SOLUTIONS TO RECRUIT TECHNICAL WOMEN

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FOR WOMEN AND TECHNOLOGY

About the Anita Borg Institute for Women and Technology

The Anita Borg Institute provides resources and programs to help industry, academia, and government recruit, retain, and develop women leaders in high-tech fields, resulting in higher levels of technological innovation. Our programs serve high-tech women by creating a community and providing tools to help them develop their careers. ABI is a not-for-profit 501(c) 3 charitable organization.

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FOREWORD

The barriers facing women as they strive to enter the computing field often persist throughout their careers and affect their advancement. These challenges have been documented by several recent reports:[1]

- Young women are less likely to be encouraged to pursue technical careers than their male peers;
- Women in technical fields face isolation, lack of access to influential social networks, mentors, lack of sponsorship, and a lack of role models. Ongoing work-family pressures affect technical women's retention and advancement. Unwelcoming organizational cultures hurt the recruitment and retention of technical women.
- Persistent unconscious biases keep women's representation in technology low.

At the same time, companies are growing increasingly aware of the benefits of gender diversity for innovation.[2] Faced with these challenges and a desire to bring more top talent into their companies, organizations seek concrete solutions to recruit, retain, and advance technical women. Companies have tried a variety of approaches in recent years to develop practices that make their companies more welcoming to and supportive of technical women and some "best practices" are clearly emerging while other attempts have not worked. At the same time, such practices are not magic bullets or one size fits all; a different array of solutions will need to be adapted and customized to meet the needs of each company and its particular context.

This resource is Part 1 in a series of reports focused on solutions companies can employ to improve the recruitment, retention, and advancement of technical women.

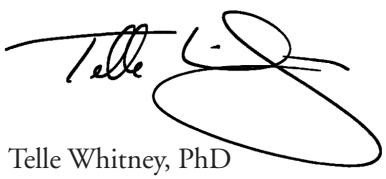
Our series will focus on sharing:

- Research-based solutions from established academic research;
- Evidence-based solutions from companies that have shown success for their organizations; and
- Innovative new programs that show promise from current corporate efforts.

Part 1 focuses on recruitment. We begin by examining the state of research on recruitment practices and how such practices impact women. We then feature company-specific practices that address the barriers identified by research and either show promise or are working to recruit technical women in many organizations.

These solutions are not intended as one-offs for companies to pick and choose from, but an "arsenal" that companies should bundle together and deploy broadly to achieve maximum impact. Companies wishing to benefit from gender diversity need integrated strategies on the recruitment, retention, and advancement of technical women through the highest levels of the organization. We do not prescribe a particular path to success but instead suggest that each company start by looking at the numbers, taking stock of where its challenges are most acute and then developing a coherent strategy that best addresses its particular culture given available resources. Rather than relying on *ad hoc* efforts, success depends largely on the development of an integrated array of programs and tactics to address each company's particular challenges as it seeks to recruit, retain and advance women.

We hope that the strategies and tactics outlined in this paper help you identify the challenges most crucial to your organization and help you find steps that achieve the goals you set to make your organization's culture more welcoming to women. The Anita Borg Institute is committed to working with organizations to create a culture where women are equally represented in the creation of technology.



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INTRODUCTION

When it comes to technical talent, industry recruitment and hiring practices have become highly complex over the past decades as the labor market for scientists and engineers has shifted from individual national economies to a truly global labor market (Freeman, 2008). Multinational companies face significant challenges and competition to fill technical positions. Renewed talk of a "global war for tech talent" emerged shortly after the recent economic downturn:

- Technology recruitment site Dice.com reports a 30% growth in the number of technical positions in the United States in 2011 (Dice, 2011); and
- In a global survey of 1,400 Chief Information Officers, nearly three quarters (73%) report that finding skilled IT professionals is somewhat or very challenging (Robert Half Technology, 2011).

By now, it has become standard for large companies to invest significantly in their recruiting infrastructures, building teams to handle such functions as campus recruitment, university relations, and internship programs. Even small companies, to stay competitive, need to invest heavily in their recruiting functions to attract the best talent and compete with the sophisticated recruiting mechanisms of large organizations. For both large and small organizations, this often means spending resources on outsourced recruiters and head hunters.

There are consistent blind spots in recruiting and hiring practices, however, that prevent companies from tapping into the full range of technical talent available — men, women or underrepresented minorities. Extensive organizational research indicates that these blind spots are concentrated in four areas:

- Concentrating recruitment at a small number of sites;
- Narrow recruitment criteria;
- Hiring processes that are implicitly biased; and
- Lack of organizational infrastructure to support recruitment and hiring efforts that yield high returns to both talent and diversity.

Research shows that when companies ignore these blind spots, they risk costs to equity, productivity, and innovation (Page, 2007; Herring, 2009).

This report is designed to help companies overcome these blind spots based on data-driven results in both academic research and corporate practice. We provide solutions for companies across four themes that correspond to each blind spot: **recruitment avenues** (page 5), **recruitment practices** (page 9), **the hiring process** (page 15), and **overarching considerations** (page 23). We highlight the very best literature in each area and present examples that show how high-profile companies have implemented the solutions we recommend. Some practices are more difficult or resource intensive to implement than others, but the array of practices drawn from companies that have begun to improve the representation of women and underrepresented minority talent represent opportunities for other companies who can learn from their experience. The goal is to continuously improve and adjust practices to reduce barriers, and in doing so, see greater returns on their searches for and investment in top technical talent.

Throughout this report, we focus on rigorous research as well as on practices and programs that companies link to measurable results in increasing the representation of technical women. Data for these examples were reported by companies themselves and do not represent evaluative work conducted by the Anita Borg Institute for Women and Technology. Several of these examples are drawn from IBM, the inaugural winner of the Anita Borg Top Company for Technical Women Award, based on their representation of technical women at all levels as well as sustained year-over-year improvement.

Solutions to Recruit Technical Women

"Solutions to Recruit Technical Women" explicates a variety of solutions that can help companies improve the representation of technical women through recruitment. While the text provides a framework for a recruitment strategy, the selection and bundling of tactics should be driven by the particular culture and success of a company's current recruitment efforts. Implementation can be customized depending on resources available and goals to be achieved and the levels of positions the company wishes to target. Recruiting at the entry level, for example, necessitates a strong university relations and internship program, while recruiting at the mid and senior levels necessitates a strategic understanding of the social networks at play in referrals. The Anita Borg Institute recommends the following solutions and provides resources and programs to help companies leverage the innovative power of technical women.

RECRUITMENT AVENUES

How can companies expand their avenues of recruitment to reach more and diverse technical women candidates?

1 Build strong ties to conferences, colleges and universities, and professional organizations where there are high proportions of women from diverse backgrounds.
2 Build a gender-balanced internship program for technical positions.
3 Use social networks strategically to increase the number of female candidates for technical positions and minimize homogeneity in referrals.

RECRUITMENT PRACTICES

How can companies refine their recruitment practices to bring more and diverse technical women into their candidate pool?

4 Apply broad individual and institutional criteria to the recruitment effort.
5 Re-think the meaning of "cultural fit" to broaden the talent pool under consideration and limit the effect of hidden bias.
6 Revise job descriptions to reduce gender stereotypes.

HIRING PRACTICES

How can companies re-tool the hiring process to improve the representation of technical women among new hires?

7 Institute a blind resume screening process to reduce the potential for unconscious bias.
8 Build gender-diverse hiring teams and showcase technical women during the interview process.
9 Set targets to hire technical women.
10 Require that every open technical position has a viable female candidate.
11 Support and reward hiring managers' open hire practices.
12 Adapt the interview process to be welcoming to diverse candidates.
13 Train hiring teams and managers to reduce implicit biases.
14 Implement dual-career support mechanisms when relocation is involved.

RECRUITMENT AND HIRING: OVERARCHING CONSIDERATIONS

How can companies institutionalize recruitment and hiring practices that increase the representation of women among their top talent?

15 Hold executives and managers accountable for reaching diversity goals and targets.
16 Develop, maintain and project a welcoming culture.
17 Redefine the pipeline — create alternative pathways to technical positions and establish mechanisms to bring women back to technical roles.
18 Measure and evaluate your efforts to increase the representation of women.
19 Fund or create K–12 initiatives around the world and advocate for computer science education to encourage a bigger pipeline of technical women for the future.

HOW CAN COMPANIES EXPAND THEIR AVENUES OF RECRUITMENT TO REACH MORE AND DIVERSE TECHNICAL WOMEN CANDIDATES?

Research shows that targeted diversity recruitment efforts are a significant predictor of diversity in companies (Kalev et al., 2006). A first step in this effort is to increase the breadth of the potential candidate pool. Companies that aim to increase the pool of women candidates for technical positions should start by seeking out new recruitment venues and opportunities, engaging young women as students, or employing networks to reach a broader range of women. It is important to encourage more women to apply as well as for the company itself to consider a broader range of possible candidates.

1. BUILD STRONG TIES TO CONFERENCES, COLLEGES AND UNIVERSITIES, AND PROFESSIONAL ORGANIZATIONS WHERE THERE ARE HIGH PROPORTIONS OF WOMEN FROM DIVERSE BACKGROUNDS.

Attracting top talent, especially at the entry level, requires a broad recruitment strategy. Companies need to "reach technical women where they are" and build relationships with institutions and organizations that have a strong representation of technical women, as well as with promising women and minority students themselves. Appendix A includes a list of conferences, universities, and professional organizations where companies can consider establishing such relationships, as well as some global venues to consider.

To leverage these new ties, companies might take the following actions as part of their strategic university and external relations efforts:

- **Encourage and engage technical women from your company to serve as role models and ambassadors,** encouraging them to give technical talks on campuses, take seats on advisory boards and boards of these institutions, or serve as speakers and committee members at conferences.
- **Engage your technical workforce in mentoring women and underrepresented minority candidates** at universities or through services such as MentorNet (www.mentornet.org). Participate in outreach activities at conferences, universities, and colleges with female technical students, interacting with their "Women in Computer Science" student and faculty groups. Engage with university alumnae/alumni networks from Science, Technology, Engineering, and Mathematics (STEM) fields (for example, the Indian Institute of Technology global alumni networks, or the MIT alumnae Association, AMITA), and consider partnering with or creating your own corporate alumnae network. Companies often start alumni networks for access to quality referrals from former employees (Xing, 2006). Social media also significantly extend the reach and opportunities associated with alumni networks. Engage with key professional organizations (see Appendix A).
- **Fund targeted projects with universities,** which have been shown to develop strong future employees (Curtis et al., 2009). For example, fund research projects that increase women's exposure to computer science research during their undergraduate studies. One such initiative is the Distributed Research Experiences for Undergraduates (DREU), which is implemented by the Computer Research Association–Women (CRA-W) and the Coalition to Diversify Computing (CDC). This initiative, which aims to increase the number of women and underrepresented minorities pursuing

graduate studies in computer science and engineering, has been found to strengthen women's interest in computing and increase their persistence in graduate programs (Herrera, 2001). Similar programs can be found in many other countries.

- **Fund scholarship programs for women students in technical fields.**
- **Seed initiatives in engineering, IT, and/or research and development departments that facilitate collaborations with academic faculty and students.** For example, Intel has established "Intel Science and Technology Centers" at major research institutions to foster ongoing research collaborations between their corporation and academia. Similarly, Microsoft Research Collaborative Institutes establish enduring university-industry collaborations in Asia, Europe, and the Americas.

These practices, by establishing solid relationships with emerging technical talent in academic institutions around the world, can be a cornerstone strategy for companies who wish to recruit diverse talent.

Best Practices in University Recruiting

Over several years at Cisco, Engineering Inclusion and Diversity Manager Stefi Ganesan has developed a set of best practices to build a diverse pipeline for university recruiting.

