17 Confronting the Absence of Women in Technology Innovation

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Only 19 percent of all software developers are female, and very few are in technology leadership roles that would enable them to make truly innovative contributions. Consider that 88 percent of all information technology patents (1980–2010) have male-only invention teams while only 2 percent have female-only invention teams.[1] These statistics and others imply that a largely homogeneous group is creating the technology the world uses today—US white males (and increasingly Asian males). Women, and especially women of color, are essentially absent from technology innovation—absent because of low participation, absent because the world does not experience their potential contributions, and absent because when women do make technical contributions, they are often ignored, not recognized, or not given credit for their ideas. This is especially troubling given ample evidence of the critical benefits diversity brings to innovation, problem-solving, and creativity. Indeed, innovation springs from diversity—diversity of ideas, perspectives, voices, and in short, a diversity of people.[2]

However, numerous social and cultural influences are increasingly impeding women's contributions to technical creation in today's tech workforce. Recognizing women as technical contributors requires explicit, conscious effort. Simply adding women to the pot and stirring is not going to make their ideas recognized or used. Technical design teams need to employ democratic principles and techniques for making sure ideas are heard and discussed. Managers and supervisors (both men and women) need to perform as champions for their female technologists. And they need to be informed and equipped to do so effectively, with a clear understanding of both the values and unique challenges to gender inclusion embedded in our current systems and operations.

A pressing need to address these factors led to the formation of the National Center for Women and Information Technology (NCWIT) in 2004, a National Science Foundation (NSF) funded effort to "*significantly* increase women's *meaningful* participation in computing." We emphasize "significantly" because clearly the numbers were quite low then and "meaningful" because this effort was not intended to be merely a numbers game. We must have women in the roles critical to the invention of future technology (architect, lead designer, etc.) and not only in the jobs that support those who create it (such as project management and system verification).

In this chapter, we look briefly at the latest research documenting the benefits that diversity brings to innovation, identify what "meaningful participation" really means, and explore the underlying psychological and cultural mechanisms behind women's continued absence in technical innovation. We describe actionable practices that not only can mitigate these impacts, but also help organizations adopt pro-innovation strategies through effective diversity and inclusion efforts involving the important work and practical resources of NCWIT.

Why Does Addressing Women's Absence Matter?

Women's current underrepresentation spells trouble for the tech industry and for the future of technical innovation, especially in light of an increasing body of research documenting the significant benefits that diversity brings to innovation. Some of these key benefits are summarized below. Let's consider a few examples:

- A 2009 study of five hundred US-based companies found that higher levels of racial and gender diversity were associated with increased sales revenue, more customers, greater market share, and greater relative profits. Racial diversity, in particular, was one of the most important predictors of a company's competitive standing within its industry.[3]

- A 2007 study by the London Business School of one hundred teams at twenty-one different companies found that work teams with equal numbers of women and men were more innovative and more productive than teams of any other composition. They attributed this finding to the fact that members on these teams were less likely to feel like "tokens" and better able to meaningfully contribute their ideas and efforts.[4]

- Using computer and mathematical modeling, Scott E. Page of the University of Michigan has demonstrated that diverse teams consistently outperform even teams comprising only the "highest-ability" agents.[5]
- Another recent study of work teams revealed that the intelligence level of individual team members was not a predictor of the collective intelligence of the team. However, one of the key predictors of the collective intelligence of a team was a larger number of female team members.[6]

Additional studies have found benefits of gender diversity for start-up companies as well. For example, an analysis of more than 20,000 venture-backed companies showed that successful start-ups have twice as many women in senior positions as unsuccessful companies.[7] In addition, in a study of all investments made in US-based companies between 2000 and 2010 by US-based venture capital (VC) firms, those that invested in women-led businesses saw an improvement in their VC firm's performance.[8]

In light of research studies such as these, technical organizations cannot afford to continue losing out on the benefits that gender diversity and other kinds of diversity can bring to technical advancements. Technology innovation is a creative process that involves teams; often many teams, both large and small, work on a single product or service from front-end requirements generation, through design and development, to product rollout and support. Clearly, it matters who sits at the table on these teams, and all of them would benefit from the increased participation of women. But as we noted earlier, by and large, women are *not* participating in technology innovation roles, but rather in the roles that support others who are engaging in leading-edge technology design and development. This point is not intended to be an evaluative statement about the importance of these support roles—indeed, they are critical. However, they are often not the roles leading to new technology breakthroughs. NCWIT partners with many of the world's largest companies, and it is rare to find a woman, let alone a racial minority, leading any significant technical development effort. We need a diverse array of people contributing to both support and creation roles.

