
Women In Tech: Addressing the Root Causes of Attrition

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There remains a staggering absence of women in technology-related fields. Enabling diversity is not only a social imperative, but also a competitive advantage for companies and institutions resulting in demonstratively greater returns. In this paper, we provide a comprehensive look at technology's gender gap and give evidence of the benefits of gender diversity. Acknowledging this divide is merely a first step. We further devise and execute a broad study of women in technology, and our results reveal key barriers that reduce the presence of women across all levels. The survey results were the jumping off point for the first Women In Technology Leadership Round Table, an event aimed at developing solutions to prevent the attrition of women in the technological workforce. We detail the results of this round table and the solutions developed therein, including roadmaps and specific action items needed in order to realize each solution. Finally, we summarize with an ongoing call to action, which acts as a continuation of our efforts to develop sustainable solutions that will address barriers to women and help produce diversity in the technology ecosystem.

Introduction

The number of women in technology-related fields is dismal by all accounts and according to any metric. In order to present a comprehensive view of the current status of women in technology, we examine many different perspectives from the technology ecosystem, ranging from education and resulting workforce representation, to executive positions and gender-pay to percent representation, to entrepreneurship funding and representation in the investment of technology. In nearly every dimension, we find a gross disparity between the status of men and women. These statistics are concerning because the number of female technology graduates has never been higher, and yet, due to factors both internal and external, these graduates are not percolating into the workforce.

The contextual relevance of this problem is higher than ever. Newspapers cover this issue daily and gender or discrimination litigation has never been more prominent. The challenge in many cases is the subjectivity of views expressed on the issues. Whether discrimination was responsible for a management decision is a tenuous and controversial subject. Here, we take a quantitative approach with a focus on tangible facts and data. We gather research in the area and distill the results of this research that are pertinent to women in technology-related areas. The results span university graduates, academia, the corporate power-line, and finance. The data and analysis show that with the exception of academia, the statistics on women in technology-related roles are dismal and show limited or no progress. In particular, statistics with time-lagged analysis between input and representation have been disappointing: While the number of women graduates has been increasing, their attrition rate compared to men has been significantly higher. This problem has often been called the "leaky pipe" syndrome.

In this work, we attempt to go further by investigating the specific barriers that exist for women, and then proposing solutions to these barriers. This paper serves three purposes: First, it helps to distill the recent, vast body of work that highlights the gender gap in technology, painting a picture of the true gender divide across this area. Second, it presents results of a study of women in technology-related fields, helping to determine the barriers that prevent them from thriving. Third, it shares specific solutions that can help to eliminate these barriers.

Both background research and the results of the survey we conducted indicate that external factors such as bias and discrimination have the greatest negative impact on women's careers, and are overwhelmingly singled out as the first areas for improvement. Most women reported the need for real, actionable impact in their professional lives both in the form of removal of the aforementioned factors, and in the availability of mentors and accessible role models among their own colleagues. The overwhelm-

ing majority of women surveyed were highly confident in their abilities, comfortable with their work-life balance, and rarely suffered from impostor syndrome, despite working in predominantly male environments.

These results are important because they mark a divergence from many popular interventions that are currently being pursued, such as helping to develop female professional networks, boosting self-confidence, or promoting policy changes in work-life balance.

In holding the inaugural *Women in Technology Leadership Round Table*, we made a first attempt at developing actionable solutions that can help address these barriers. We share results of this event, which include the creation of specific solution roadmaps that were developed through collaborative dialog from numerous accomplished professionals in the field of technology.

This paper is organized as follows. In Section 1, we discuss detailed statistics on the status of women in technology and related fields. The magnitude of these statistics is discussed in Section 2, in which we cover the quantitative and qualitative impact of diversity. In Section 3, we present the results of our survey, providing concrete evidence on the major roadblocks that women face throughout their careers. In Section 4, we share actions that can be taken to help remove these roadblocks via the results of the 2015 Women in Technology Leadership Round Table.

1. The Numbers

Attempts to quantify the dearth of women in technology and related fields are not new: there are studies and findings published almost daily that aim to quantify the magnitude this issue. In this section, we provide a comprehensive view of the number of women currently active in technological fields. We present statistics spanning numerous career stages and domains, including women and STEM education (K-12, undergraduate, and graduate); women in industry (from small start-ups to Fortune 500 companies); and women in leadership roles (e.g., professors, senior engineers, management, and CEOs). The statistics highlight an important trend: the main issues seem to be *not* a lack of willing participants at the inlet of these stages, but instead highlight poor management of women throughout their professional tenure.