1. **Consistency is key!** Develop at least a three-year diversity goal and engagement plan. Align all activity towards the goal — and stick to it. Do not apply a stop-and-go tactic to the strategy; a level of engagement needs to be maintained to sustain momentum and establish key relationships.
2. **Integrate your communication strategy** internally and externally.
3. **Tie accountability to performance** for all stakeholders involved.
4. **Ensure diversity is a consistent part of the decision-making process** when business priorities require adjustment to the overall recruiting strategy.
5. **Invest in multiple touch points** — successful diversity recruitment requires high touch. Ensure that a strong and consistent business interface with diverse talent is represented at critical events and university campuses.
6. **Establish strong diversity tracking metrics** to drive business results.
7. **Be aggressive and committed to your goals** and execution.
8. **Execute on offers ASAP.** Competition for high caliber, diverse talent is fierce; first mover advantage is rewarded.
9. **Develop a plan and prepare the recruiting team** for conferences and diversity programs or events. Execute well so you don't miss opportunities to engage and hire diverse candidates.
10. **Maximize ROI at national and regional conferences** that offer opportunities for recruiting technical women. Leverage branding and visibility, maximize engagement from your technical women, incorporate technology products at the conference, take advantage of additional sponsorship opportunities, provide or sponsor scholarships, and access resume databases in advance to pre-screen candidates, schedule interviews and engage top talent.

2. BUILD A GENDER-BALANCED INTERNSHIP PROGRAM FOR TECHNICAL POSITIONS.

Internship programs have well documented positive effects for companies and the students who participate and can be a cost-effective way to develop technical talent. Internship programs can help build relationships with key institutions and organizations (Curtis et al., 2009). They are an important element of university-industry knowledge exchange mechanisms that are critical to driving innovation (Hughes, 2007; Etzkowitz, 2004). Internships also provide hands-on experience for students from diverse backgrounds and can help build their confidence in computing work (Dahlberg et al., 2007; Burgstahler and Ladner, 2007).

The experience of a successful internship can change attitudes within companies as managers work with students who might not usually be selected into candidate pools due to bias in recruiting processes and norms in hiring (see Solutions 4, 5, 6, 12, and 13). This can increase the willingness of hiring teams to consider and hire from a broader range of educational institutions. Companies can:

- **Develop strong technical and research internship programs** that allow undergraduate women and men to gain exposure to industry settings and develop skills that are valued in technical workplaces.
- **Ensure internship programs are gender balanced** by developing programs where women comprise a "critical mass" of participants — at least 30% and as much as 50%. Indeed, research documents beneficial returns to having a critical mass of at least 30% women (Ely, 1995; Reskin et al., 1999; Kanter, 1977). For optimal innovation returns, recent research suggests that a 50% representation is ideal (London Business School, 2007; Wooley et al., 2010).

Internship programs offer additional benefits such as facilitating outreach to women in computing fields and increasing women's participation in industry settings. Companies should see internship programs as a high-potential recruitment venue for technical women.

IBM: Research Internships for Women in Computing

IBM has designated research internship positions for undergraduate women in STEM fields, in order to encourage persistence, expose them to research experiences, establish strong relationships with universities, and build a broader community of potential hires.

Key elements:

- Internships are paid, enabling students from all socio-economic backgrounds to consider applying.
- Applicants go through a rigorous selection process based on academic interest, credentials, and appropriate letters of recommendation. Applications are reviewed by IBM researchers.
- Interns are assigned a mentor for the duration of the internship, increasing the benefits of their experience. The company keeps in touch with former interns.
- Many female IBM Researchers participate in recruiting events, panel sessions, and workshops, as well as activities planned around "Engineers Week" aimed at increasing women in technical fields and generating interest in internship opportunities.
- 25% of IBM Research's University Relationship managers are female. This is not only aimed at recruiting females but retaining females within the Research community.

Outcomes:

- A majority of former IBM Research interns pursue graduate level degrees as a direct result of their internship opportunity with IBM.
- Successful internship experiences have resulted in more women candidates for permanent positions and increased hires for women.

3. USE SOCIAL NETWORKS STRATEGICALLY TO INCREASE THE NUMBER OF FEMALE CANDIDATES FOR TECHNICAL POSITIONS AND MINIMIZE HOMEGENEITY IN REFERRALS.

When looking to recruit technical women, companies should strategically and selectively leverage the power of existing social networks among their employees and, possibly, alumni/ae. Several network dynamics may affect your hiring process. Employees tend to hire others who are like them (Torres and Huffman, 2004; Gorman, 2005; Rubineau and Fernandez, 2010). This is a double-edged sword for companies seeking diversity, since the majority population within a company or profession will be more likely to hire those who are similar to them.

Research on how people get jobs underlines this effect. Jobs are more likely to be found through social networks (Granovetter, 1974; Marsden and Gorman, 2001). Men are more likely to have the connections that bring job offers, and are more likely than women to get their jobs through informal networks (McDonald, 2011; McDonald et al., 2009). Women are less likely to obtain jobs through informal networks and less likely to receive unsolicited job offers, even after controlling for experience (McDonald, 2010; McDonald et al., 2009). Jobs that are male-dominated are more likely to see male referrals regardless of the gender of the referrer (Rubineau and Fernandez, 2010).

These studies suggest that social networks have the potential to negatively affect diversity. **Companies need to carefully manage the role of networks in recruitment such that they lead to more, not less, diverse candidate pools.** Attempts to leverage those networks with a goal to increase diversity, therefore, need to explicitly focus on eliciting references to women and minority candidates. Specifically, companies can:

- **Encourage technical women to refer candidates, and encourage female referrals from all employees for technical positions.** As employees are likely to know others with similar profiles and backgrounds, technical women within the organization can leverage their social networks to reach out to other female candidates. Technical women are also powerful role models for potential hires (see Solution 8).
- **Establish and leverage alumnae networks** to keep in touch with former employees who may be interested in returning to your organization and who can foster introductions to other women candidates.

IBM: Leveraging Global Employee Networks to Sustain Employee Diversity

In recruiting technical women, IBM has made internal networks of technical women a cornerstone of its diversity recruitment. Technical women within IBM are actively encouraged to refer other technical women for employment at IBM.

Key elements:

- Leveraging employee networks makes recruitment more personal.
- Referrals are strategically encouraged where they contribute to the diversity strategy.
- Incentives are specifically designed for diversity referrals, with bonuses for referrals of diversity candidates. The amount of the referral or incentive varies by country.
- The infrastructure for support of technical women within the organization is strong, making existing employees more likely to refer others for employment.
- The success rates of referral are closely monitored.

Outcome: IBM estimates that close to 30% of the total professional women hires worldwide are made through these connections.

HOW CAN COMPANIES REFINE THEIR RECRUITMENT PRACTICES TO BRING MORE AND DIVERSE TECHNICAL WOMEN INTO THEIR CANDIDATE POOL?

Expanding avenues of recruitment is the first step in the process to improve the representation of technical women. The second step involves refining recruitment practices, or those practices that are designed to identify the "right" people for the job, introduce them to the company, and encourage them to apply. This is, in many ways, the company's opportunity to market itself as a potential employer to the full pool of available technical talent. How a company advertizes its positions and to whom it reaches out will shape the group of candidates who self-select into the potential pool for each position.

4. APPLY BROAD INDIVIDUAL AND INSTITUTIONAL CRITERIA TO THE RECRUITMENT EFFORT.

Recruiting at elite institutions and through elite networks lowers diversity by favoring white upper middle class graduates (Rivera, 2010). Many technology companies target specific schools for their entry-level hiring, focusing on technical talent from a small number of elite computer science and engineering programs. As a result, their pipeline of technical women (and men) at the entry level is determined not on the national availability of talent earning technical degrees, but on the perhaps narrow admissions decisions of a very small number of universities, compounding any bias existing in the external entity's processes.

Recruiting individuals for a narrow set of skills (such as limited programming experience or GPA) can also drastically limit the pool of candidates, whereas expanding criteria to also include qualities like problem solving can elicit a larger and more varied pool to consider (Anita Borg Institute, 2009). Re-thinking the range of required skills does not amount to "lowering the bar" — rather, it can increase access to different types of talent that can, collectively, serve a company's needs more effectively. The company is likely to gain not only in diversity but in innovation capacity, as teams with cognitive diversity outperform homogeneous teams (Page, 2007). Companies can apply broad institutional and individual criteria to recruitment efforts:

- **Look beyond GPA,** which does not predict long-term career success (Abele and Spurk, 2009).
- **Search for problem-solving ability and candidates who offer a different perspective** in addition to evidence of academic achievement and programming skill (Ashcraft, 2008; Page, 2007).
- **Consider the skills that match the strategic direction your workforce needs for the long term** (Curtis et al., 2009).
- **Ask what kind of team building and collaboration skills candidates should have,** in addition to technical skills.
- **Eliminate policies that concentrate on a narrow set of universities.**
- **Reach out to talented individuals from a broad range of schools.** Reconsider whether institutional criteria you apply to recruiting harm your effort to attract talented women and men from diverse backgrounds. (See Solution #1 and Appendix A for more.).

In one example, in order to increase its talent pool, Intel successfully targeted its recruitment programs to include graduates across STEM fields. Intel currently actively targets the following disciplines as part of its recruiting strategy: Electrical Engineering, Computer Engineering, Computer Science, Mechanical Engineering, Electronics Engineering Technology, Chemical Engineering, Materials Science, Industrial Engineering, Environmental Engineering, Physics, and Chemistry.

Indeed, when it comes to diversity, not all fields are created equal. In the United States, women hold only 9% of electrical engineers bachelor's degrees. Yet women earn 50% of bachelors' degrees and 25% of PhD degrees in Chemistry in the United States (National Science Foundation, 2010), along with 19% in engineering fields overall. **Considering graduates across STEM fields creates a broader potential pool to hire women in technical positions, both in hardware and in software positions.**

Recruiting for Team Problem Solving through Pair Programming

Faced with the realization that traditional hiring practices were failing to identify the kind of team players they were looking for, Menlo Innovations, a custom software design start-up firm, created a hiring process that mapped onto the skills they were looking for to match their "agile programming" methodology: hires who could successfully engage in pair programming.

Their hiring process was re-designed to test the ability of candidates to put the team ahead of the individual. The hiring process brings candidates in pairs and focuses on their ability to solve problems in a pair setting, in a series of three different observed pairings. Candidates with the strongest teamwork skills are selected.

The methodology described by Menlo Innovations does not discuss the gender and minority makeup of the resulting hires. However, it serves as a promising example of hiring with broad criteria (Goebel et al., 2002). This specific approach also resonates with the finding that pair-programming is one of the most successful instructional methods to engage women and underrepresented minority students at the university level (McDowell et al., 2006).

IBM: Project View — Targeted Outreach Activities for Women and Minorities

Project View targets women, under-represented minorities, and individuals with disabilities who have specific skills (hardware, software, business) to consider employment at IBM. Candidates are referred to the program by recruiters, and broad outreach with key institutions is also conducted to increase the pool of applicants. The program invites screened applicants to spend two days at IBM, all expenses paid, to consider career opportunities within a specific area or business unit. Managers with open positions actively participate in the events, and offers are extended based on mutual interest at the end of the two days.

Key elements:

- The project benefits from strong executive and management support.
- The program is tied to managerial accountability and targets (see Solution 15) for hiring women and underrepresented minorities. The program provides managers with a critical infrastructure to meet their objectives in bringing diverse talent into the company.

Outcomes:

- Project View has helped to attract over 2,000 minority candidates to IBM.
- The events have achieved consistent results: offers are made to 40–50% of those attending.

5. RE-THINK THE MEANING OF "CULTURAL FIT" TO BROADEN THE TALENT POOL UNDER CONSIDERATION AND LIMIT THE EFFECT OF HIDDEN BIAS.