Toward this end, we need to understand *why* women are absent in the first place. Here, it is important first to clarify that women (and other underrepresented groups) are not simply *absent* from technical environments, but that even the few women who *are* present are leaving the field. A 2008

study found that 74 percent of technical women report "loving their work," yet 56 percent of these women leave midcareer (after ten to twenty years). For the most part, they are not leaving, as many often suspect, for familial or other kinds of obligations. Of the 56 percent of women who leave, 75 percent remain in the workforce full time. Fifty percent remain in technical jobs, but not in the private sector; they either take positions in government, nonprofits, or start-ups. Only 25 percent leave the workforce. These patterns suggest that women leave not because they do not like tech or because they want time out of the workforce, but rather because of factors in the private sector's corporate technical environment itself. Imagine what would happen if we could change these factors and stem the tide of female attrition. The same study estimates that reducing female attrition by 25 percent would return hundreds of thousands of women to science and technology workplaces.[9]

The good news is that we have extensive knowledge about the factors causing women to leave technology or preventing them from entering in the first place. An understanding of these barriers is the first step in addressing them. In the next section, we examine some of the principal reasons for women's absences, most notably the pervasive and subtle effects of unconscious bias.

Why Does Women's Absence from Technology Persist?

We contend that for lasting change to occur, companies need to understand and focus serious attention on the role that unconscious bias plays in women's persistent absence from technology contexts. Doing so is crucial for at least three reasons. First, unconscious bias is arguably the most pervasive, but least understood, factor affecting women's participation in technology. As we shall see, these subtle biases are encoded in both institutional barriers and in everyday instances in technology workplaces, creating myriad stealth barriers to women's meaningful contributions.[10] In an encouraging turn of events, recent public conversation around these biases has increased, but we have a long way to go to help company leaders, managers, and employees understand the impact of these biases on the technical workforce.[11] Second, an understanding of how unconscious bias works helps to quell the "blame game" and other kinds of unproductive conversation so often present in discussions around women in tech.[12] Addressing these issues is not about pitting groups against each other; it is

not about "good" people who are enlightened and "bad" people who are biased. We *all* share these biases, women and men alike, and while at first glance this may seem rather discouraging, the good news is that we can all work together to address these biases in meaningful ways. Finally, it is worth pointing out that unconscious biases can be relatively inexpensive to address. While larger company programs are also needed to fully address these biases, individual managers and leaders can often make a significant difference by altering their behaviors in small but significant ways.

When NCWIT presents this body of knowledge in technical organizations, the reaction is largely one of relief and confidence in a new way of talking about these issues that avoids pitting groups against each other. We stress, however, that it is important to move beyond awareness and training and toward action. As a result, we often see significant action to "operationalize" this newfound awareness and address biases in everyday business processes.

We also wish to note that while the focus of this chapter is on the experiences of women, it is important to remember that women vary in terms of race, class, gender, ability, sexual orientation, and other points of difference. As a result, considering how these unconscious biases play out for a *diverse range* of women is crucial. Likewise, increasing the participation of all underrepresented groups is also important. Although most of our examples focus on women (and will, therefore, sometimes gloss over important differences among women), it is vital that we keep in mind that these unconscious biases affect members of all underrepresented groups in various ways. Importantly, many of the strategies that we recommend will also improve the work environment for members from a variety of underrepresented groups.

What Is Unconscious Bias, and How Does It Work?