Women & STEM Education

Much attention in the last decade has been given to increasing girls' interest in STEM fields. Some initiatives include Girls Who Code, which provides programs to educate girls in computer science; Million Women Mentors, an organization that pairs established women or men working in STEM fields with female mentees; and the Anita Borg Institute, which, among many other

Percent of B.A.'s in Field Received by Women

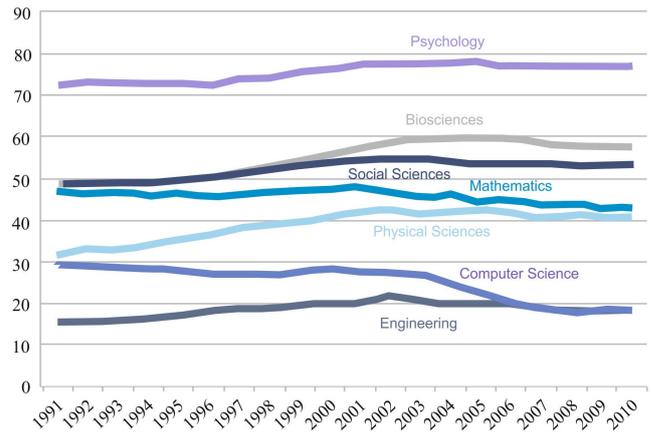


Figure 1: The fields of computer science and engineering have the lowest female representation, with just under 20% of degrees awarded to women. These numbers have declined in the last 10-20 years. Source: [2].

efforts, hosts the Grace Hopper Celebration of Women in Computing, a technical conference for women with an emphasis on bringing together junior women for networking, mentoring, and exposure to role models.

Re-thinking course design also seems to be making an impact: in 2014, for the first time on record, UC Berkeley was able to draw more women than men to their introductory CS course. According to the Instructor of the course, Dan Garcia, this was due to dramatic changes in the course structure, including an emphasis on group projects and creative thinking [1]. Still, the overall number of female undergraduate CS majors across the country is quite low – at 18.7% in 2012, as compared to 37% in 1984 and 29.6% in 1991 [2].

Indeed, as shown in Figure 1, across STEM fields, computer science and engineering continue to have the lowest level of participation from women, at below 20%. In other scientific fields such as biosciences and psychology, women actually take the lead. The discrepancy between genders remains when considering different levels of degrees, with women representing less than 30% of those receiving degrees in computer science across the Bachelor's, Master's, and Doctorate levels (Figure 2). The most alarming result from these statistics is that they have been trending downward over the past 20 years, despite efforts towards remedying the issue.

Attracting women to computer science and related fields at an early age is invariably a good thing. However, more needs to be done to keep them there after graduation. We discuss this issue in the next two subsections.

Women & Industry

Google made headlines last summer by announcing it's diversity numbers, which were surprisingly (or perhaps unsurprisingly) low. At Google, women account for a

Computer Science Degrees Awarded to Women by Level

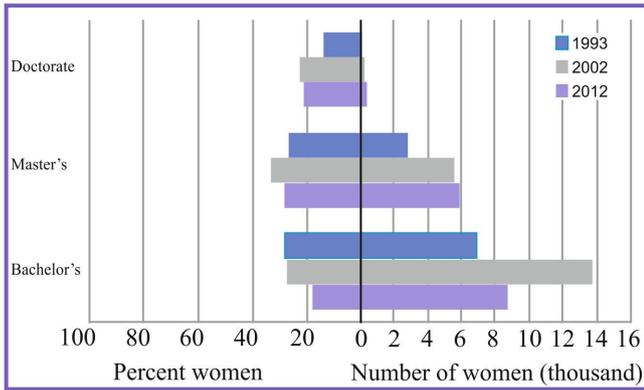


Figure 2: Various levels of degrees received by women in the field of computer science. The percent of women receiving degrees decreased for all levels from 2002 to 2012. Higher level degrees have shown slight improvement from 1993 to 2012, but still remain low (below 30%). Source: [2].

mere 17% of tech-related employment. These numbers are mirrored by other tech giants. Women account for 15% of tech positions at Yahoo!, 15% at Facebook, and 10% at Twitter [3, 4, 5, 6].

These numbers are shared by the general workforce. Computer science and engineering are among the occupations with the lowest percentage of female employees (Figure 3). Additionally, in terms of pay, one year out of college, women earn only 82% of what men earn for the same role despite having a slightly higher GPA [7].

Percent of Women Employed by Occupation

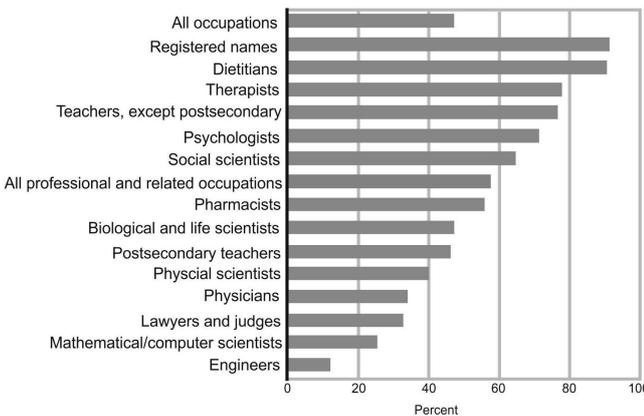


Figure 3: Percentage of women employed in various occupations. Computer scientists and engineers make up the bottom, at less than 25% female employment. Source: [2].