Many modern recruiting practices are predicated on screening candidates for "cultural fit." While alignment of candidates with an organization's values and direction is important, cultural fit should not be used as a proxy for creating homogeneous teams. "Fit" often gets evoked as a vague reason not to hire someone — and may be tied to stereotypical assumptions around the kind of people who succeed in an organization (Ashcraft, 2008). Indeed, "fit" has been found to be routinely used to justify the hiring and promotion of men over women (Lyness and Heilman, 2006). In the case of computing, these assumptions are often based on stereotypes of masculine behavior (Simard et al., 2008; Cheryan et al., 2009). Technology companies that are based on "cultural fit," peer evaluation, and emotional attachment to the company (also known as a commitment model), have been shown to be the most inhospitable to women (Baron et al., 2007; Ridgeway, 2011).

- **Review where you reach out and list openings and consider a broader range of institutions.**
- **Ask hiring managers and teams not only what they are looking for but what they are missing on their teams currently.**
- **Push back on hiring teams when "fit" is evoked in candidate reviews.**

The Computer Boys Take Over by Nathan Ensmenger

The framing of jobs involving stereotypically male characteristics has been found to be partly at fault for the masculinization of the computer science profession. In "The Computer Boys Takeover," historian Nathan Ensmenger documents how hiring practices that rose out of the 1960s continue to influence the industry today. The demand for skilled programmers in corporations, combined with a lack of training and availability, led companies to go to great lengths to identify technical talent and led to the creation of aptitude tests designed to look for "innate characteristics" that would predict the success of a computer programmer: "The central assumption was that programming ability was an innate rather than a learned ability, something to be identified rather than instilled…" (p.67).

This assumption of "innate ability" fueled a preponderance of male candidates who had previous exposure to computers, excluding candidates from diverse backgrounds. A study then identified that a large proportion of programmers were disinterested in people and excessively independent. Even while critics suggested that this finding was the result of the existing selection process, a powerful and enduring image of the "bearded, sandal wearing, anti-social, independent and assertive programmer" was born, resulting in implicit bias against women candidates:

"The primary selection mechanism used by the industry selected for antisocial, mathematically inclined males, and therefore antisocial, mathematically inclined males were overrepresented in the programmer population; this in turn reinforced the popular perception that programmers ought to be antisocial and mathematically inclined (and male), and so on ad infinitum. Combined with the often-explicit assumption of programming personnel with beards, sandals, and scruffiness, it is no wonder that women felt increasingly excluded from the center of the programming community… the fact that the use of lazy screening practices inadvertently excluded large numbers of potential female trainees was simply never considered. But the increasing assumption that the average programmer was also male did play a key role in the establishment of a highly masculine subculture" (pp.78–79).

Cisco: Cisco Choice — An Innovative Approach to Hiring Technical Talent

The Cisco Choice Program, Engineering's university hire program, flipped the hiring process on its head. Rather than interviewing and hiring computer science and engineering students for specific positions with potentially narrow job descriptions, the program has funneled pre-screened, talented technical students to a three-week orientation program where candidates:

- Get exposure to senior executives;
- Meet with business unit leaders and managers; and
- Learn about different parts of the business and technology.

At the end of the process, the students have the opportunity to choose the Engineering department, job, and manager that best suits their goals and interests.

In the US as well as globally, university hiring is a major focus for Cisco – approximately half of the university hires go to Engineering and approximately 30% of total Engineering hiring comes from University Hiring.

The Cisco Choice program has been designed to be a critical part of the company's diversity recruitment strategy. The program ran as described here from 2006 to 2011, and is currently being adapted to meet recruiting needs and align with strategic business priorities.

Key elements:

- The initiative benefits from strong executive support and commitment.
- The program includes a diversity strategy informed by industry and customer benchmarks.
- Interviewers go through rigorous training in how to screen and interview diversity candidates.
- The approach provides all candidates, including women, with an opportunity to find the right personal and cultural fit within the organization.
- The power of individual managers to hire through well-worn networks or to focus on narrow skill sets is limited, since candidates were not hired for a specific job description.
- The program consistently measures its success rates in recruiting technical women through the program and in retaining them.
- The training and salary of Choice employees has been assumed by the corporate budget, not individual managers, offering additional incentives for managers to attract Choice candidates.
- The program has been tightly integrated with strong retention initiatives like Cisco's Early in Career Network, an employee resource group.
- The process resonates with Millenials who have been shown to come into the workforce with high expectations over doing meaningful work, career advancement, development opportunities, and organizational culture (De Hauw and De Vos, 2011).

Outcomes:

- On average, the program has brought in 500 interns and full-time hires per year.
- With these program elements in place, Cisco Engineering has seen a 10 percent increase in the representation of technical female college recruits since its inception.
- The program has improved the retention rate of female university technical hires by about 30% over Engineering's overall average.
- Over 1,000 Millenials have been hired for full-time positions through Cisco Choice over a four-year period; among those who have been there three or more years, the voluntary retention rate is 95.2%.

6. REVISE JOB DESCRIPTIONS TO REDUCE GENDER STEREOTYPES.

Companies should strive to create gender-neutral hiring processes, starting with a careful review of job descriptions. **Job descriptions send signals that influence both the recruit *and* the recruiter.** When job descriptions are linked to typically masculine traits or characteristics (e.g. competitive or assertive), hiring teams are more likely to hire men than women, and male candidates are more likely to apply. Conversely, when a job description includes a trait or characteristic that is thought of as stereotypically feminine, such as "collaborative", women are more likely to be hired (Gorman, 2005). One study found that over half of law firms referenced stereotypically masculine behaviors in their job descriptions and that each additional masculine criterion reduced the odds of a woman filling the position by about 4–7% (Gorman, 2005). Other studies have shown that job titles with a male word component (e.g. "chairman") prime gender stereotypes and result in bias in hiring (McConnell and Fazio, 1996).

People tend to ascribe greater potential success to stereotypically masculine characteristics when the profession is male dominated, further reinforcing gender segregation in jobs (Cejka and Eagly, 1999). This also lowers women's chances of being hired to a leadership position, as leadership is perceived as a male domain in the U.S. (Eagly and Carli, 2007; Reskin and Bielby, 2005). Male characteristics or personality traits (e.g. assertive, competitive, tough) are thought to be necessary to succeed in jobs that are male dominated, whereas female characteristics (e.g. nurturing, collaborative, warm, helpful) are thought to be necessary in jobs that are female dominated (Cejka and Eagly, 1999).

Companies should review job descriptions, considering how the description might unintentionally favor consideration of certain candidates or narrow the pool of applicants by communicating implicit biases:

- **Eliminate bias in the way open positions are structured.** For example, ask whether the position favors candidates in a specific age group or with a specific family structure. Change descriptions that narrow your pool implicitly such as avoiding setting expectations of "energy" and "availability."
- **Reduce the use of gendered character traits.** Job descriptions and requirements that include characteristics such as "assertive, outspoken, and ambitious," words that permeate many job descriptions in high-tech today, are likely to favor male candidates being hired.

A resource to check on your job descriptions is NCWIT's Supervising-in-a-Box series (NCWIT, 2010).

Job Description Do's and Don'ts

Do:

- Focus the job description on the required skills that are measurable and non-stereotypical.
- Clearly articulate what the position entails.
- Focus on measurable and quantifiable criteria.
- Consider the current and future skills that are needed for your company beyond the individual job description (Curtis et al., 2009).

Don't:

- Use terms that evoke stereotypes such as "rock star hacker" or "coding ninja." These evoke strong stereotypes of "geek" and egocentrism that are unlikely to appeal to a broad audience and increase the likelihood that hiring teams will be influenced by stereotypes in hiring.
- Use qualifiers that are strongly associated with masculine stereotypes: "assertive," "driven," "ambitious," "outspoken."
- Use masculine-type job titles such as "chairman" — instead, use gender-neutral titles.
- Use terms that evoke age stereotypes, which are likely to alienate older workers and dual career candidates: "24/7," "tireless," and "young."
- Include subjective criteria and descriptors such as "has a positive attitude," "shows initiative," and "calm under pressure."

HOW CAN COMPANIES RE-TOOL THE HIRING PROCESS TO IMPROVE THE REPRESENTATION OF TECHNICAL WOMEN AMONG NEW HIRES?

As companies expand their avenues of recruitment and refine their recruitment outreach, it is also imperative to re-tool hiring processes to remove or reduce "implicit" biases and work toward greater diversity among new hires.

"Implicit" biases are those biases resulting from our unconscious thoughts and opinions about people and topics that influence our decision-making. For example, an implicit association was found between math and science and "male" in the majority of the population of over 30 countries (Nosek et al., 2009). **Designing a recruiting process that is free of implicit biases can be difficult—but not insurmountable.** Look for the following traps documented by research:

- **Men are more likely to be perceived as competent than women, even among job candidates with equivalent qualifications** (Ridgeway, 1997). This finding has been consistent across decades of hiring studies (Isaac et al., 2009). This perception is especially salient in male-dominated domains such as information technology (Ridgeway, 2011).
- **Experiments show that for identical resumes, male candidates are preferred over female candidates for jobs that are typically thought of as male-dominated** (such as construction and sales), and for jobs that appear gender neutral. Female candidates are preferred over male candidates for jobs that are stereotypically feminine such as nurse, teacher, or secretary (Davison and Burke, 2000; Rosenwasser and Dean, 1989; Cejka and Eagly, 1999).
- **Men and women who have young children receive significantly fewer quality job referrals than those without young children** (Huffman and Torres, 2002).
- **Because of implicit biases, minority candidates often have to show superior qualifications to majority candidates to be considered for employment** (Wilson et al., 1999).
- **Recent research finds that women in male dominated technical environments learn to downplay their technical competence in order to be accepted in the male dominated environment, affecting their hiring experiences** (Peterson, 2010). A job interview that emphasizes one's ability to "sell oneself" puts women at a disadvantage (Peterson, 2010).

These types of biases are particularly problematic when companies recruit for technical positions, as stereotypically masculine traits are often ascribed to computer programmers/scientists, and computing is a male-dominated profession (Cheryan et al., 2009). Conflating "technical work" with "men's work" leaves women on the periphery.

Technical Women in India: The Effect of Implicit Biases on Hiring

In India, women in technology face significant societal pressures once they are in the workforce and have a family, with deep-seated perceptions that women's main responsibility is to their family. This belief influences women's likelihood of being hired and their advancement opportunities; research shows executives report concern that technical women hires will leave their jobs when they marry or have children and cite this concern as a consideration in hiring (Parikh and Sukhatme, 2004).

To combat these pervasive biases, make sure your recruiting process — from design and structure through implementation — does not overly emphasize male traits or perceptions of cultural fit that inadvertently prevent you from considering all the top technical talent available. Set a target for the representation of women in the hiring pool and for positions, and institute some or all of the following recommendations.

7. INSTITUTE A BLIND RESUME SCREENING PROCESS TO REDUCE THE POTENTIAL FOR UNCONSCIOUS BIAS.

Research suggests that in both hiring and promotion, unconscious biases lead to perceptions of women candidates as "risks", especially when the job is stereotypically male, such as leadership positions (Eagly and Carli, 2007). The same biases are at work for other jobs traditionally held by men, such as technology work. Men are more likely to be implicitly tied to characteristics such as logic, leadership, ambition, and decisiveness, whereas women are more likely to be implicitly tied to sensitivity, nurture, care, friendliness, and cooperation (Cejka and Eagly, 1999; Eagly and Carli, 2007). Many individuals faced with a hiring decision for a technology leadership position are therefore likely to unconsciously prefer the male candidate.

Making a hiring process "gender blind" by masking the gender of candidates, however, significantly reduces the introduction of bias in hiring (Wilson and Brekke, 1994; Reskin and Bielby, 2005). In one well-known study of elite orchestral auditions, gender blind auditions (concealed with a screen) increased women's chances of making it past the first round of auditions by 50 percent, and increased the proportion of women hired by 30 percent (Goldin and Rouse, 2000).