Unconscious biases are the direct result of schemas—or maps that we all have in our head—that help us quickly filter new information and categorize it in meaningful ways. These schemas are vital and necessary; without them we would be paralyzed by all the information we receive in a given day. For example, we have schemas for simple concepts such as a tree, a car, or a mall. We may drive by a strange group of buildings we have never seen before, but because we have developed a schema for "mall," subtle cues let us know that this set of buildings is another example of a mall. In other words, we do not have to start from scratch and examine new objects

closely each time we see them. We also have schemas for more complex things like "leader" or "technical person." These schemas shape our definitions of what makes a good leader or what a talented technical person looks like. We also have schemas related to gender, race, class, and other intersecting categories of identity. These schemas subtly influence our perceptions about what is appropriate behavior for women, men, and so on.

Of course, because these schemas help us filter information, they can also lead us to filter in ways that result in misrecognition, misinterpretations, or misunderstandings. When it comes to more complex interactions in the workplace, these schemas can cause us to misinterpret people's behaviors or to miss certain strengths, talents, or characteristics that do not fit our schemas for, in this case, a good leader or a good technical person. Likewise, such schemas also can cause us to characterize women as "too aggressive" and advise them to "tone it down" when the same behavior from men is often deemed more acceptable.[13]

A great deal of research has shown that society has significant biases about gender, science, and technology.[14] Likewise, these biases pervade popular culture—for example, from overt displays in advertisements and children's books to more subtle messages of omission, such as the lack of media representations of women in key technical roles.[15] Keep in mind that we do not necessarily need to buy into or consciously believe these messages to be affected by them. A lifetime of exposure to these messages affects our schemas even if we *consciously* believe that anyone can do science or technology. To test this out yourself, try taking the Implicit Association Test created in 1998 by researchers Tony Greenwald, Mahzarin Banaji, and Brian Nosek.[16] The test related to gender and science/technology measures the speed of associations test takers make between male and female terms and science, technology, or liberal arts terms. Over the past two decades, thousands have taken the test, with nearly 90 percent having some kind of masculine-associated bias when it comes to gender and technology. We too have taken the test, and though we work at NCWIT, we both still test moderately or mildly biased.

Similar patterns of bias also have been demonstrated repeatedly in myriad studies.[17] For example, several studies have shown that evaluators consistently score résumés lower when they are assigned a female name instead of a male name, even though the résumés are exactly the same.[18] Similar patterns have also been documented when it comes to race, where résumés with stereotypically "white-sounding" names received 50 percent more

callbacks than résumés with stereotypically "black-sounding" names.[19] In some of these studies, the participants making the biased evaluations were psychologists themselves—individuals who study and are especially well versed in this kind of phenomenon![20] In addition, both female and male evaluators tend to make lower assessments of women candidates. The important takeaway here is that this is not about "enlightened" versus "prejudiced" people; we all (both women and men) share these subtle biases and need to work together to address them.

How Do These Biases Play Out Every Day in Workplaces—and in Particular, Technology Workplaces?

Biases are already circulating in society at large, and individuals encounter them in a variety of contexts even before they enter organizations. We then bring these biases into our organizational cultures. They shape organizational cultures in two ways: (1) *subtle dynamics* or everyday interactions that may seem small in the moment but that add up over time, creating an exhausting or unwelcome environment; and (2) *institutional barriers*, formed where these biases become unconsciously embedded in the organization's policies and programs, making these systems appear as simply the "natural order of things."

Subtle Dynamics

Let's consider some examples of both of these kinds of biases, beginning with subtle dynamics. Micro-inequities are one powerful example of these kinds of subtle instances (see box 17.1).[21]

All of these examples are subtle, tiny jabs that can slowly erode a woman's sense of belonging, confidence, and her sense that she "fits in." For those making the comments, it is also subtle; remember, this differs from overt discrimination. These interactions stem from unconscious biases that cause us to misjudge, misread, or be unaware of the effects of these kinds of comments. While any one instance can seem small, like a dripping faucet, the effect adds up over time, making women feel as if they do not really belong and undermining what is often thought of as a meritocratic organization.

Another pervasive example of these subtle biases surfaces in a phenomenon called stereotype threat—that is, the fear that our performance or actions will confirm a negative stereotype about an identity group to

Box 17.1
Micro-Inequities in the Workplace

Slight: "Actually [surprised tone], Susan has a good idea."

Exclusion: "Oops, I forgot to cc her on the email about the architecture review."

Recognition: "No, I'm pretty sure Jane would not have had the idea to use a link algorithm."