Women & Leadership

Importantly, we note that in terms of leadership, a lack of women to choose from is not the main issue: despite the increasing numbers of women who are educated to a leadership level, only a small percentage go on to take leadership roles within their profession.

Women in the Management Power Line



Figure 4: The percentage of women decreases when moving up the management power line. Source: [8].

Going back to the numbers released by Google and other tech companies, these statistics remain stark when looking at women in leadership roles. Females account for 21% of leadership roles at Google, 23% at Facebook, 23% at Yahoo!, and 21% at Twitter [3, 4, 5, 6].

As this group moves up the pyramid, the statistics get progressively worse. Credit Suisse has shown that in the management power-line, women occupy only 3.9% of the CEO suite [8]. They further illustrate that the majority of women serve in supporting roles with less advancement to the top, for example, with shared services at 19% and CFO/Strategy/IT at 17.5%. This statistic does not vary much by industry. It is not surprising then that the number of women on boards is a low 10%. In fact an analysis of S&P 1500 companies show that there are more men serving on boards with the name John, Robert, William, or James than there are women serving on boards in total [9].

Given the lack of women in the corporate pyramid, one wonders whether alternate options exist for women in entrepreneurship. Unfortunately, despite many statistics showcasing the desire of women to be entrepreneurs, they do not receive adequate funding support. The U.S. Small Business Administration reports that women form almost 50% of new businesses and engender 16% of new job creation. Yet the Kaufman foundation showed that female CEOs only receive 3% of VC funding, and only 5% of ventures that receive VC funding had any women on their team [10]. This blatant lack of resources hampers growth and potential. In fact, 90% of VC investments in technology areas like Semiconductors,

Percent of Venture-Funded Businesses with Male CEOs

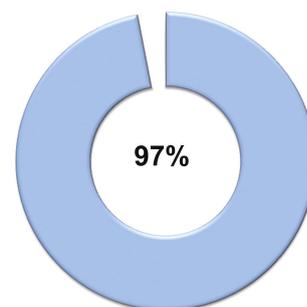


Figure 5: More than 97% of venture-funded businesses have male CEOs. Source: [10].

The Limited Impact of Education

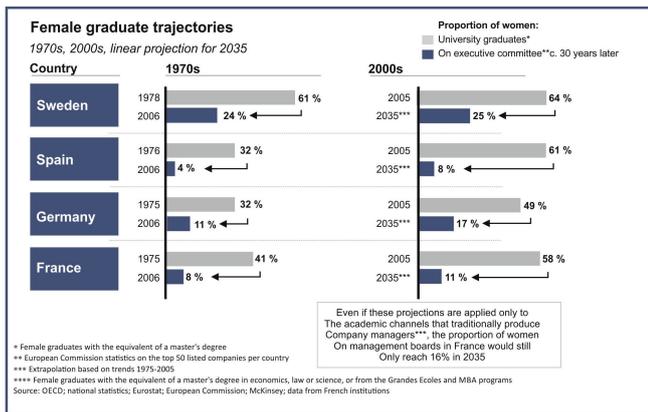


Figure 6: The increased number of female graduates has had limited impact on diversity at the leadership level. Projections based on these trends reveal little improvement moving forward. Source: [12].

Computers, Peripherals, Electronics, Instrumentation and Media/Entertainment had a startling 0% women in leadership. Research has shown that investors invariably prefer ventures pitched by attractive men by a factor of 2x over women whether attractive or not [11].

Therefore, it is not surprising that women are also grossly underrepresented in the investment of technology. The Kaufman foundation reports only 6% of VC partners are women, a decline from 10% over a decade ago [10].

Evidence on the inherent competence of women is bolstered by STEM analysis showing that women get higher grade point averages and are graduating from college in increasing numbers. But the impact (on a time shifted scale) is not seen in the future. This starkly illustrates the fact that graduating women are not thriving in the work environment. Analysis from Mckinsey (Figure 6) shows that while 32% of graduates in 1978 in a country like Spain were women, by 2006 it only showed up at 4% of the executive management teams. In France, 41% of college graduates were women but 20 years later only 6% of executive management were women.

2. Why Diversity Matters

Reasons for diversity go beyond moral or social imperatives. Extensive studies have shown that the presence of diversity results in superior performance. Intuitively, this makes sense: if problem solving is pattern recognition and fitting exercise in social systems, then a group with greater diversity recognizes more patterns than a group without it. Diverse companies have greater collective intelligence and a greater range of ideas as well as perspectives.