While face-to-face interviews in technology organizations preclude the possibility of a complete gender-blind hiring process, an innovative practice for high-tech companies would be to introduce gender blind processes in as many recruitment and hiring steps as possible. Consider these ideas:

- **Conceal the names attached to resumes** in the pre-screening process.
- **Screen for technical proficiency and problem solving without any gender information.** For example, invite candidates to submit a code sample unattached to names or faces when applying for a programmer position.
- **Consider innovative approaches such as pair programming exercises** (see Solution 4).
- **Encourage hiring team members to assess and rank candidates separately** before making their recommendations to avoid activating biases in group dynamics.

8. BUILD GENDER-DIVERSE HIRING TEAMS AND SHOWCASE TECHNICAL WOMEN DURING THE INTERVIEW PROCESS.

A known barrier to gender diversity in hiring is that individuals tend to hire those who are like them (Torres and Huffman, 2004; Gorman, 2005; Rubineau and Fernandez, 2010; Kanter, 1977; Fernandez and Sosa, 2005; Fernandez and Fernandez-Mateo, 2006).When evaluating candidates, interviewers tend to prefer those

with similar educational and cultural backgrounds (Rubineau and Fernandez, 2010), resulting in a homogeneous workforce.

Remember that while your company seeks to narrow its choices, each candidate is also interviewing you to determine if they want to work for your company. The top talent will have numerous options and may eliminate your company for consideration. Technical women within your organization are critical to your hiring efforts, therefore, both to identify the best candidate for each position and to engage potential candidates, address their concerns, and encourage women and minority candidates to accept offers.

Research shows that the presence of women in high-level positions has a significant effect on the presence of women in companies at all levels, and this effect has been shown to be strong for technical positions (Cohen et al., 1998; Kalev et al., 2006; Chambliss and Uggen, 2000). Moreover, the presence of women on hiring teams, committees, and searches is linked to increased likelihood of hiring female candidates (Gorman, 2005; National Academy of Sciences, 2010).

- **Ensure that hiring teams for technical positions are diverse** by including women and minorities.
- **Include experienced managers on hiring teams.** Don't leave hiring decisions to inexperienced managers alone. Research shows managers with more experience are slightly less likely to make biased hiring decisions (Marlowe et al., 1996).

9. SET TARGETS TO HIRE TECHNICAL WOMEN.

Goal setting and measurement at the highest level have been found to be critical to the success of diversity initiatives (Leonard, 1985; Kalev et al., 2006). Companies that are serious about hiring technical women (and in retaining and advancing them) set goals, or targets, for the numbers they want to achieve. The target for recruiting should reflect the strategy of the company — for some companies, target numbers that reflect the product customer base is the right call to action whereas, for others, hiring a ratio of technical women that meets or exceeds the pipeline of graduates in the company's relevant disciplines is articulated. Meeting these targets requires broadly communicating them to hiring teams, supporting the effort through techniques such as gender-diverse hiring committees (see Solution 8), and holding hiring managers accountable to reaching targets (see Solution 15).

Setting targets is sometimes met with resistance. There is fear that setting a target is equivalent to a quota and constitutes reverse discrimination; however, not setting a specific, measurable goal for the hiring of women in technical roles is likely to end up in a failed effort. Targets are not the same as quotas — a quota is a mandatory number of women in a specific position, regardless of reality. Quotas are often perceived as "lowering the bar," which can damage perceptions of women's competence and create a negative reaction from women themselves (Heilman and Alcott, 2001). *A target, on the other hand, is a goal to be attained, like any other company goal.* In practice, it means that hiring managers need to make an effort to find female candidates and favor a female candidate only when candidates are of *equal competence and experience.* Indeed, research shows that setting a target of at least 25% female candidates in the pool considerably helps diminish the potential for gender bias in the hiring process (Heilman, 1980).

Intuit: Changing Mindsets at the Local Level

Regardless of whether a company sets targets formally, leaders across the company can have a significant impact on hiring by putting diversity at the forefront. This involves the sometimes slow process of shifting mindsets by emphasizing the importance of a diverse pipeline of candidates for open positions.

When an engineering executive at Intuit needed to grow her team in India, which was initially all male, she made it her personal mission to represent women in numbers comparable to those of the broader Intuit engineering community — a significant increase from the typical percentage on teams in India. She first needed to convince her hiring managers of the value of diverse teams, since many of them had never participated on or managed a diverse team. She then worked with the managers to extend their recruiting reach to attract qualified female candidates and provided them with goals.

Key elements:

- Executive commitment can ensure that the pool of candidates has a fair representation of women.
- Set goals to guide managers.

Outcome: Through hiring, the group achieved an increase in the representation of technical women from 0% to 20% in six months. A committed leader can ensure that the pool of candidates has a fair representation of women.

10. REQUIRE THAT EVERY OPEN TECHNICAL POSITION HAS A VIABLE FEMALE CANDIDATE.

One of the most influential practices to increase the representation of technical women among new hires is to mandate that female candidates be included in the pool of candidates for open technical positions. This practice ensures that the hiring teams will spend sufficient time finding viable female candidates and circulate the position outside traditional networks (Simard et al., 2008). **One study of hiring at a high-technology company over a period of 10 years showed that women fared as well as men in their likelihood of being hired once they were in the slate of candidates** (Petersen, Saporta, and Seidl, 2000).

In a powerful example of how such a rule can increase the representation of women and minorities, the National Football League (NFL) has implemented the "Rooney Rule," requiring that at least one viable minority candidate be interviewed for every head coach position. As a result of the policy, African American representation in head coach positions increased from 6% in 2001 to 22% in 2006, closer to but still lagging the 65% of players who are African American (Collins, 2007). High-tech companies might consider adopting such a rule in their own practices.

Intuit: Holding Recruiting Firms Accountable

Despite efforts to increase the representation of technical women, many companies are faced with all-male slates coming from recruiting firms, especially at the executive level.

In working with executive search firms, Intuit Chief Technology Officer Tayloe Stansbury established clear guidelines that he fully expected recruiters to present the company with a gender-diverse slate of candidates. From August 2010 through August 2011, he was responsible for filling four technical vice president positions. He filled two of them with women.

Key elements:

- Executive commitment ensures that the pool of candidates has a fair representation of women.
- Recruiting firms are required to present female candidates, thus supporting a recruitment strategy that considers women for jobs.
- The hiring infrastructure, including recruiting firms, is aligned with the goal to increase the representation of women.

Outcomes:

- Intuit doubled its number of women technical executives over a twelve-month period.
- These search firms develop relationships to female technical talent, benefiting female candidates as well as other companies using their services.

11. SUPPORT AND REWARD HIRING MANAGERS' OPEN HIRE PRACTICES.

When not managed, hiring through networks and referral has been shown to reinforce inequality in organizations and undercut diversity by encouraging in-group favoritism, as people tend to know and value others who are like them (Braddock and McPartland, 1997; Fernandez and Fernandez-Mateo 2006; Fernandez and Sosa 2005; Mouw, 2002; Petersen et al., 2001; Ibarra, 1993, 1995; Stainback, 2006b). In technology, this can lead to a counter-productive cycle of identifying and selecting male candidates for masculine-typed technical jobs, who, once hired, go on to hire more in-network men.

Research shows that **open recruitment practices for internal and external hiring can increase the number of women** in leadership positions and at all levels of the organization (Reskin and McBrier, 2000; Eagly and Carli, 2007). A large-scale study showed that each open recruitment practice reduces the odds of a man being selected for a management position by 13 percent (Reskin and McBrier, 2000). "Open practices" mean that jobs are broadly advertised and that the criteria for the position are transparent.

Companies should institute open hiring practices.

- Announce and disseminate position postings broadly.
- Ensure all candidates have equal access to critical hiring information.
- Limit the power of managers to hire through networks.
- Eliminate discretion in selection.
- Hire with clear and measurable criteria devoid of personal or style characteristics (Reskin and Bielby, 2005).

Companies should support and reward hiring managers for their implementation of these open recruitment and hiring practices. Doing so reflects a corporate culture that is committed to increasing the diversity of technical hires.

Examples of such supports and rewards are to:

- **Ensure the HR function is adequately staffed to conduct outreach to diverse candidates,** to announce the position through a broad array of venues (see Section 1), and to present appropriate candidates to the hiring manager. Indeed, if there is no infrastructure of support for outreach, companies cannot realistically expect managers not to rely on their personal networks to identify candidates.
- **Create tools that make it easy for a diverse array of candidates to apply,** thus providing managers with a bigger pool from which to select. For example, IBM has created a Global Opportunity Marketplace recruiting tool that enables candidates to apply for positions around the globe from internships to permanent positions. This tool supports IBM's managers, enabling them to view their entire talent pool from one source.
- **Support managers in identifying objective hiring criteria** and job descriptions that minimize the potential for bias.
- **Align rewards structure to recognize managers' results in hiring diverse candidates** (see Solution 15).

12. ADAPT THE INTERVIEW PROCESS TO BE WELCOMING TO DIVERSE CANDIDATES.

In a setting where women are severely underrepresented, simple cues can activate "stereotype threat" (Steele and Aronson, 1995; Steele, 1997), a well-documented phenomenon where fears about being judged and confirming a negative stereotype about a group in a particular domain leads to underperformance in that domain in a test-taking situation (Kray et al., 2001). Because an interview situation is, in fact, an evaluation with judging elements, and women are known to be vulnerable to negative stereotypes about math and science competency (Spencer etal., 1999), the technical job hiring process is especially vulnerable to this dynamic. The technical woman's anxiousness over confirming a stereotype on women's presumed competence in technical spheres could interfere with their interview performance.

Technical women may downplay their competence or underperform on coding tests in environments where tech stereotypes are rampant, for example, in male-dominated workplaces that clearly signal "men are the norm of success here." Research shows that asking a minority group to perform a task that evokes stereotypes is not enough to trigger stereotype threat. In addition to the task being required (in this case, a mathematical or coding test for a female candidate), the task needs to be difficult, the subject needs to be personally invested in the situation (such as an interview setting would suggest) and the context of the task needs to reinforce the stereotype. However, counter-stereotype messages can reduce women's vulnerability to negative cues about their competence (Davies et al., 2005). Even changing the objects in a room can increase women's sense of "ambient belonging" in a technical community (Cheryan et al., 2009).

This suggests that **companies need to take a hard look at the negative messages embedded in the interview process,** and actively counter environmental cues that may lead women to experience stereotype threat. Even re-thinking the physical characteristics of interview settings is imperative.

Interview Do's and Don'ts

Do:

- Have women leaders and people from diverse backgrounds conduct interviews of potential women hires.
- Emphasize that both men and women have been successful at your company or in this role.
- Consider how your existing recruitment "tests" and criteria may reinforce stereotype threat.
- Look at the success rate of male and female candidates on specific interview tasks, especially those involving mathematical problem solving and coding. If there is a consistent gender discrepancy, stereotype threat is likely at work.
- Provide guidance and suggest strategies for potential hires and avoid a "sink or swim" attitude (Roberson and Kulik, 2007).
- Consider changing the context of the interview (Roberson and Kulik, 2007); does the setting activate a "geek" stereotype?
- De-activate stereotype threat by emphasizing that candidates who make it to the face-to-face interview generally have the skills to succeed (Roberson and Kulik, 2007).
- Emphasize your company's emphasis on learning and problem solving.
- Emphasize that the interview is designed to get insight into a person's thinking process rather than their ability to find the right answer (Spolsky, 2006).
- Involve and present role models that de-bunk stereotypes, such as successful technical women, or technical men that do not evoke a "geek" stereotype (Cheryan et al., 2009; Roberson and Kulik, 2007).

Don't:

- Make statements that evoke gender stereotypes in computing (e.g. "we are all hackers here").
- Conduct interviews in stereotypically "computer geek" office spaces.
- Evoke stereotype threat by making inferences that male characteristics such as assertiveness are a hallmark of success at your company.
- Express surprise at a woman's technical competence.
- Conduct an interview with only male recruiters or peers, putting her in a "token" situation where stereotype threat is more likely (Roberson and Kulik, 2007).
- Emphasize that only "the top 5%" have successfully passed this coding test or problem.
- Use coding tests and puzzles that are not relevant to the open position.