Isolation: "Dude, let's talk about it over a beer."

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which we belong. In nearly two hundred studies with a variety of different populations, this phenomenon has been shown to reduce confidence, performance, and risk-taking.[22] For example, elderly people perform worse on memory tests when told the test is designed to increase understanding about connections between age and senility. Likewise, students of color perform worse on tests when racial stereotypes about intelligence are invoked ahead of time, and girls or women perform worse on math tests when gender/math stereotypes are called to their attention. In fact, simply moving the race or gender question to the end of a standardized test has been shown to dramatically increase the scores for women and students of color.[23]

In a particularly interesting study, the researchers wanted to see if a single instance of stereotype threat could induce similar effects. To do so, they conducted an experiment with white male engineering students at Stanford University, all of whom had high math scores. Half of the students were simply told that they were taking a math ability test while the other half were told that they were part of a study to understand why Asian students scored better on math tests than white students, thereby invoking the one context where white men might experience stereotype threat around math. As you might imagine, the students in the latter group did significantly worse than those who were not exposed to the stereotype threat. This study demonstrated that even one (or relatively few) instance of exposure to stereotype threat can have powerful effects.[24] Imagine the effect that a lifetime of exposure has on individuals.

So how does stereotype threat show up in the technical workplace? It is important to recognize that being a minority in a majority environment can be a significant trigger for stereotype threat, reducing confidence and

risk-taking and resulting in not speaking up in meetings, a reluctance to take on leadership roles, and overly harsh evaluations of one's work products and personal performance.

Often other colleagues attribute these types of actions as evidence of "innate personality" traits of these individuals. You have perhaps heard this expressed in comments such as "so-and-so just isn't very confident" or "isn't much of a risk taker." But it is important to remember that these incidents are often about the *environment* and not the *individual*.[25] Reducing stereotype threat and making the environment more welcoming goes a long way toward increasing confidence and performance and eliminating these kinds of survival strategies. This points to the importance of building structures and strategies that create productive team environments, such as soliciting the opinions of quieter employees and creating environments where everyone can be heard, not just the loudest speakers. It also involves intervening when someone gets credit for an idea someone else offered earlier and ensuring that quieter employees get credit for their work.

NCWIT spends considerable time explaining stereotype threat research and its practical applications within organizations, and we find the gained understanding can quickly shift the institutional focus from that of "fixing" individuals to one of changing the environment. Of course, individual employees need professional development, and individual people must take action to change the environment, but this is distinctly different from interventions that assume women are not risk-takers or that they just need to be more confident.[26] While these kinds of "fix the individual" approaches pervade popular discourse, they often ignore important environmental reasons why women may seem or choose to be "less assertive" or to not take risks.[27] Without addressing these fundamental environmental or systemic issues, real change will not occur.[28]

Likewise, encouragement goes a long way toward reducing the effects of stereotype threat. Countless women have told us how encouragement from a colleague was the critical factor in their decision to apply for a promotion or an award; without this encouragement, they would have felt it was too risky. If they receive the promotion or award, this also further reinforces their sense of confidence and belonging. Research also shows that encouragement is one of the most effective strategies for increasing the retention of women in computing.[29]

It is important to point out here that strategies for confronting stereotype threat will benefit all employees. For example, quieter men will also benefit from more inclusive team meetings. These strategies make the environment better for everyone, but they are especially important for minorities working in a majority environment.

Institutional Barriers

A great deal of research also highlights how biases become encoded in larger policies and programs in the workplace, thereby forming institutional barriers that supersede individual behaviors or interactions. Earlier, we discussed how these biases subtly influence hiring with the evaluation of female and male candidates' résumés. But other institutionalized hiring practices also can reflect hidden biases. For example, relying primarily on personal contacts, referrals, or recommendations when hiring tends to perpetuate the status quo. When it comes to referrals and recommendations, people tend to recommend people much like themselves, a phenomenon known as "assortative matching."[30] According to a study for the Federal Reserve Bank of New York, 64 percent of employees recommended candidates of the same gender, while 71 percent referred candidates of the same race or ethnicity.[31] At least one study has found that women referred for entry-level tech jobs are significantly more likely to be hired than women without referrals; the same study found that for executive high-tech jobs, referred candidates are much more likely to be men than women.[32]