Recent research by Catalyst shows that companies with top quartile gender diversity in top management

The Impact of Women in Leadership

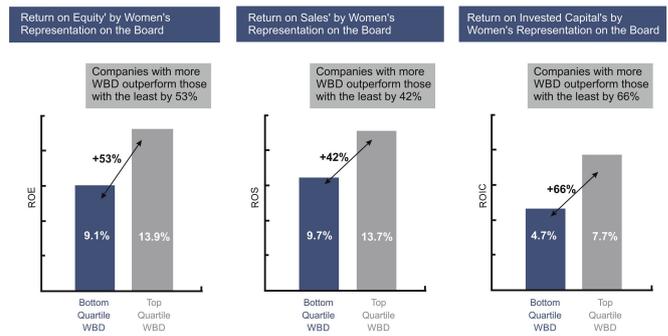


Figure 7: Companies with more female board members outperform those without, in terms of Return on Equity (ROE), Return on Sales (ROS), and Return on Invested Capital (ROIC). Source: [13].

outperform companies with bottom quartile gender diversity, by 17.7% to 13% ROE (Return on Equity) and 128% to 95% TRS (Total Return Swap) (Figure 7). This research was conducted on the Fortune 500 or the top 500 largest market cap companies. By recursive argument, this should apply to all groups in an organization. But it isn't just in active management: Studies also show that companies with greater female board representation have 66% greater ROIC (Return on Invested Capital), 42% greater ROS (Return on Sales), and 53% greater Return on Equity (ROE) than companies without female board representation. As the percentage of women board members increases, so does the performance of the company.

Of course, these quantitative metrics alone don't fully explain why diversity is important. There are social and moral constraints: The very intent of democracy and equitable human society is disturbed if one part of the population is made to feel inferior. To form a democracy it is critical that women must have the same opportunities and representation as men. The principles aside, it is important to note that the increasing incidences of discrimination or harassment lawsuits as well as other actions destructive to enterprise value, are directly correlated to the inherent societal frustration around the current status-quo.

In leadership, leaving out half the population is also a huge missed opportunity to consider the needs and perspectives of half the population. It is difficult for a team designing products to be used by men and women to truly understand the needs of half the population if they do not represent it. There are numerous examples of this in the tech industry. The results range from being a minor nuisance, such as smart watches with huge faces and bands that don't fit smaller wrists, to life-altering, such as Carmat's fully artificial heart, designed to fit 86% of men and only 20% of women [14].

In the next section we discuss the barriers that are creating this dearth in diversity. We note the importance

of the need for equitable representation as compared to role models: A role model is merely a public placeholder for recognition of equitable representation. Just as giving a few exceptional women the right to vote does not constitute franchise, placing a few token women as role models does not constitute an equitable, diverse world. However, the role models are in the nature of a promise and a visible public perception effort that gives the general population of the world a belief (which may or may not be false) that equal opportunity is a goal.

3. Barriers to Success: Survey Summary

The prior research provides compelling evidence on the presence of issues hampering women in technology. The numbers from Section 1 and impacts in Section 2 are alarming, but are unfortunately well-known and are starting to become well-documented. However, two significant omissions are notable: Firstly, none of the prior research attempted to examine the set of all women in technology. In fact, seminal research focused on women in a narrow set of large corporations and had the inherent disadvantage of survivorship bias. We have no input from those women who left the large corporate workplace either willingly or un-willingly. Secondly, none of the prior research attempted to understand the underlying causes of the high attrition but merely focused on issues such as the lack of advancement articulated by the survivor population. We have no insight on the factors that caused women to leave the technology marketplace. *Given that the statistics show that attrition rather than inflow is the nodal issue, the omissions are particularly notable.*

In this section, we gather insight about a less studied, but perhaps more important question: *What are the reasons for the lack of women in technology?* To do so, we conduct an extensive and ongoing survey with initial results from over 200 women in technology and related fields.

The survey reveals important insights into the barriers that exist for women in technology. While examining numerous possible factors, it emerges that extenuating external environmental factors are by far the greatest culprits. An overwhelming number of women surveyed reported incidents of discrimination and harassment: Over 60% of women responding had experienced discrimination moderately to frequently in their profession, and nearly three-fourths (74%) had experienced some form of intimidating or inappropriate behavior such as harassment in their careers. Internal factors were less of hindrance than external, with nearly 90% of women indicating that they were very confident in their skills and abilities as they pertain to their career. Related factors like work-life balance did not affect the majority of women, with less

than a third (32%) describing their lives as unbalanced.

Interested parties may download a copy of the entire survey from our website. The survey was granted full IRB-approval (UC Berkeley CPHS Protocol No. 2015-05-7543).

Composition of Respondents

While this survey is an ongoing effort, the first exercise that targeted 5,500 participants resulted in 200+ respondents within a month of dissemination. The survey was sent to multiple women-in-technology mailing lists and posted on social media forums such as LinkedIn or Meetup. In the space of a month, 202 qualified women responded to the survey, representing a 4% effective response rate overall. Though this rate appears lower than rates traditionally required in survey practice, it is worth noting that it likely differs significantly from *true* response rate, a number which is difficult to calculate directly given the diffuse nature of social media.