13. TRAIN HIRING TEAMS AND MANAGERS TO REDUCE IMPLICIT BIASES.

Reducing and removing implicit biases in individuals and groups charged with recruitment and hiring is difficult, but building awareness and setting standards or expectations that clearly commit to that effort is a good place to start. Broadly communicating an expectation that there will be transparency in hiring criteria and involving multiple stakeholders — hiring managers, diverse hiring teams and human resources — helps to ensure as much fairness as possible in the hiring process. Companies and managers can institute some of the following practices:

- **Demand tangible evidence** for the choice of a candidate based on concrete accomplishments.
- **Continuously emphasize candidates' specific accomplishments** during the hiring process to mitigate the potential for implicit bias (Isaac, Lee, and Carnes, 2009).
- **Leave out information about candidates that is not relevant to the job** such as family status, hobbies, or inapplicable experience, which can trigger implicit biases (Heilman, 1980; Heilman and Okimoto, 2008). Push the hiring team to commit to measurable qualifications and criteria before the interview process (Uhlman and Cohen, 2005).
- **Remove subjective components from the process** (Heilman 1980).
- **Direct members of the hiring team to use an inclusive strategy** — that is, have them pick candidates to include in the pool, rather than ask them to "eliminate" unsuitable candidates (Hugenberg, Bodenhase, and McLain, 2006).
- **Give hiring managers and teams ample time.** While companies are under increasing pressure to hire quickly, research shows that hiring managers and teams are more likely to evoke implicit biases when they are in a situation of multi-tasking or competing cognitive demands. (Sczesny and Kühnen, 2004).

14. IMPLEMENT DUAL-CAREER SUPPORT MECHANISMS WHEN RELOCATION IS INVOLVED.

Technical women in industry are significantly more likely to be in dual-career technical couples than are their male colleagues (Simard et al., 2008). This is especially salient for mid-level and senior-level hires. While academic institutions have long had to contend with the difficulties inherent in dual-career hires, the issue is seldom raised in industry. When a hire involves a family's relocation, dual-career couples face additional constraints. Consider forming strong ties to neighboring institutions and fostering introductions to facilitate the relocation of the hire's partner. Additionally, consider how your company's work-life initiatives and programs can support the family's work-life challenges in relocation (Shiebinger et al., 2008).

HOW CAN COMPANIES INSTITUTIONALIZE RECRUITMENT AND HIRING PRACTICES THAT INCREASE THE REPRESENTATION OF WOMEN AMONG THEIR TOP TALENT?

None of the practices described above yields long-term, sustainable benefits without the big picture in mind — and measurable action in this big picture space. The entire organizational infrastructure must support recruitment and hiring avenues, practices, and processes (re)designed to improve the representation of technical women.

15. HOLD EXECUTIVES AND MANAGERS ACCOUNTABLE FOR REACHING DIVERSITY GOALS AND TARGETS.

A critical component of meeting recruitment goals is executive and managerial accountability mechanisms. Managers' ability to recruit, retain, and advance technical women should be a part of performance evaluations. Failure to create accountability mechanisms is a key barrier to achieving change and fuels a "knowing-doing" gap within companies, whereby values and policies are not aligned with reward systems (Pfeffer and Sutton, 2000).

In a broad study of the impact of diversity practices on the presence of women and minorities in leadership positions, researchers found that institutional accountability at the executive level had significant impact (Kalev et al., 2006). In several studies of gender and hiring, accountability mechanisms were found to have significant impact on the representation of women (Tetlock, 1992; Baron et al., 1991; Gorman, 2005; Tomaskovic-Devey et al., 1996).

Accountability among managers and executives to meet the company's workforce goals can be incorporated in various ways:

- **Create financial incentives such as bonuses or stocks to meet workforce goals (Curtis et al., 2009).**
- **Assign weight to meet diversity goals in the review and promotion process.**
- **Review goals at the highest levels of the organization and ensure executives model the expected behaviors.**
- **Recognize the value of outreach activities in performance evaluations.**
- **Institute systematic reporting and oversight by superiors.**

IBM: Recruiting Scorecards and Institutional Accountability

IBM established targets and executive and managerial accountability as the backbone of its strategy to increase the recruitment, retention, and advancement of women and minorities. Targets for the recruitment of women are set and communicated from executive to line-staff level. At review time, manager compensation and evaluation is tied to targets in the recruitment, retention, and advancement of women and minorities.

Key elements:

- Managerial and executive accountability is a critical component of a successful diversity strategy.
- The targets are perceived as the responsibility of all levels of employees and not only that of the human resources function.
- Recruiting targets are reviewed regularly by executive level diversity task forces, shown to be an effective mechanism to increase diversity.
- Targets take local labor market conditions and availability into consideration, part of a "glocal" (global and local) diversity strategy.
- IBM clearly communicates its expectations for diverse candidate slates to external partners such as recruiting firms.
- The accountability mechanisms across functions make hiring managers an integral part of efforts to increase the representation of women, providing them with the appropriate recruiting support to reach a diverse pool of candidates.
- Accountability on all diversity metrics is tied to managerial evaluation and compensation.

Outcomes:

- Through the establishment of targets with a clear accountability mechanism, IBM has exponentially increased the representation of women at all levels of the organization since the 1990s, up by 596% in leadership positions worldwide.
- The internal promotion of Virginia "Ginni" Rometty to be IBM's first female CEO and one of three women CEOs of a fortune 500 technology company as of January 1, 2012[4], shows that internal alignment and accountability on gender diversity leads to results at the highest level of the organization.

16. DEVELOP, MAINTAIN AND PROJECT A WELCOMING CULTURE.

Your company's signaling of its own culture can be a detriment to drawing a diverse slate of candidates. Research has documented a strong and pervasive stereotype of computer professionals as devoid of a social life, which alienates women and minorities. Subtle cues in the physical environment of companies such as Star Trek posters and video games led to women being less interested in being a part of an organization when compared to a neutral office environment (Cheryan et al., 2009; Cheryan et al., 2011). These cues activated stereotypes around a "geek" image and made women feel less welcome. In the interview process it is, therefore, critical for your company to project a broad and inclusive image. This goes beyond showcasing other women in the interview process; the cues that affect a person's perception of fitting in a potential environment are significant predictors of interest (Cheryan and Plaut, 2010). This means examining recruiting materials,

naming conventions, office environment, and the specific questions asked in the interview process for their likelihood of activating "geek" stereotypes.

Furthermore, depictions of diversity in recruiting materials have been shown to influence the perception of potential candidates (Avery et al., 2004), and women and minorities are more likely to consider signaling about diversity in choosing a workplace (Backhaus et al., 2002; Freeman, 2003), as they are less likely to have access to informal networks within companies to gain information (Giscombe and Mattis, 2002; Roberson and Kulik, 2007). The inclusion message should, however, be consistent with the company's culture –diversity recruiting messages that emphasize a supportive culture in the absence of such a culture can increase the turnover of minority hires shortly after their hiring (McKay and Avery, 2005).

Companies should also consider how to emphasize their company benefits and retention practices with potential candidates, and they should ensure that practices most important to female candidates at various stages of their careers are addressed. To ensure the retention and advancement of technical women, companies should embrace and strengthen practices that provide flexibility and an inclusive culture, opportunities to work with cutting edge technology on highly visible assignments, and provide opportunities for networking, mentoring and sponsorship, all of which are especially important to technical women (Simard et al., 2008; Hewlett et al., 2008).

Intel: Retention Programs Increase Recruitment

In recent years, Intel has invested significantly in work-life programs to target enhanced retention and recruitment of women beyond the entry level. This focus resulted not only in the enhanced retention of technical women at the mid and senior levels, but also provided a compelling recruitment mechanism to attract women at the mid level.

Key elements: Intel has focused its work-life programs to address a broad variety of needs that are compelling to potential hires across backgrounds, male and female. These include:

- A paid eight-week sabbatical program for United States and Canada employees for every seven year of service.
- Compressed work weeks, part-time work options, and telecommuting.
- Family support such as homework help and tutoring for the children of Intel employees.
- Paid parental leave and a "new parent reintegration program" allowing for gradual return to full-time work.

Outcome: Between 2004 and 2010, through a focus on recruitment, retention, and advancement initiatives, Intel has increased its representation of technical women at the mid and senior levels by 24% (Intel, 2010).

17. REDEFINE THE PIPELINE — CREATE ALTERNATIVE PATHWAYS AND ESTABLISH MECHANISMS TO BRING WOMEN BACK TO TECHNICAL ROLES.

The limited availability of women computer science and electrical engineering graduates means that companies aiming to achieve critical mass in the representation of technical women (i.e., 30% or more) (White House Project, 2009; Kanter, 1977) need to **create alternative pathways to technical careers** (Ashcraft and Blythe, 2010). Such pathways can include hiring graduates from adjacent science, math, and engineering fields, i.e., mathematics, biology, information sciences, symbolic systems, physics, bioinformatics, and other related fields. Across engineering, math, and biology fields, 89,000 women graduated with a bachelor's degree in 2007, providing a rich pool of talent for companies (Hill et al., 2010).

Another way to broaden the pool is to **provide training for those inside or outside the company to onboard to technical positions,** or to establish ways to bring back technical women who have left the organization or have moved to non-technical positions. According to statistics from the National Science Foundation, 35 percent of women holding computer or information science degrees and 23 percent of women holding electrical engineering degrees are working in non-technical occupations, compared with 20% and 18% of men holding these degrees, respectively (National Science Foundation, 2006). Fully 52% of women employed in science and technology leave their companies at the mid level of their career, and 51% of these women are leaving the field altogether (Hewlett et al., 2008). Some companies have successfully established on-ramping programs to re-engage technical women who had previously left the workforce (Ashcraft, 2008).

18. MEASURE AND EVALUATE YOUR EFFORTS TO INCREASE THE REPRESENTATION OF WOMEN.

Companies that have become especially savvy about gender diversity in technical roles closely monitor the efforts of each of their practices over long periods of time. Much like the process involved in software deployment, they pay close attention to the elements that are working or not, in terms of outreach, interviewing, conversion to hire, and subsequent turnover. These measures are tracked over successive periods, and the takeaways are fed back into the practices for continuous improvements. Research shows that several popular diversity practices fail to increase the representation of women in companies (Kalev et al., 2006). **Ongoing evaluation is critical for companies to invest in the right efforts given their culture, their needs, and the state of organizational research.**

Evaluation Do's and Don'ts:

Do:

- Measure the representation of technical women among your new technical hires at each level of your company ladder (e.g., entry, mid, senior, executive), from year to year.
- Measure the overall representation of technical women at each level of your company ladder (e.g., entry, mid, senior, executive), from year to year.
- Calculate the promotion rate of technical women from level to level, and compare these rates to those of technical men, from year to year.
- Calculate the voluntary turnover rate of technical women at each level, and compare these rates to those of technical men, from year to year.
- For innovative programs and interventions, establish your baseline—what does the representation of technical women look like prior to your intervention? Then measure change over time as you implement the intervention. What does the representation of technical women look like one year into your intervention? Two years in?
- Compare your intervention data to those of a "comparison group", i.e., settings or sites that do not have your intervention, but look like your "experimental group" in every other way. Comparison group data allows you to better understand the "net effect" of your innovation. For instance, you might pilot and test the intervention in one department or campus before implementing it nationally or globally.
- Talk to technical women. Conduct interviews, focus groups, and case studies of technical women's experiences in different departments. Learn about their day-to-day concerns. Seek their input on recruitment and hiring practices.
- Apply the same scientific principles and methods to evaluation as you would to "core research and development."

Don't:

- Assume that your company will self-correct for severe gender imbalance.
- Assume that innovations in recruitment and hiring will run themselves.
- Accept evidence that is not derived from scientifically rigorous methods.
- Underfund program evaluation.