These biases also shape performance evaluations and promotion processes. For example, evaluations for men tend to be longer and to contain more comments about skills and individual achievement, while letters for women are shorter and contain more comments about "softer," stereotypically feminine skills such as communicating and collaborating. Evaluations for women tend to attribute achievement to hard work or luck rather than talent or intelligence, and to contain more "doubt raisers."[33] Similarly, men tend to receive more "constructive criticism" related to skills, whereas women tend to receive more of this kind of criticism related to personality issues, with comments about sometimes coming across as "abrasive" or needing to be less "judgmental" in tone. One investigation found that these kinds of comments appeared in seventy-one of the ninety-four critical reviews received by women but only twice in eighty-three critical reviews received by men.[34]

Finally, and especially important for our concerns here about women's participation in innovation, biases also pervade the kinds of jobs or tasks women take on or are asked to do. As a result, it is important to look for unintended biases in the assignment of particular tasks—who gets assigned the "high visibility" tasks and who gets assigned the more mundane tasks or the "higher risk, scapegoat" kinds of projects. These kinds of subtleties are more difficult to measure, and we are only beginning to understand how they play out in technical workplaces. One study found that nearly half of all women in technology workplaces felt that women were more often pushed into "execution" roles and had less access to "creative" roles.[35] There is anecdotal evidence to suggest that technical women are told they are "better communicators" and "better team players" than men—in essence, that they are more valuable in those roles than in the lead technical creative roles. More research to understand these kinds of barriers is vital for fostering women's involvement in technical invention.

At this point, we have mostly discussed the bad news. Thankfully, there is also good news. We can employ strategies that help expand our schemas and that reduce the effects of these biases. Consider one powerful example from a different industry. In the 1970s and 1980s, many orchestras began implementing a "blind audition" screening process. Previously, hopeful musicians would perform in person, allowing the evaluators to see the individual giving the performance. With blind auditions, performers were required to audition behind a curtain, and great care was taken to avoid unintentional gender cues (e.g., removing shoes so that one couldn't hear the click of high heels). This simple change increased the chances that female performers would make it out of preliminary screening rounds by 50 percent and resulted in a 25 percent increase in the number of females ultimately hired.[36] In the next section, we explore how we might work toward change when it comes to increasing women's participation in technical innovation.

Call to Action: Addressing Biases and Creating Inclusive Organizational Cultures

Over the past ten years, NCWIT has learned quite a bit about ways to address these existing biases and to ultimately develop more inclusive technical cultures where a diverse range of employees can thrive. In what follows, we first focus on promising practices and systemic reform in corporate

technical culture. We call particular attention to this arena because, to date, it is one of the most often overlooked areas for change. Typically, change efforts tend to focus on the educational pipeline, from engaging girls earlier in school to recruiting and retaining them in postsecondary education. These efforts will do little good, however, if we do nothing to change the conditions currently causing women and other underrepresented groups to leave tech. Changing these cultures to improve retention and advancement is equally if not more important and needs to be given more attention than it currently receives. At the same time, of course, the pipeline is also important. We conclude then with a look at some of NCWIT's national and local efforts to support organizations across the pipeline in creating change.

Corporate Organizational Strategies for Action

Drawing from the available research, Catherine Ashcraft developed an industry change model for how companies can take an "ecosystem" or multipronged approach that addresses the primary biases and factors that affect women's participation in information technology (figure 17.1).[37] Such an approach is necessary for lasting change to occur. Instituting piecemeal practices may be helpful in some cases but will not result in sustained, systemic change.