The respondents were primarily engineers (46.8%) and graduated between 1970-2015, with the largest segment, almost a third, graduating between 2000-2010. An overwhelming majority (92.9%) worked in North America, making this a US-centric result. Nearly 58% of respondents were white, 33% were Asian and just under 8% Hispanic. These statistics also reflect the composition of the women in technology workforce. We provide complete statistics on the respondents in the Appendix.

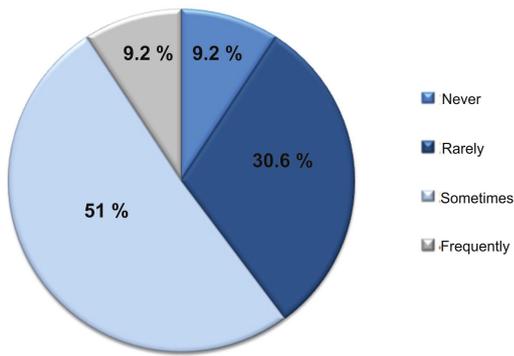
Detailed Results

The survey examined three types of external issues (discrimination, harassment, and adequate promotion); two types of internal issues (impostor syndrome and confidence); and four types of “competitive” issues, or issues that are contributors to professional effectiveness (networks, work-life balance, role models, and mentorship). Results indicate that external factors cause the greatest impact on the majority of women. The quantitative data reveal that an overwhelming number of women (over 90%) had faced some form of discrimination. Over 75% of these respondents noted that the discrimination they experienced ranged from subtle to overt, and over 40% of women felt that their careers had been negatively impacted by the discrimination (Figure 8).

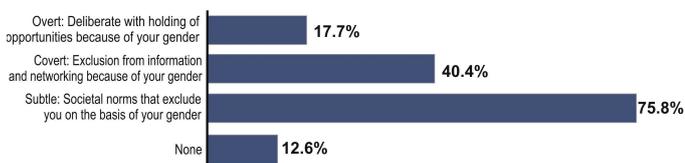
Direct comments suggested that this type of discrimination ranged from things like having consistently lower wages to having consistently less access to opportunities. Harassment (inappropriate or intimidating behavior) was only marginally less prevalent than discrimination, with over 60% of women having faced at least some form of harassment. In addition, over 60% of women reported negative career impacts because of facing this type of behavior. Most felt that having a colleague, witness, or senior manager confront the perpetrator was the

External Factors: Discrimination

Have you experienced gender discrimination (sexism) in your profession?



What type(s) of discrimination have you faced, if any?



How has your career been affected by discrimination?

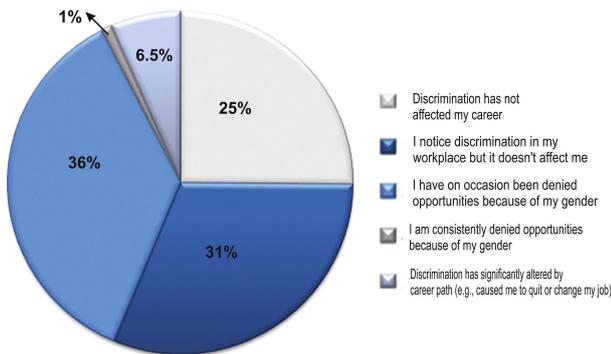


Figure 8: Discrimination had the largest impact of all factors surveyed, considering the numbers affected and resulting effect.

most effective action in addressing this issue. However, comments instead reported that those surrounding the victim frequently avoided confrontation and attempted to dissociate from the situation.

Another type of external factor investigated was the promotion process. Surprisingly only 30% of women felt they had not been given adequate opportunities for promotion, though most (over 80%) wished that there was more transparency in this process. In effect, the gender discrimination noted earlier appears to have had more to do with lower wages and exclusion rather than overt denial of promotion. This fact was noted again in direct comments from the respondents.

Internal factors were the least significant area of concern for the respondents of the survey. Though the majority of women reported attributing some of their successes to luck (a sign of impostor syndrome), the

Internal Factors: Self-Confidence

I feel confident in my skills as they pertain to my career.

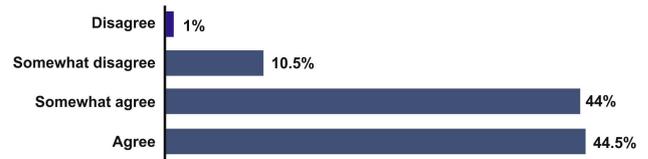


Figure 9: Self-confidence did not seem to be an issue for respondents, with almost 90% reporting that they felt somewhat to very confident in their careers.

great majority of women reported that despite this they felt highly confident in their skills. In fact, only 1% of women did not feel confident in their abilities or skills, and only 2% attributed any negative career impact to a lack of self confidence. A slightly higher 5% attributed career impact to a more subtle impostor syndrome when relegated to predominantly male workplaces.

Competitive factors, such as professional networks, work-life balance, role models, and mentorship were important, though not nearly as critical as the external factors. Of all the competitive factors, mentorship appears to have the most need for improvement, with more than half of women reporting that they received poor mentorship or none at all.