Cisco: Using Data to Drive Positive Outcomes

Companies criticized for low representation of women sometimes focus on the minimum needed to satisfy critics. Cisco Engineering has taken the opposite approach, asking how many diverse candidates can we bring in that add talent to our innovative teams?

A narrow focus on graduation statistics for women in a small subset of schools can hinder the achievement of diversity goals. Cisco Engineering developed a suite of diversity metrics to set aspirational guidelines for diversity hiring in university recruitment and measure the success of their efforts.

Cisco Engineering's Inclusion and Diversity Manager also identifies and engages in supplemental avenues to recruit technical women such as leveraging conferences, reaching out through professional associations, and building a presence at diversity events. These activities promote Cisco as an employer of choice among diverse technical candidates. The following practices help drive the desired results.

Set diversity recruitment goals :

- Assess an exhaustive and broad list of schools rather than the "usual suspects."
- Distinguish between the *representation* of women in specific disciplines (e.g., percentage of female students graduating with computer science degrees) at each school of interest and the *diversity pool* (e.g., number of female students graduating). The actual *number* of qualified women applicants may be significant, even if the *percentage* of women in the pool is low.
- Benchmark against industry competitors – how do you want your company to compare against other technology employers in hiring women?
- Develop a diversity-focused approach for university hiring that is both grounded in data and aspirational. While offers are always based on merit rather than gender, understanding your numbers is the only way to evaluate and improve your success at building a richly diverse workforce.
- Set a stretch but achievable goal based on the diverse candidate pool you want to target and support it with infrastructure that would remove systemic barriers to your end goal. For example, how many candidates would your company have to interview to reach your aspirations based upon historical experience?
- Aspirations to increase diversity should not be limited by low benchmarks and trends and should be aggressive enough to move the needle.
- Partner closely with your legal department – well-managed diversity efforts can reinforce merit-based hiring as well as decrease liability.
- Ensure your diversity strategy and hiring success are regularly communicated to key stakeholders and part of reporting structures.

Measure diversity recruitment success:

- Measure the company's past success in hiring diversity candidates at each targeted institution and overall.
- Assess staffing needs and other operational considerations that impact success.
- Every recruiting effort at every school, conference and event venue is carefully documented with metrics (number interviewed, number of touch points, and conversion rates). Success rates per school are tracked against focus, resources and aspirational goals to increase the pipeline. Learnings are assessed and then fed back into the recruiting process in a continuous fashion.
- Evaluate your experience hiring at each institution and overall.
- Identify where there is room to grow.

19. FUND OR CREATE K–12 INITIATIVES AROUND THE WORLD AND ADVOCATE FOR COMPUTER SCIENCE EDUCATION TO ENCOURAGE A BIGGER PIPELINE OF TECHNICAL WOMEN FOR THE FUTURE.

The ability of companies to recruit technical women in the future is directly tied to increasing the proportion of women choosing these fields of study around the world.

Companies that aim to increase the representation of technical women and realize the business benefits of diverse talent have a responsibility to support efforts to increase diversity and access to math and science education at the kindergarten through 12th grade levels (K–12). In the United States, a list of initiatives can be found at the Girls Collaborative Project (www.ngcproject.org).

Among current efforts in the United States, the National Center for Women & Information Technology (NCWIT) is an umbrella organization that represents organizations working to increase the representation of girls and women in computing fields in the United States — the efforts of their K–12 alliance include the Aspirations Awards for Computing, the Counselors for Computing, and resources for K–12 outreach.

Beyond working directly with girls, companies should consider entering a global dialogue about computer science and engineering education — with policy makers or organizations working to improve the representation of girls and minorities in STEM. In the United States, the Computer Science Teachers Association (CSTA) represents computer science teachers and provides them with curriculum tools to increase participation in computing. The National Center for Women in IT's K–12 alliance represents a coalition of organizations dedicated to increasing women's participation in computing. The Women in Engineering ProActive Network (WEPAN) engages engineering educators to increase the participation of women. Such efforts and organizations are present in several countries.

Intel: Inspiring Young Innovators

Intel Science Talent Search (Intel STS) and Intel International Science and Engineering Fair are two programs that make a difference in redefining the pipeline.

The Intel Science Talent Search, the oldest and most prestigious pre-college science competition in the United States, provides an opportunity for high school seniors to complete an original research project and have it judged by highly regarded professional scientists. The Intel Foundation awards more than $1.25 million to winning students and their schools during the annual competition. In 2010, over 1,700 students entered the contest, and 40 finalists traveled to Washington, D.C., where they competed for scholarships ranging from $20,000 to $100,000.

The Intel International Science Fair engages 1,500 youth from grades 9 to 12 in a global science competition across 65 countries annually. Millions of students compete in local events to be a part of the fair for the top prize of $75,000.

Key elements:

- The programs are well funded and are run by an independent organization, the Society for Science and the Public, involving specialists in science education and disseminating the excitement of science to the public.
- Beyond a "winner take all" format, both programs recognize young scientific talent in several categories and also recognize and reward the schools of the winning participants. For example, the Intel Talent Search program recognizes 40 finalists among 300 semi-finalists.
- Through engaging programs like Intel sponsored science competitions, Intel has seen girls embrace science, technology, engineering and math when it moves beyond abstract concepts to projects they create to impact their families, communities and the world.

Outcomes:

- Evaluation of the Intel International Science Fair has shown that engaging in the fair contributes to student interest in STEM careers, and that a school's engagement in the fair increases its focus on teaching science. Indeed 89% of participants in 2005 reported that participating in the Fair has increased their commitment and interest in a STEM career. Participants also overwhelmingly report that the fair has increased their confidence levels in science. (Rillero et al., 2005).
- Since its inception, the Intel Science Talent Search has seen seven of its winners become Nobel Laureates.
- Girls' level of participation in the Intel Science Talent Search has now grown to almost 50%. In 2010, Erika DeBenedictis of Albuquerque, New Mexico, captured the top award for developing a software navigation system to improve spacecraft travel through the solar system. Other top female winners include Shivani Sud of Charles E. Jordan High School in Durham, North Carolina, in 2008 and Mary Masterman of Westmoore High School in Oklahoma City, Oklahoma, in 2007.

CONCLUSION

This guide offers companies some research- and evidence-based strategy sets — two externally facing and two internally facing — to recruit technical women. Some can be implemented by individual managers within their own departments, while others require broader institutional accountability, organizational change and funding. Research and case studies suggest that these strategies are effective, and the potential to make a difference is significant. None of these efforts, however, are likely to be enough in isolation. Rather, they should be thought of as an arsenal of options to deploy in bundles to better realize the benefits of diversity on innovation.

Recruitment Avenues

One of the first questions a company should ask if it aims to recruit more women is whether enough women are being considered for open positions in the first place. If the answer is "no," companies can expand recruitment avenues by reaching out to students and new graduates at a broader array of institutions, develop relationships with promising women through internships or other programs, and leverage social networks to target students as well as entry-, mid- and senior-level technical women. Given that only 20% of computer science graduates nationwide are women — and even smaller percentages in related engineering disciplines — companies must make an intentional effort to reach out and ask women to consider their organizations.

Recruitment Practices

Carefully examining your company's internal recruitment practices — how it organizes to market its job opportunities externally — will have a tremendous effect on how potential talent views the company and considers whether to join a candidate pool. Care should be taken to review and, if necessary, broaden the institutional and individual criteria to be considered and articulated. Similarly, companies should be aware of and seek both to create and project a culture that is welcoming to diverse technical workers. This can affect both the women who self-select to apply for a job as well as the hiring teams who should focus on individual criteria rather than a more subjective notion of cultural "fit." Reviewing job descriptions to remove stereotypes and culture references that signal diverse candidates to stay away can also improve both the external face the company projects as it recruits candidates as well as better focusing the internal hiring team on the competencies most desired and perhaps currently missing on their teams.

Hiring Practices

As your company begins to attract more diverse candidates to your pools, it then becomes important to focus on the hiring process itself, both to ensure a positive experience for the candidate and to reduce the elimination of candidates based on implicit biases. Three solutions focus on the candidates' experience. Companies can improve the hiring process by including women and diverse staff on the hiring teams, showcasing technical women during interviews, adapting the entire process to be more welcoming, and introducing negotiating incentives that accommodate the needs of diverse candidates such as implementing dual-career support mechanisms. Internally, companies can change processes such as creating blind resume screening and setting targets to hire technical women. They should include strong female candidates in short lists to encourage teams to seriously consider talent that happens to be female. Companies can also train hiring teams and managers to reduce implicit biases and reward those who hire diverse candidates.

Recruitment and Hiring: Overarching Considerations

While many of the solutions outlined to improve recruitment and hiring will have success in isolation, lasting change is unlikely to be institutionalized without paying attention to an overarching structure of support — both in leadership and management attitudes and commitments as well as in processes. Perhaps the most important focus is to ensure that executives and managers realize how important diversity of talent and perspective can be to the bottom line so that there is commitment from the top to improve the culture not just for recruitment but also to maintain it in the management of teams and day-to-day work. Measurement and evaluation of progress against a goal to increase the representation of women can help drive strategies by identifying areas for improvement, assessing what tactics are working, and holding leaders accountable for improvement. Structural changes to redefine the pipeline can be effective; by creating flexible on ramps that bring women with technical and management experience back to the technical track, companies can better leverage strong employees with broadened experience that can improve product development and innovation. Finally, a very long-term strategy — building the pipeline by funding or engaging in K–12 initiatives — is increasingly important, not only to encourage girls to pursue STEM educations and careers but to increase the numbers of technical candidates overall to fill the increasing needs for such talent among women and men.

With women comprising 18% of computer science graduates in the US (National Science Foundation, 2011) and 25% of current computer occupations (Bureau of Labor Statistics, 2011), we would hope to see similar ranges of representation in technical companies at the entry, mid and senior levels.[6] While a few companies keep steady representation across levels, the vast majority see the representation of women drop significantly at each level.

The Anita Borg Institute for Women and Technology works with companies at all stages on the spectrum, from those just beginning to focus on this goal or with few resources to continue improving their gains, to those companies who are doing well and focusing very tightly to improve even more in specific areas. The solutions outlined in this report provide guidelines and tactics that can help companies or individual managers at any point on this spectrum to recruit technical women.

We recommend you first gather and assess the data for your baseline and identify one or two areas to start, based on resources and staff support available, to make a difference. Each company should find the right bundle of strategies to suit the specific goals that make sense for it. Over time, companies aiming to increase the representation of women and make their cultures more welcoming to diversity build on those initial successes, developing momentum that carries them to ever higher targets.

Despite the relatively low "supply" of female technical talent, companies should strive to reach critical mass in technical positions across levels — a majority of studies put this critical mass at or around 30% (Ely, 1995; Kanter, 1977; Reskin et al., 1999). This requires a mindset of "redefining the pipeline" — investing in the training of non-traditional candidates, hiring from adjacent disciplines, avoiding narrow recruitment criteria, and investing in efforts to increase the representation of women in computing early on.

Recruiting women is only one part of organizational efforts to improve the representation of technical women and support their success. Ultimately, the success of efforts to recruit technical women depends on strong retention and advancement practices as well. Creating cultures that are welcoming to women and address the career needs of technical women necessitates a multi-pronged approach. Our next reports will focus on solutions for the retention and advancement of technical women.

Notes

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3 William Curtis, William E. Hefley, and Sally A. Miller, *The People CMM: A Framework for Human Capital Management,* 2nd ed. (Boston: Pearson Education, 2009).

4 At print time, the three women CEOs of Fortune 500 companies were Virginia Rometty, CEO, IBM; Ursula Burns, CEO, Xerox; and Meg Whitman, CEO, Hewlett Packard.

5 Such cases are reviewed by Catherine Ashcraft (2008) at http://www.ncwit.org/images/practicefiles/ConstructingOnRampsHelpingMidCareerWomenReturnWorkITpdf.pdf.