The two elements in the center of the model are vital for the sustained success of all other efforts: (1) establishing top leadership support and institutional accountability, and (2) improving the managerial relationship. What gets measured is what gets done. Accordingly, leaders must give more than lip service to these efforts and must institute "accountability metrics" that track progress. In addition, educating and resourcing managers in order to create inclusive environments is critical because managers can make daily life difficult for employees, even if many inclusive policies are formally on the books. Without these two foundational efforts, other change efforts are less likely to have the desired impact. Over years of working with companies on these efforts, we have developed a set of resources to equip managers and senior leaders with strategies for reducing biases in recruitment and selection, employee development, team management, and performance evaluation and promotion.[38]

The six areas in the outer part of the circle indicate the key areas where change is typically needed to create an inclusive ecosystem. We encourage companies to engage in data collection and strategic planning to identify

Ongoing Evaluation & Data Transparency

Interrupting Everyday Biases

Employee Development / Sponsorship

Top Leadership Support/ Institutional Accountability

Managerial Relationships

Recruitment / Selection

Performance Evaluation & Promotion

Support for Competing Responsibilities

Figure 17.1
NCWIT's Industry Change Model. Courtesy of NCWIT.

the areas in which they are weaker and stronger.[39] Below are a few central practices that relate to different areas of the Industry Change Model.

- *Analyzing job descriptions and interview practices.* Resources exist to help ensure that job ads are free of subtle biases in language, that they are engagingly written, and that they contain clear criteria about what skills are required versus "preferred."[40] Also, interview teams should include diverse representation and ensure that interview questions really probe the skills needed for the job, as opposed to assessing vague qualities such as "fit" for the organization. The latter is a red flag for the presence of biases.

- *Auditing physical environment and recruitment materials/practices.* Ensure that recruitment materials, website pictures and text, and pictures and décor in the physical environment represent a diverse range of people.

- *Analyzing performance reviews and assigning tasks.* The following types of questions should be considered: Are particular employees always assigned the highly visible tasks instead of the high-risk tasks? Who routinely gets offered "stretch" assignments? Do performance reviews for men tend to be longer than for women? Are there differences in the kinds of criticism offered or the kinds of skills highlighted?

- *Setting accountability metrics.* As the old adage goes, "What gets measured is what gets done." Top leaders need to demonstrate their support for inclusive practices, holding themselves and other leaders accountable for measurable change. This involves establishing metrics for progress and connecting these to the business.[41]

- *Creating healthy team environments.* As noted earlier, it is important for team leaders (and everyone, really) to solicit the opinions of quieter employees either during meetings or after. It is also important to ensure that individuals get credit for their ideas and work. Simple comments such as "I'd like to hear more about what she has to say" or "I believe she mentioned that same point earlier, and I'd like to hear more about what she was thinking" can make an enormous difference in team climate.

It is also important to point out that in many ways these types of practices are also just good leadership practices. Conveniently, this means that they are good for men; however, they are even more important for women and other underrepresented groups—for anyone who is a minority in a majority group environment.

NCWIT Strategies and Platforms for Action

We have focused up to this point mostly on private-sector technology innovation, even though such progress also emanates from universities and public-sector institutions. We also acknowledge the importance of inclusion in technical education; hence, we will discuss NCWIT's work across the full computing pipeline.

Founded in 2004, NCWIT is a change-leader network whose mission is to significantly increase the meaningful participation of women and girls in technology. We employ a three-pronged approach to effecting this change:

(1) convene, (2) equip, and (3) unite. First, as a capacity-building organization, we *convene* more than 650 universities, companies, nonprofits, and government organizations nationwide working across K–12 education, higher education, industry, and policy contexts to increase women's participation in computing and technology. Member organizations participate in one or more of five NCWIT alliances spanning the educational "pipeline" (K–12, academic, workforce, entrepreneurial, and affinity group alliances). As part of their membership in these alliances, they are entered into a change-leader community and connected to myriad other organizations working on similar efforts to make computing curriculum, as well as educational and workplace environments, more inclusive.

Members meet annually at the NCWIT National Summit to learn about and share promising practices and the latest research related to gender, diversity, and technology. Throughout the year, we employ a "personal trainer model," helping these organizations assess their needs and plan strategies for change in their own organizations. In so doing, we emphasize changing the overall culture around computing and technology, as opposed to promoting professional development efforts that tend to focus on helping women fit into existing cultures (e.g., creating a personal brand, developing an executive presence, speaking more assertively). While professional development efforts can help women survive their current organizational climate, we believe that, given the extensive research regarding the pervasiveness of bias, lasting change will not occur unless we work to change existing technology cultures.