Most women (60-70%) felt that they had a helpful network and over 50% had experienced occasional or notable benefits from their network. Work-life balance or the "mommy-track" that has been touted as a causal factor by conventional wisdom was not observed as a factor for most respondents. Surprisingly nearly 65% of women felt somewhat to very balanced in terms of work-life balance, and only 9% had significantly altered their careers due to work-life balance issues. However, despite reporting relatively balanced schedules of work vs. life, 71% still wanted more flexible working hours.

Competitive Factors: Work-Life Balance

Describe your level of work-life balance.

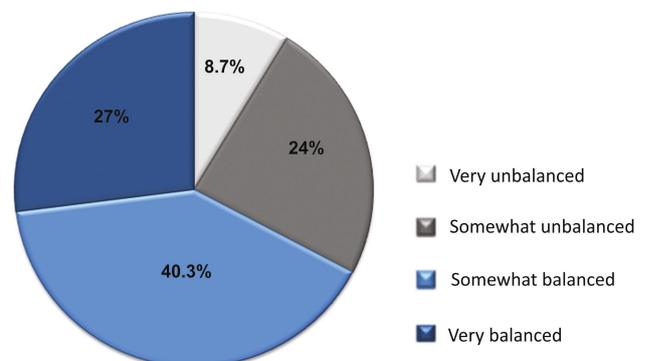


Figure 10: Work-life balance was not a major issue, with the majority reporting levels somewhat to very balanced.

Over 75% of women additionally wished for more “real” role models in the form of colleagues that inspired them. This method of seeking role models in colleagues was preferred to avenues like PR and news-media reports, which the fewest number of women advocated for. In fact, rather than role models, nearly 70% of women noted the positive impact of mentors on their career.

4. Solutions Roadmap

The numbers tell a clear story: The current representation of women in technology is not appropriate nor sufficient. While the number of women entering the field is approaching parity, there are notable hurdles that cause significant derailment and subsequent attrition. Even though women in technology form nearly 40% of the student population, the average number of women in technology at giants like Google and Facebook dwindles to 15%, and senior management representation in the C-line is far worse at 3%.

To find solutions to the aforementioned issues, accomplished professionals in the field of technology convened Friday, November 6th for the inaugural *Women in Technology Leadership Round Table* at UC Berkeley. The aim was to develop sustainable solutions that will reduce the attrition of women in the technical workforce. The event was unique in that it created a coalition of influential leaders intent on making a multilateral effort to eliminate barriers to the advancement of women.

The round table was structured in a simple format:

1. Share past experiences and issues
2. Brainstorm solutions
3. Prioritize and select top solutions
4. Plan detailed action steps for top solutions

The round table began with the sharing of experiences and best practices for raising awareness of the gender gap and for increasing diversity. Both effective measures and ineffective measures were described, as well as implications of the terms ‘diversity’ vs. ‘inclusion.’ Ideas for actionable solutions were then brainstormed. The interested reader may find a sample of the raw brainstorming output from the round table discussion in Figure 14. The brainstorming resulted in a high-level landscape of solutions as laid out in Figure 13. This landscape of solutions can be organized under 3 major categories:

- **Assess Continually:** Implement methods and metrics for monitoring the health of the situation both in a company and in the industry as a whole.
- **Create Awareness:** Develop strategies for increasing industry-wide awareness of the situation.
- **Enable Change:** Provide training, structures, and incentives or disincentives to ensure improvements to the situation are made.

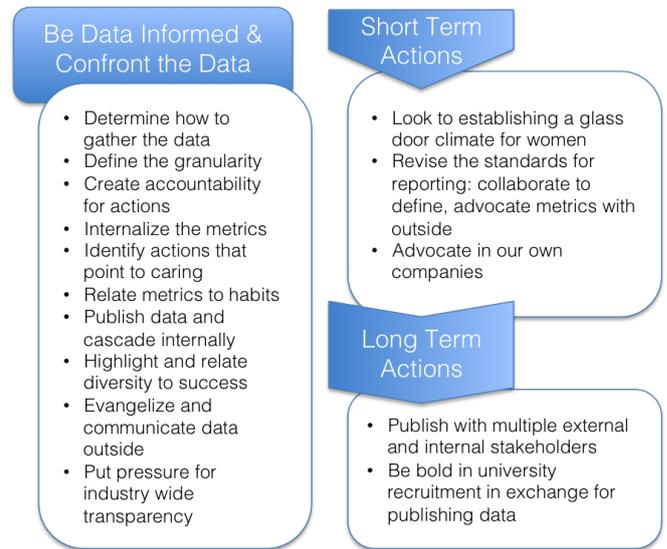


Figure 11: A Roadmap for Solution Area 1: *Be Data Informed & Confront the Data.*