6 There is a dearth of consistent comparable data across countries. In Western countries, the representation of women in computer science degrees tend to mirror the U.S. numbers; more variation exists outside the West.

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Appendices

Appendix A. Outreach Opportunities to Build a Pipeline

This is a sampling of conferences with recruiting opportunities for technical women, professional associations, and programs.

Conferences — North America

The Grace Hopper Celebration of Women in Computing — North America	www.gracehopper.org
The Grace Hopper Regional Consortium	www.ghcregionalconsortium.org
The Richard Tapia Celebration of Diversity in Computing	www.tapia.org
The Society of Women Engineers Conference	www.swe.org
The Stars Celebration	www.starsalliance.org
WITI (Women in Technology International)	www.witi.com

Conferences — Outside the US and Canada

Australian Women in Computing, Australia	www.ozwit.org
The Grace Hopper Celebration of Women in Computing India	http://gracehopper.org.in/
London Hopper Colloquium, UK	http://www.dcs.qmul.ac.uk/women/LondonHopper.php
Women in Technology UK	www.womenintechnology.co.uk

Professional organizations and associations

Ada Belgium	http://ada-online.be
Ada Initiative (Open Source)	http://adainitiative.org/
Association for Computing Machinery (ACM)	www.acm.org
Association for Computing Machinery-Women (ACM-W)	http://women.acm.org/
Association for Women in Computing (AWC)	www.awc-hq.org
British Computer Society (BCS) Women's Forum	http://www.bcs.org/category/8630
Canadian Advanced Technology Alliance	www.cata.ca
Canadian Women in Technology	www.catawit.ca
Canadian Coalition of Women in Engineering Science and Technology (CCWEST)	www.ccwestt.org
Computing Research Association (CRA)	www.cra.org
Committee on the Status of Women in Computing Research (CRA-W)	www.cra-w.org
IEEE	www.iee.org
IEEE-Women	http://www.ieee.org/membership_services/membership/women/index.html
National Center for Women in IT (NCWIT)	www.ncwit.org
Society for Canadian Women in Science and Technology	www.scwist.ca
Society for Women Engineers (SWE)	www.swe.org

Networking events and programs

Girl Geek Dinners	www.girlgeekdinners.com
SWE and WITI local chapters	
Digital Sisters	www.digital-sistas.org
She's Geeky	www.shesgeeky.org
Women of Color Action Network (WCAN)	www.womenofcoloractionnetwork.org
Women 2.0	www.women2.org

Appendix B. Computer Science Pipeline of Technical Women*

Table 1: U.S. institutions with most computer science bachelor degrees awarded to women among bachelor granting institutions in 2009

Academic Institution	Number of computer science bachelor's degrees awarded to women
St Leo College	52
CUNY New York City Technical College	36
Franklin University	35
Limestone College	29
Davenport College	27
University of South Carolina at Spartanburg	22
DeVry Institute of Tech (Cty of Industry, CA)	19
Baker College of Flint	18
Dakota State University	18
Louise Salinger Academy of Fashion	16
Villa Julie College	15
Baker College of Flint	14
ITT Technical Institute (Indianapolis, IN)	14
CUNY York College	13
Wellesley College	13
Elizabeth City State University	10
Rust College	10
Columbia College (Columbia, MO)	9
Johnson C Smith University	9
Bassist College	8
Concordia College-St Paul	8
Dickinson State University	8
Mount Union College	8
North Carolina Wesleyan College	8
SUNY at Farmingdale	8
Shaw University	8
Electronic Data Processing College	7
High Point University	7
New England Inst of Technology	7
Ramapo College of New Jersey	7
University of PR Bayamon Tech Univ Col	7
Winston-Salem State University	7
Art Institute of Fort Lauderdale	6
Benedict College	6
East-West University	6
Franklin Pierce College	6
International Academy Merch Design	6
Lane College	6
Mount Olive College	6
Regents College, Univ of the State of New York	6
Spelman College	6

Table 2: U.S. institutions with the most computer science bachelor degrees awarded to women among masters granting institutions in 2009

Academic Institution	Number of computer science bachelor's degrees awarded to women
University of Maryland University College	191
Strayer College	175
Rochester Institute of Technology	31
Bellevue University	28
Troy State University, Main Campus	27
Lakeland College	26
Johnson and Wales University	25
Kennesaw State University	25
Friends University	21
School of Visual Arts	21
Regis University	19
Tarleton State University	17
University of North Carolina at Charlotte	17
City University	16
Lindenwood College	16
Southwestern College (Winfield, KS)	16
Virginia State University	16
CUNY Bernard M Baruch College	15
CUNY Brooklyn College	15
California State University-Northridge	15
Point Park College	15
University of West Florida	15
Towson State University	14
Columbus State University	13
Park College	13
San Jose State University	13
University of Phoenix	13
Wilmington College (New Castle, DE)	13
California State University-Chico	12
Coleman College	12
James Madison University	12
Alabama State University	11
Bentley College	11
Norfolk State University	11
Northeastern Illinois University	11
Southern Polytechnic State University	11
Loras College	10
Northwest Missouri State University	10
University of Nebraska at Omaha	10
University of North Carolina at Asheville	10
Bowie State University	9
CUNY Herbert H Lehman College	9
Long Island University C W Post Campus	9
Metropolitan State University	9
SUNY College at Buffalo	9
Siena Heights College	9
University of Mary	9

*Source for all tables: National Center for Education Statistics Data Sources. IPEDS Completion Survey, 2009. Webcaspar: National Science Foundation Integrated Science and Engineering Resources Data System.

Table 3: U.S. institutions with most computer science bachelor degrees awarded to women among doctorate granting institutions in 2009

Academic Institution	Number of computer science bachelor's degrees awarded to women
Pennsylvania State U, Main Campus	136
Massachusetts Institute of Technology	45
Ohio University, All Campuses	39
University of Maryland Baltimore County	37
University of Washington - Seattle	30
Syracuse University, Main Campus	29
University of Maryland at College Park	28
Carnegie Mellon University	25
Pace University New York Campus	25
Barry University	24
De Paul University	24
Rutgers the State Univ of NJ New Brunswick	24
Florida State University	23
Tulane University	22
University of California-Irvine	21
SUNY at Binghamton	20
Cornell University, All Campuses	19
Georgia Institute of Technology, Main Campus	19
Grambling State University	19
Florida International University	18
Drexel University	17
Georgia State University	17
University of Nevada-Reno	17
New Jersey Institute Technology	16
University of Massachusetts Lowell	16
University of Texas at Austin	16
Southern Illinois University-Carbondale	15
University of North Carolina at Greensboro	15
Central Michigan University	14
Indiana University at Bloomington	14
Rutgers the State Univ of NJ Newark Campus	14
Indiana University-Purdue Univ at Indianapolis	13
Morgan State University	13
St John's University (Jamaica, NY)	13
Alabama Agricultural and Mechanical University	12
Lehigh University	12
North Carolina State University at Raleigh	12
University of Illinois at Chicago	12
University of Illinois at Urbana-Champaign	12
University of Pittsburgh Main Campus	12
University of Texas at Dallas	12
University of Wisconsin-Milwaukee	12
Virginia Commonwealth University	12
Baylor University	11
Illinois State University	11
Marquette University	11
New Mexico State University, All Campuses	11
Ohio State University, Main Campus	11
Rensselaer Polytechnic Institute	11
Southern University A&M Col at Baton Rouge	11
University of North Carolina at Chapel Hill	11
University of Pennsylvania	11
University of Texas at Arlington	11

Table 4: U.S. institutions with most computer science master's degrees awarded to women among masters granting institutions in 2009

Academic Institution	Number of computer science master's degrees awarded to women
University of Maryland University College	71
Strayer College	68
Regis University	32
University of Illinois at Springfield	31
University of North Carolina at Charlotte	30
Rochester Institute of Technology	28
Towson State University	26
Southern Polytechnic State University	24
California State University-Hayward	22
California State University-Fullerton	21
DeVry Institute of Tech (Oakbrook Terr, IL)	21
Governors State University	21
Robert Morris College (Coraopolis, PA)	20
Bradley University	19
San Jose State University	19
CUNY City College	17
School of Visual Arts	16
University of Houston-Clear Lake	16
Capitol College	15
Northwest Missouri State University	15
Bellevue University	14
CUNY Bernard M Baruch College	14
Pratt Institute	14
Lawrence Technological University	13
Southwest Texas State University	13
Fitchburg State College	12
Kennesaw State University	12
New York Institute of Technology - Manhattan	12
University of Texas at San Antonio	12
Walsh College of Accountancy & Business Admin	12
Western Illinois University	12
California State University-Chico	11
New Hampshire College	11
University of Michigan at Dearborn	11
Bentley College	10
CUNY Brooklyn College	10
California State University-Long Beach	10
Norwich University	10
Quinnipiac College	10
University of Massachusetts at Dartmouth	10
University of Nebraska at Omaha	10
California State University-Sacramento	9
Long Island University C W Post Campus	9
Marist College	9
SUNY College at Potsdam	9
Western International University	9
California Lutheran University	8
Eastern Michigan University	8
Western Kentucky University	8
Arkansas Tech University	7
Hood College	7
Lewis University	7
Monmouth University	7
Tarleton State University	7

Table 5: U.S. institutions with most computer science master's degrees awarded to women among doctorate granting institutions in 2009

Academic Institution	Number of computer science master's degrees awarded to women
Arizona State University Main	135
Boston University	122
Carnegie Mellon University	97
Cleveland State University	97
Columbia University in the City of New York	86
De Paul University	84
Drexel University	74
Duquesne University	73
Fairleigh Dickinson U, All Campuses	68
George Mason University	62
George Washington University	59
Georgia Institute of Technology, Main Campus	59
Illinois Institute of Technology	59
Johns Hopkins University	58
Maharishi University of Management	57
Massachusetts Institute of Technology	55
New Jersey Institute Technology	47
New York University	45
North Carolina State University at Raleigh	43
Northeastern University	43
Northern Illinois University	41
Nova Southeastern University	41
Pace University New York Campus	39
Polytechnic University	38
San Diego State University	35
Stevens Institute of Technology	35
SUNY at Albany	33
SUNY at Binghamton	32
SUNY at Buffalo	32
SUNY at Stony Brook, All Campuses	30
Syracuse University, Main Campus	30
Texas A&M University Kingsville	28
Texas A&M University Main Campus	28
Texas A&M University-Commerce	27
University of Arizona	26
University of Bridgeport	25
University of Houston	24
University of Illinois at Chicago	24
University of Maryland at College Park	23
University of Maryland Baltimore County	22
University of Michigan at Ann Arbor	22
University of Minnesota - Twin Cities	20
University of Missouri, Kansas City	20
University of North TX	20
University of Pennsylvania	20
University of Pittsburgh Main Campus	19
University of Southern California	19
University of St Thomas (Saint Paul, MN)	19
University of Texas at Dallas	18
University of Washington - Seattle	18
Virginia Polytechnic Institute and State Univ	18

Table 6: U.S. institutions with most computer science doctoral degrees awarded to women in 2009

