majority of these state that the rate of women is higher in this field compared to ICT in general, moreover, some believe that female are dominant in software testing (or, at least in certain roles thereof) e.g. [29], [30], [31].

III. Evaluation data

We collected the data for our research goals in this paper by analyzing the composition of a significant number of software testing conferences from the year 2016. The conferences under consideration were classified into two main categories following our earlier work in a related topic [21]: academic and industrial. Academic conferences include the scientific events, which are usually organized by a university or other research institute, and are often supported by organizations like ACM or IEEE. On the other hand, industrial conferences are more practitioner oriented, and are typically sponsored by companies or other for-profit or non-profit organizations. General conferences (which perhaps include testing topics as well) were not included. The examined academic conferences were the *aistq, amost, asqt, ast, atest, atva, cav, cstva, fmics-av, icst, ictss, insta, intuitest, isola, issre, issta, iwct, lt, met, modevva, mutation, nfm, prepost, qrs, quatic, ret, rv, sac-svt, sast, sbst, spin, stam, tacas, taicpart, tap, v2cps, valid, volt, vst, woda*, while the industrial ones were *atd-agile, atd-australia, btd, cast, cc, cstqb, dstb, dstc, dtd, etc, eurostar, gtac, gtd, hustef, iqnite, lets, ntd, pnsqc, psqt, qa, qatest, qs, quest, rtc, seetest, sigist, stc, stf, stpcon, swqd, tad, testbash*, which we believe cover both fields sufficiently. Websites and other details about these can be found on our website.[2]

We base all our analyses on public information from the conference websites. In particular, we collected the names and affiliations of invited keynote speakers, conference organization chairs and program committee members. Then, we determined the gender of these persons. In some cases the required information was not available on the conference website, so we searched for the person's professional profile information on the web. This typically included personal web pages, LinkedIn or google scholar profiles.

In addition to the name and gender, we collected the affiliations of the persons. Identifying the workplaces was important to be able to classify the type of a person's employment. We used these categories for this purpose:

- university or college (shortly *academia* in the following);
- research laboratory (*research laboratory* in the following);
- nonprofit organization, testing board, government or standardization office (*nonprofit* for short);
- a company which offers some solution or product to other companies *Business-to-Business (B2B providers)* in the following);
- a company whose products are used by end-users (shortly *Business-to-Consumer (B2C providers)* in the following).

For some of the analyses that follow, we simplified this classification to only two categories: *academia* and *industry*. In particular, the first two types will commonly be treated as academia, while the rest as industry. If a person had more than one affiliation in 2016, we recorded all of them separately. Persons with academic and industrial affiliations at the same time were marked as *Mixed*.

IV. Results

In this section, we present our findings related to the research questions set forth at the beginning of the article.

TABLE I
Summarized information about the collected data

Type	Number of organizers	academic members	industry members	mixed
Academic (40)	1143 (199)	923 (165)	200 (29)	13 (4)
Industrial (32)	290 (64)	61 (14)	205 (41)	1 (0)
Total (72)	1413 (258)	968 (174)	402 (70)	13 (4)

Table I contains a quantitative summary of the data we obtained by analyzing the testing conferences and their organizers in the mentioned roles. As can be seen, we examined 40 academic and 32 industrial conferences, which involved 1413 organizers altogether. The numbers in parentheses for each statistic represent the number of female members in the corresponding category. We distinguish between academic and industrial members as discussed above. One may observe that the sum of organizers with academic, industrial and mixed affiliations is less than the total number of persons involved. This is due to the fact that in some cases we were unable to unambiguously determine the affiliation of a person. On the other hand, the reason for the lower number of total organizers in the last row compared to the corresponding sums

[1] Data from February 8, 2017.
[2] http://www.inf.u-szeged.hu/∼jasy/research/WomenInTesting/conferences.html

of the different conference types is that several organizers were attending both types of conferences. The overall rate of female organizers was 18%, which is a bit different in the case of academic (17%) and industrial conferences (22%).

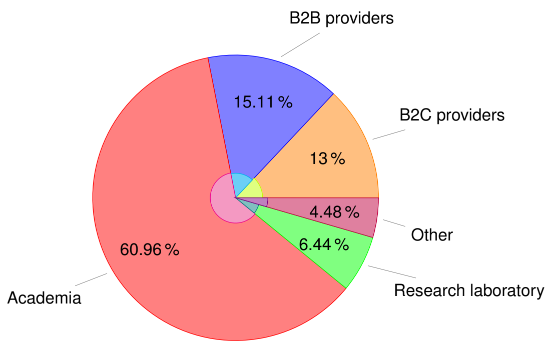

Fig. 1. Gender ratio and affiliations: *both conference types*

Figure 1 summarizes the gender ratio of the employees broken down according to the different affiliation categories. This set of data is presented for both types of conferences cumulatively. The *Other* category includes organizers who work at some unidentified organization or who have multiple affiliations. Each slice in this pie-chart is divided to two parts according to the gender distribution. In particular, the inner parts represent the ratio of females in the given category. For easier comparision, Table II presents these ratios numerically in the last row. As can be seen, this ratio seems to be independent from the category and is about 17%-19% in each case, which is aligned with the overal ratio from Table I.

This leads us to answer our **RQ1** as this: the gender gap in the case of the software testing conference organizers is similar to what was reported for other areas in ICT, in fact it is even slightly worse. However, industrial conferences attract a bit more female organizers than academic ones.