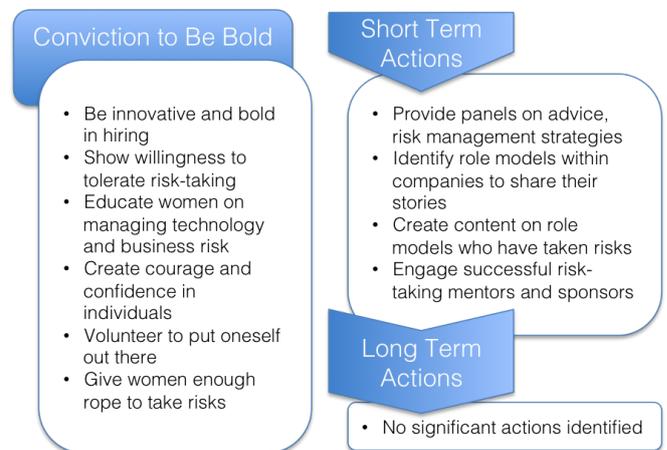


Figure 12: A Roadmap for Solution Area 2: *Conviction to Be Bold.*

Following the brainstorming, the participants voted to prioritize the actions for the year. The final results of the vote determined the top two priorities for the year as follows:

1. **Be Data Informed and Confront the Data:** This priority referred to the creation of proper metrics about women in technology to enable universal assessment, tracking, and corrective actions. To ensure adoption and motivate action, the metrics must be calculated with industry-wide data and made transparently available to the general industry.
2. **Create Conviction to Be Bold:** This priority referred to methods that enable and create acceptance for greater risk-taking among women in technology. An emphasis was put on both training women to manage risk better, as well as creating industry support for women’s risk-taking initiatives.

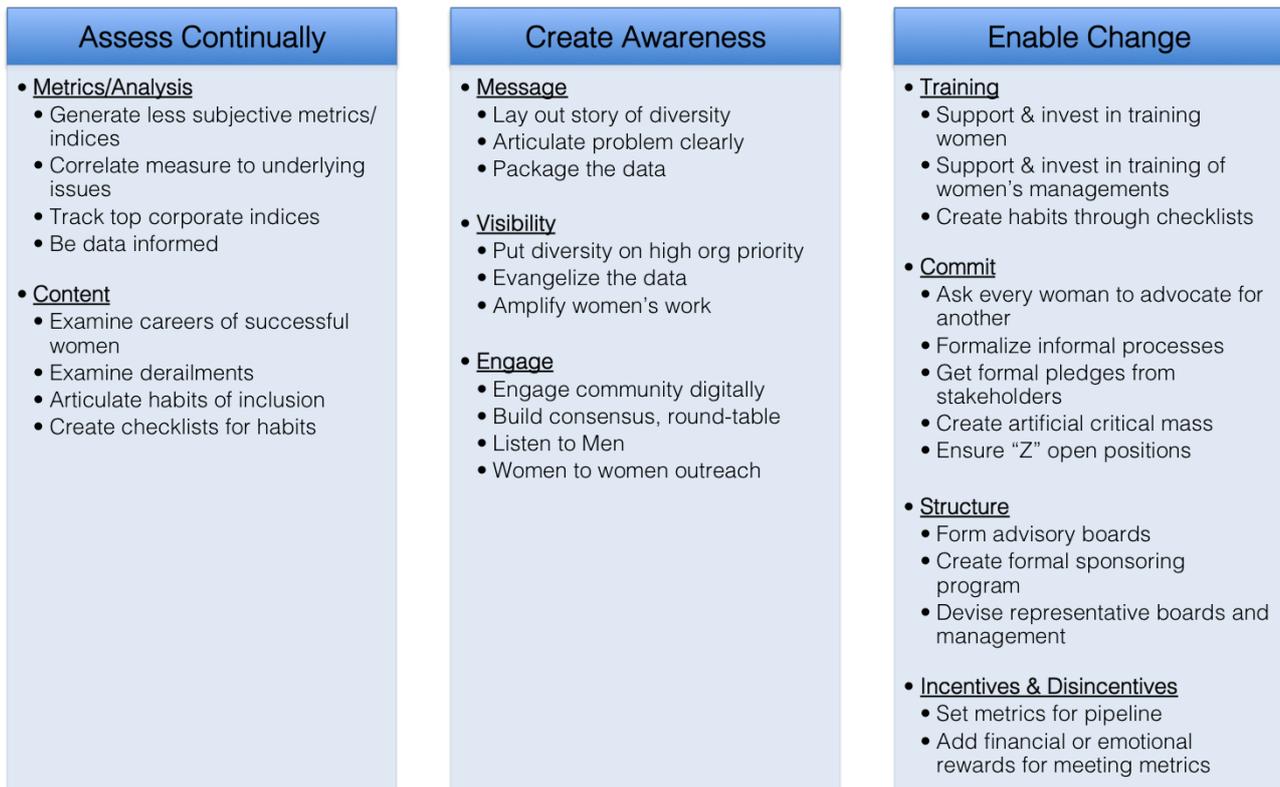


Figure 13: Landscape of solutions.