Academic Institution	Number of computer science doctoral degrees awarded to women
Carnegie Mellon University	14
University of California-Irvine	14
University of Illinois at Urbana-Champaign	11
Pennsylvania State U, Main Campus	10
Nova Southeastern University	10
University of North TX	10
University of Washington - Seattle	10
Massachusetts Institute of Technology	9
SUNY at Stony Brook, All Campuses	8
University of Pittsburgh Main Campus	7
University of Southern California	7
Texas A&M University Main Campus	6
George Washington University	6
Georgia State University	6
University of California-Berkeley	6
Arizona State University Main	5
Drexel University	5
Washington University	5
New Jersey Institute Technology	5
University of California-Santa Barbara	5
Robert Morris College	4
Georgia Institute of Technology, Main Campus	4
Virginia Polytechnic Institute and State Univ	4
Claremont Graduate School	4
Cornell University, All Campuses	4
Duke University	4
New York University	4
North Carolina State University at Raleigh	4
University of Alabama in Huntsville	4
University of California-San Francisco	4
University of Colorado at Boulder	4
University of Pennsylvania	4
Colorado Tech	4
University of North Carolina at Charlotte	4
Harvard University	3
Johns Hopkins University	3
Pace University New York Campus	3
Syracuse University, Main Campus	3
University of Maryland at College Park	3
University of Tennessee at Knoxville	3
University of Texas at Austin	3
Columbia University in the City of New York	3
Indiana University at Bloomington	3
SUNY at Buffalo	3
Stanford University	3
University of California-Los Angeles	3
University of Kentucky	3

Appendix C. Electrical Engineering Pipeline of Technical Women*

Table 7. U.S. institutions with most electrical engineering (EE) bachelor degrees awarded to women among bachelor granting institutions in 2009

Academic Institution	Number of EE bachelor degrees awarded to women
Universidad Politecnica de Puerto Rico	15
United States Naval Academy	5
Claflin College	3
Benedict College	2
Johnson C. Smith University	2
United States Military Academy	2

Table 8: U.S. institutions with most electrical engineering (EE) bachelor degrees awarded to women among master's granting institutions in 2009

Academic Institution	Number of EE bachelor's degrees awarded to women
Rochester Institute of Technology	21
San Jose State University	21
California State University-Long Beach	20
North Carolina Agricultural & Tech State Univ	16
University of Michigan at Dearborn	14
California State Polytechnic University Pomona	13
California State Polytechnic U-San Luis Obispo	11
CUNY City College	10
California State University-Sacramento	9
GMI Engineering and Management Institute	9
Prairie View A&M University	8
Purdue University, Calumet Campus	8
University of Texas at San Antonio	8

*Source for all tables: National Center for Education Statistics Data Sources. IPEDS Completion Survey, 2009. Webcaspar: National Science Foundation Integrated Science and Engineering Resources Data System.

Table 9: U.S. institutions with largest number of electrical engineering (EE) bachelor's degrees awarded to women among doctoral granting institutions in 2009

Academic Institution	Number of EE bachelor's degrees awarded to women
University of PR Mayaguez Campus	41
Purdue University, Main Campus	26
University of Texas at Austin	26
Texas A&M University Main Campus	25
University of California-Berkeley	25
University of Illinois at Urbana-Champaign	25
Georgia Institute of Technology, Main Campus	24
Carnegie Mellon University	20
Massachusetts Institute of Technology	20
University of Washington - Seattle	20
University of Florida	19
University of Michigan at Ann Arbor	18
University of Texas at El Paso	18
Virginia Polytechnic Institute and State Univ	18
University of Missouri, Rolla	17
Arizona State University Main	16
Ohio State University, Main Campus	16
University of Texas at Dallas	16
University of Maryland at College Park	15
Cornell University, All Campuses	14
Florida International University	14
Rensselaer Polytechnic Institute	13
University of Central Florida	13
Michigan State University	12
Michigan Technological University	12
Old Dominion University	12
Oregon State University	12
Polytechnic University	12
Florida Atlantic University	11
George Mason University	11
North Carolina State University at Raleigh	11
Pennsylvania State U, Main Campus	11
Princeton University	11
San Diego State University	11
University of Arizona	11
University of California-Los Angeles	11
University of Illinois at Chicago	11
California State University-Los Angeles	10
Drexel University	10
Southern University A&M Col at Baton Rouge	10
Stevens Institute of Technology	10
University of South Florida	10
Worcester Polytechnic Institute	10
Florida State University	9
North Dakota State University, All Campuses	9
Rutgers the State Univ of NJ New Brunswick	9
University of Alabama in Huntsville	9
University of Rhode Island	9
Clemson University	8
Illinois Institute of Technology	8
Louisiana State Univ & Agric & Mechanical Col	8
Morgan State University	8
Northeastern University	8
Santa Clara University	8
University of California-Irvine	8
University of California-San Diego	8
University of Hawaii at Manoa	8
Vanderbilt University	8

Table 10: U.S. institutions with most electrical engineering (EE) master's degrees awarded to women among master's granting insitutions in 2009

Academic Institution	Number of EE master's degrees awarded to women
Rochester Institute of Technology	21
San Jose State University	21
California State University-Long Beach	20
State University of New York at New Platz	20
California State University-Fullerton	18
North Carolina Agricultural & Tech State Univ	16
California State University-Sacramento	16
Gannon University	16
University of Michigan at Dearborn	14
University of North Carolina at Charlotte	14
California State Polytechnic University Pomona	13
Bradley University	13
University of Texas at San Antonio	13
California State Polytechnic U-San Luis Obispo	11
CUNY City College	11
University of Massachusetts at Dartmouth	11
CUNY City College	10
California State University-Long Beach	10
California State University-Sacramento	9
GMI Engineering and Management Institute	9
California State University-Northridge	9
Prairie View A&M University	8
Purdue University, Calumet Campus	8
University of Texas at San Antonio	8
Rochester Institute of Technology	8
University of Houston-Clear Lake	8
University of Michigan at Dearborn	8

Table 11: U.S. institutions with most electrical engineering (EE) master's degrees awarded to women among doctorate granting institutions in 2009

Academic Institution	Number of EE master's degrees awarded to women
University of Southern California	76
University of Florida	64
Arizona State University Main	52
University of Texas at Dallas	48
Georgia Institute of Technology, Main Campus	44
Illinois Institute of Technology	44
Carnegie Mellon University	37
New Jersey Institute Technology	33
Polytechnic University	32
Stanford University	32
University of Bridgeport	32
University of Minnesota - Twin Cities	32
University of Texas at Arlington	31
Southern Illinois University-Carbondale	30
Syracuse University, Main Campus	29
North Carolina State University at Raleigh	26
Massachusetts Institute of Technology	25
Northeastern University	25
University of Texas at Austin	23
West Virginia University	23
Wright State University, All Campuses	23
Purdue University, Main Campus	20
University of California-Santa Barbara	20
University of Colorado at Boulder	20
University of South Alabama	20
Wichita State University	20
Santa Clara University	19
Texas A&M University Main Campus	19
Johns Hopkins University	18
Southern Methodist University	18
University of Illinois at Chicago	18
Wayne State University	17
University of Missouri, Kansas City	16
University of South Florida	16
Fairleigh Dickinson U, All Campuses	15
George Washington University	15
University of Illinois at Urbana-Champaign	15
George Mason University	14
San Diego State University	14
University of Maryland at College Park	14
University of Missouri, Rolla	14
University of Pennsylvania	14
Drexel University	13
Princeton University	13
University of California-San Diego	13
University of Kentucky	13
Auburn University, Main Campus	12
SUNY at Buffalo	12
Texas Tech University	12
University of Michigan at Ann Arbor	12
Boston University	11
Duke University	11
Southern Illinois University at Edwardsville	11
University of California-Los Angeles	11

Table 12: U.S. institutions with most electrical engineering (EE) doctoral degrees awarded to women in 2009

Academic Institution	Number of EE doctoral degrees awarded to women
Stanford University	17
University of Michigan at Ann Arbor	13
Georgia Institute of Technology, Main Campus	12
University of Florida	12
University of Texas at Austin	11
Princeton University	11
Massachusetts Institute of Technology	9
Purdue University, Main Campus	9
University of Illinois at Urbana-Champaign	8
University of Wisconsin-Madison	8
Virginia Polytechnic Institute and State Univ	8
University of California-Berkeley	8
University of Southern California	8
University of California-Los Angeles	6
University of Louisville	6
University of Washington - Seattle	6
University of Maryland at College Park	5
Auburn University, Main Campus	5
Rensselaer Polytechnic Institute	5
University of Cincinnati, All Campuses	5
University of Texas at Dallas	5
Boston University	4
Ohio State University, Main Campus	4
University of Massachusetts Lowell	4
Yale University	4
Carnegie Mellon University	4
North Carolina State University at Raleigh	4
Rutgers the State Univ of NJ New Brunswick	4
University of California-San Diego	4
University of Notre Dame	4
University of Oklahoma, Norman Campus	4
Arizona State University Main	3
Johns Hopkins University	3
Northwestern Univ	3
Pennsylvania State U, Main Campus	3
Southern Illinois University-Carbondale	3
Texas A&M University Main Campus	3
University of Connecticut	3
University of Tennessee at Knoxville	3
University of Texas at Arlington	3
Vanderbilt University	3
Cornell University, All Campuses	3
Washington State University	3

Appendix D. Science and Technology Doctoral Pipeline*

Table 13: Top 50 U.S. baccalaureate institution for science and engineering (S&E) doctorate degrees awarded to women, 2004–08

During 2004–2008, there were 57,088 science and technology (S&E) doctoral degrees awarded to women in the United States. 12,125 of these were awarded by 50 institutions.

Academic institution	Number of S&E doctoral degrees awarded to women
University of California Berkeley	610
Cornell University	520
University of Michigan Ann Arbor	442
University of California Los Angeles	392
University of Illinois Urbana Champaign	349
University of Florida	333
Massachusetts Institute of Technology	330
University of California Davis	330
University of Wisconsin Madison	330
University of Texas Austin	328
Harvard University	327
University of California San Diego	320
Pennsylvania State University main campus	311
Brown University	283
University of Virginia main campus	269
Rutgers University New Brunswick/Piscataway	255
Duke University	245
Texas A & M University	244
Princeton University	242
University of Maryland College Park	237
Stanford University	236
University of Washington Seattle	232
Yale University	216
University of Pennsylvania	212
Michigan State University	205
University of North Carolina Chapel Hill	205
Boston University	200
University of Chicago	196
Ohio State University main campus	195
University of California Santa Barbara	192
Virginia Polytechnic Institute and State University	189
University of Arizona	188
University of California Santa Cruz	188
College of William and Mary	184
Northwestern University	184
University of Minnesota Twin Cities	181
Wellesley College	174
University of Colorado Boulder	170
University of Puerto Rico Rio Piedras	170
New York University	169
Columbia University in the City of New York	163
Indiana University Bloomington	163
Arizona State University Tempe	158
Smith College	158
Purdue University main campus	155
University of California Irvine	151
University of Delaware	151
University of Georgia	151
Dartmouth College	149
University of Notre Dame	143

* SOURCE: National Science Foundation/Division of Science Resources Statistics, Survey of Earned Doctorates, 2004–08.

Appendix E. Top U.S. Academic Institutions for Women in STEM

Table 15: Best Colleges for Women in STEM by Forbes, 2010 (based on representation)

Rank	College Name	State
1	Westminster College	PA
2	Colby College	ME
3	SUNY College of Environmental Science and Forestry	NY
4	Harvey Mudd College	CA
5	Williams College	MA
6	Tuskegee University	AL
7	Polytechnic Institute of New York University	NY
8	California Institute of Technology	CA
9	United States Coast Guard Academy	CT
10	Colorado School of Mines	CO
11	Worcester Polytechnic Institute	MA
12	Earlham College	IN
13	Embry Riddle Aeronautical University-Daytona Beach	FL
14	Wofford College	SC
15	St Marys University	TX
16	Albion College	MI
17	Colorado College	CO
18	Massachusetts Institute of Technology	MA
19	St Lawrence University	NY
20	Stevens Institute of Technology	NJ

Table 16: Academic institutions engaged in Pace Setters, an initiative of the National Center for Women in Technology, dedicated to increasing the representation of women in computer science

Carnegie Mellon University
Georgia Tech
Indiana University
North Carolina State University
Santa Clara University
University of California Irvine
University of California Santa Cruz
University of Colorado at Boulder (ATLAS Institute)
University of Texas
University of Virginia
University of Washington
Villanova University
Virginia Tech
Cal Poly
The University of Texas at Austin

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