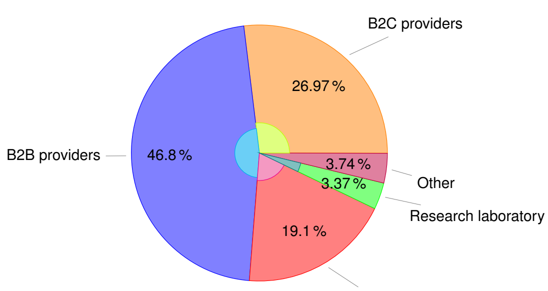

Fig. 2. Gender ratio and affiliations: *industrial conferences*

TABLE II
RATIO OF WOMEN ORGANIZERS AT THE CONFERENCES

Conference type	B2C provider	B2B provider	Academia	Research laboratory	Other
Industrial	23.6%	19.2%	21.5%	33.3%	0%
Academic	15.6%	14 %	17.1%	16.6%	24.5%
Both	18.9%	17.2%	17.3%	16.9%	21%

Figures 2 and 3 and the first two rows of Table II show similar data, but in this case separated for industrial and

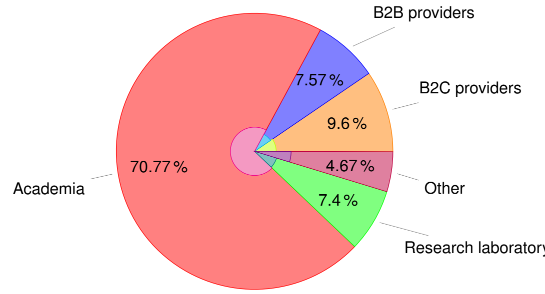

Fig. 3. Gender ratio and affiliations: *academic conferences*

academic conferences, respectively. As expected, in each case the corresponding affiliation category was prevalent: industrial conferences are represented by people from industry to a large extent and academic ones by academics. Regarding gender ratios, these results are slightly different than for the cumulative case as we can observe more variations. As we have seen above, the overall rate of female organizers in industrial conferences is slightly higher than in academic ones. A particularly notable case is people from research labs who attend industrial conferences. In this case, the gender ratio was 33%. This is quite in contrast to what we found out about industrial organizers at academic conferences. Namely, in this case only 14-15% of the organizers were women. Responding to **RQ2**, it seems that female testers working in industry are less motivated to take part in academic conferences than vice versa.

Our next investigation deals with the activity of organizers in testing conferences. We model the "importance" of a specific person in a community by the number of conferences he or she attended in the investigated period. We are dealing with the conference organizer, keynote speaker and program committee member roles – to which people get invited – so we think that people who get more invitations must be more prominent members of the communities. To compare the two genders from this aspect, we can investigate the histogram of participation frequencies. This can be seen in Figure 4, in which the blue bars represent men, while the red ones women. It shows how many cases there were (bar heights) when a person attended 1...8 different conferences in the investigated period.

As can be seen, the overall ratio near 20% is reflected in a general case when only 1-3 conferences were attended by a person. At the other end of the spectrum, there was only one prominent person from both genders who took part in as many as 8 conferences in 2016. Data for the other cases in between show an interesting trend. Namely, as the number of attended conferences grow (the "importance" of a person), the gender ratio gets more equated. As an answer to **RQ3**, we might state that women seem to be more represented in leading positions than in a general case.

Finally, we may compare the gender ratios based on the roles investigated, namely chairs, keynotes and committe members. Taking both conference types into consideration

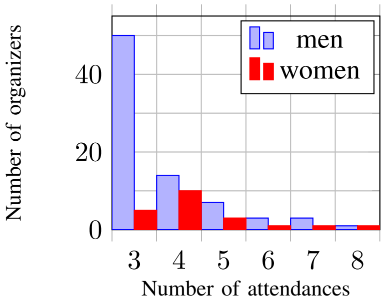

Fig. 4. Participation frequency and gender

together, we observed the following data:

- In keynote roles 38 organizers out of 182 were women, which accounts for 20%,
- Out of 70 conference chairs, 12 were women, which is 17%,
- The same for program commmittee members was 220 out of 1259, which is also around 17%.

Based on this data, we can state about **RQ4** that the ratios do not seem to show any notable differences to the overall rates. But if we investigate the two conference types separately, only 12.8% of the keynote speakers of acedemic conferences were women, while this number was 27.8% in the case of the industrial ones. This might indicate that organizers of industrial conferences pay higher attention to gender diversity when it comes to invited speakers. By investigating the chair and committee roles in a simiar way, we did not observe such differences.

V. Conclusions

In this article, we evaluated the ratio of women in a specific area of ICT: software testing conferences. Our overall finding is that the gender gap is similar to what was reported for other fields in ICT, or a bit worse. This is different to the general view that there are more female workers in this subfield. It is an open question what is the explanation for this discrepancy. We identified subtle differences when considering the different affiliations and types of conferences. For example, it was interesting to observe that the ratio of women in leading positions with these conferences seem to be higher than in a general case, and that female keynote speakers are more common at industrial conferences.

Clearly, this study looks at the field of software testing only from one angle. Nevertheless, we believe that since conferences are very important venues for professionals working in any area, our results could provide interesting insights in the demographics of this very important ICT subfield. As a future work, one might investigate the reasons behind the differences obtained in particular cases of this study. Extending the experiments would be interesting as well, such as by looking at conference attendees (if data is available), or other aspects of the software testing profession.

Acknowledgement

The authors wish to thank the help of Béla Vancsis in data collection. The project was supported by the European Union, co-financed by the European Social Fund (EFOP-3.6.3-VEKOP-16-2017-00002).

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