In particular, several key short-term actions emerged as critical for the next year under each priority. These short-, medium-, and long-term actions are summarized in Figure 11 and Figure 12.

The round table participants agreed to form an ongoing initiative for women in technology together with a steering committee to determine organizational actions required; a working group to help execute the specific actions in these two solution areas; and a commitment to an annual round table session.

Conclusion

In conclusion, in this white paper, we first assessed the current status of women in technology by providing a survey of research exploring various lenses on the issue. The number of women in technology-related fields is dismal by all accounts and according to any metric. In nearly every dimension, we find a gross disparity between the presence of men and women. These statistics are concerning because the number of female technology graduates has never been higher, and yet, due to numerous factors, these graduates are either not being retained or not advancing in the workforce. After presenting these statistics, we carried out a survey that revealed key problem areas, with ongoing issues of bias and discrimination being the most significant targets. The round table then brought together industry leaders to share their perspectives and collaboratively identify solutions. The group built a landscape of possible solu-

tions, and then prioritized top solutions and developed a roadmap of actions to achieve each top solution. The round table participants have collectively committed to institutionalize this initiative, with the next round table taking place in June 2016. The WiT initiative looks forward to improving the presence of women in technology through its ongoing collaborative dialog and development of concrete, actionable solutions.

An Ongoing Call to Action

The results of our survey reveal important areas for policy interventions, with ongoing issues of bias and discrimination being the most significant targets. The round table developed a landscape of potential solutions and recommended a prioritized set of selected actions for the next year. The group also established formal structures for continued success of this event, including a steering committee, a working group, and commitment to attend a yearly round table discussion on the topic.

The next round table will take place in June 2016. We will continue to publish and disseminate ongoing versions of this paper and other best practices, as well as policy documents that emerge from our efforts. **Interested parties may contact us at vsmith@berkeley.edu and refer to the site <http://wit.berkeley.edu>.**

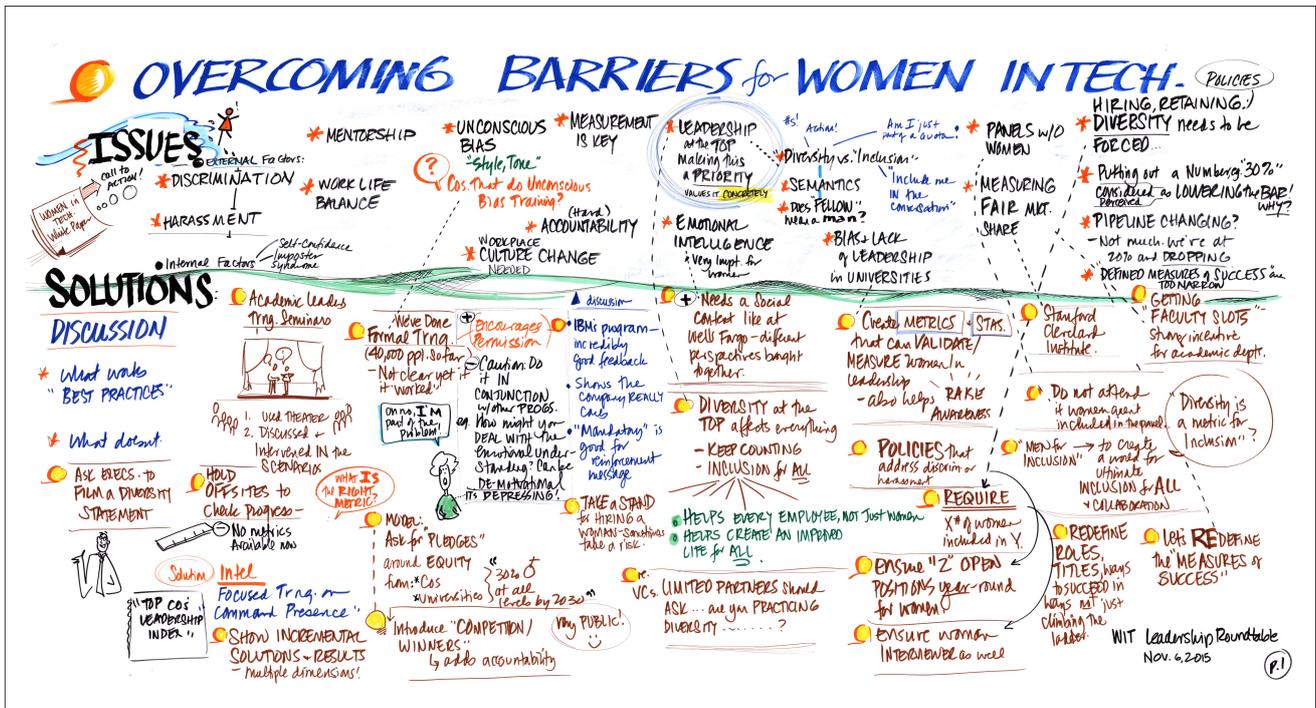


Figure 14: Raw brainstorming output from WiT Round Table.

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