The second prong in our approach revolves around *equipping* our members with research-based resources to help them implement practices that we know work for women and other underrepresented groups in computing. The NCWIT Social Science Team ensures that these resources and recommendations are grounded in the latest and best available research. According to our last member survey in 2013, our resources have been successful in raising awareness, increasing knowledge, and prompting action. Evaluation shows that eight out of ten members reported learning something new from NCWIT resources, and six out of ten used a new strategy because of a resource. Ninety percent of our members have shared a NCWIT resource with someone else.

Finally, the third prong of our approach involves *uniting* our members. We combine the efforts of programs such as Counselors for Computing,

sitwithme.org, and NCWIT Pacesetters to accelerate progress through national platforms and campaigns. Each combines the collective strength of our membership; NCWIT provides the infrastructure, tool kits, and project management to support these efforts, and members participate locally, tailoring these efforts to their own cultures and environments.

Our Counselors for Computing campaign aims to raise awareness among K–12 counselors, providing workshops and resources that build awareness about educational pursuits and careers in computing. Our Aspirations in Computing program is a pipeline program reaching thousands of girls each year from high school through college. Seed Funds and Extension Services support postsecondary practice implementation. The NCWIT Pacesetters program brings corporations and universities together to focus on quantifiable progress. Sit With Me is a platform to raise awareness about the important contributions technical women make. In providing a platform to showcase the stories of successful women in technology, this program also aims to challenge cultural images that associate technology with men or masculinity. A number of other NCWIT efforts are working to rewrite these cultural images, including our *Entrepreneurial Heroes* podcast series and Technolochicas, a new website that highlights the experiences of successful Latinas in computing.[42]

Throughout NCWIT's history we have focused on a wide variety of both aspirational and remedial efforts in each one of our strategic prongs, working with our membership and the general public at large to source ideas. For example, at the NCWIT summit, we acknowledge, inspire, and celebrate change leadership while discussing research and promising practices for change. The Aspirations in Computing program is inspirational and instructional, while Extension Services is remedial. Although it is difficult to prioritize and implement such a wide range of efforts, we have found that this range is critical to national progress. In other words, there is no "silver bullet"—the stakeholder base is broad and requires a wide spectrum of support.

Conclusion

Recognizing women as technical innovators requires explicit, conscious effort. To reiterate, simply adding women to the pot and stirring is not going to make their ideas recognized or used. The NCWIT approach (convene,

equip, unite) has resulted in practices and programs that have combined to achieve notable educational pipeline growth. We see this growth accelerating in the coming years. We also see public awareness of these important issues increasing rapidly. Note the recent attention to these matters in Silicon Valley and the subsequent release of diversity data by a number of companies.[43] We are excited to see this momentum and believe that it bodes well for a turning point in the conversation. While the numbers are often dismal, being transparent about the problem and providing a starting point from which to measure progress is vital. We cannot afford to let this momentum subside if we truly want to change existing conditions for women and other underrepresented groups in computing. We encourage organizations to take advantage of this moment and to work together across education, industry, government, and nonprofit sectors, ensuring that women no longer remain absent—that they instead are able to make vital and meaningful contributions to enhance the technology of future generations.

Notes

1. We examined all US information technology (IT) patents during this time period. We also used a multistep process to identify inventor gender. For more details on methodology, see Catherine Ashcraft and Anthony Breitzman, "Who Invents IT? Women's Participation in Information Technology Patenting," 2012 update, 19 July 2012, accessed 29 January 2016, http://www.ncwit.org/patentreport.

2. A solid body of research in computing and in other fields documents the enhanced performance outcomes when a diverse range of women are present in meaningful and creative roles. Lecia Barker, Cynthia Mancha, and Catherine Ashcraft, "What Is the Impact of Gender Diversity on Technology-Business Performance? Research Summary," 29 May 2014, accessed 29 January 2016, http://www.ncwit.org/businesscase/.

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6. Anita Williams Woolley, Christopher F. Chabris, Alex Pentland, Nada Hashmi, and Thomas W. Malone, "Evidence for a Collective Intelligence Factor in the Performance of Human Groups," *Science* 330, no. 6004 (2010): 686–688.

7. Jessica Canning, Maryam Haque, and Yimeng Wang, "Women at the Wheel: Do Female Executives Drive Start-up Success?" Dow Jones and Company (2012).

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