WOMEN IN IT: THE FACTS

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INFORMATION
TECHNOLOGY

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The authors thank Jenny Slade, Stephanie Hamilton, Caroline Simard, Jerri Barrett, and the Workforce Alliance Practices Committee for their helpful feedback in preparing this report.

“If current trends continue, by 2018 the information technology industry will only be able to fill half of its available jobs.”

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About This Report

Technical innovation will play a critical role in virtually every sector of the U.S. and global economy.

The technology industry is one of the fastest-growing industries in the U.S. The United States Department of Labor estimates that by 2018 there will be more than 1.4 million total new computing-related job openings when considering growth and replacement needs. Technology job opportunities are predicted to grow at a faster rate than all other jobs in the professional sector, or up to 22 percent over the next decade.[1]

Highly-qualified women are well-positioned to move into these open jobs, yet the industry is failing to attract this talent. Furthermore, women already employed in the technology industry are leaving at staggering rates. Failing to capitalize on this talent threatens U.S. productivity, innovation, and competitiveness. To further strengthen the U.S. position as a technical leader we need to examine the reasons why the industry is not attracting more people with varied backgrounds and take action to stem the current tide.

In 2004, the National Center for Women & Information Technology (NCWIT) set out to address this challenge. Since its inception, NCWIT has been compiling data from existing national sources and sponsoring research projects on technical women in an effort to understand why participation is declining and how companies can reclaim the technical talent of women and other under-represented groups. This report, sponsored by NCWIT's Workforce Alliance, is the culmination of these efforts and brings together the latest findings from recent research on technical women.

Goals of This Report

- Tell a "coherent story" about the current state of affairs for technical women, synthesizing the best available data into one, easy-to-access resource.
- Provide an overall summary of the key barriers to women's participation in technology and promising practices for addressing these barriers.
- Serve as a benchmark for measuring the future effects of national industry efforts to increase women's participation.
- Serve as a benchmark for companies who wish to use the report to gauge their own internal progress.
- Serve as a resource for advocates and change agents.

Components of This Report

- ***Executive Summary.*** This chapter summarizes the existing problem regarding women in technology, lays out the business case for addressing this problem, and begins to identify potential solutions.
- ***The Current State of Affairs.*** This chapter presents a snapshot of women's current participation in technology, including numbers of women in the field, average salaries, leadership status, involvement in innovation, and trends over time.
- ***Identifying the Barriers.*** This chapter helps explain why the current state of affairs exists. It provides an overview of the key barriers to increasing women's meaningful participation in technology as identified by a number of research studies.
- ***Addressing the Barriers.*** The final chapter of the report summarizes key promising practices for addressing the primary barriers for women in technology.

Complementary Components

A number of complementary components also are available from the report website at **http://www.ncwit.org/thefacts.** These include:

- ***Women in Technology: The Business Case*** Use this short "teaser" document to raise awareness and make the case for addressing these problems with company executives, co-workers, or the general public.
- ***Primary Source Summaries and Links:*** Use these short summaries to find out more information about the major studies included in this report. Links to these original studies also are provided.
- ***Presentation Modules:*** Use these ready-made, downloadable modules to create presentations and other materials that educate people within your organization or other contexts about the issues.

Ways to Use This Report

- Make the business case for diversity in technology with top-level executives, colleagues, and others.
- Inform others about various issues related to women and underrepresented groups in technology.
- Motivate others to advocate for reform and act as change agents.
- Measure or compare your company's performance regarding women in technology to national benchmarks.
- Implement efforts to measure your company's progress in improving conditions for women in technology.

Computer professionals rank among the **Top 10** fastest-growing occupations.

Definition of Terms

Because this report draws on a number of data sources and studies that define technical or technology differently, a careful discussion of terms is important.

Technology/Information Technology/IT: In this report, we use these words synonymously to refer specifically to computing and computing-related professions and industries. Whenever possible, findings for technology environments are distinguished from findings in the other sciences.

Science, Engineering, Technology (SET): Some reports studied technical women in particular, while others studied women in science, engineering, and technology. When possible, we report findings specific to the technology industry. Of course, technical men and women also work in engineering and the other sciences, so we also present relevant data for the whole science, engineering, and technology (SET) workforce when this data is not available by industry. In these cases, we identify that this data pertains to SET companies or environments.

Technical Men and Women: We use these terms to refer to employees who work in computer-related occupations or occupations involved in technological design.

Mid-Career Level: Because the mid-career level has been identified as a particularly perilous time for retaining technical women, special attention is often given to this career point. Different reports define mid-level slightly differently. In general, however, the term refers to employees who have significant work experience, ranging between 10-20 years, but have not yet reached high-level leadership positions. For many women, this occurs during their early- to mid- thirties, at a time when competing life pressures are particularly acute.

“To further strengthen the U.S. position as a technical leader we need to examine the reasons why the industry is not attracting more people with varied backgrounds and take action to stem the current tide.”

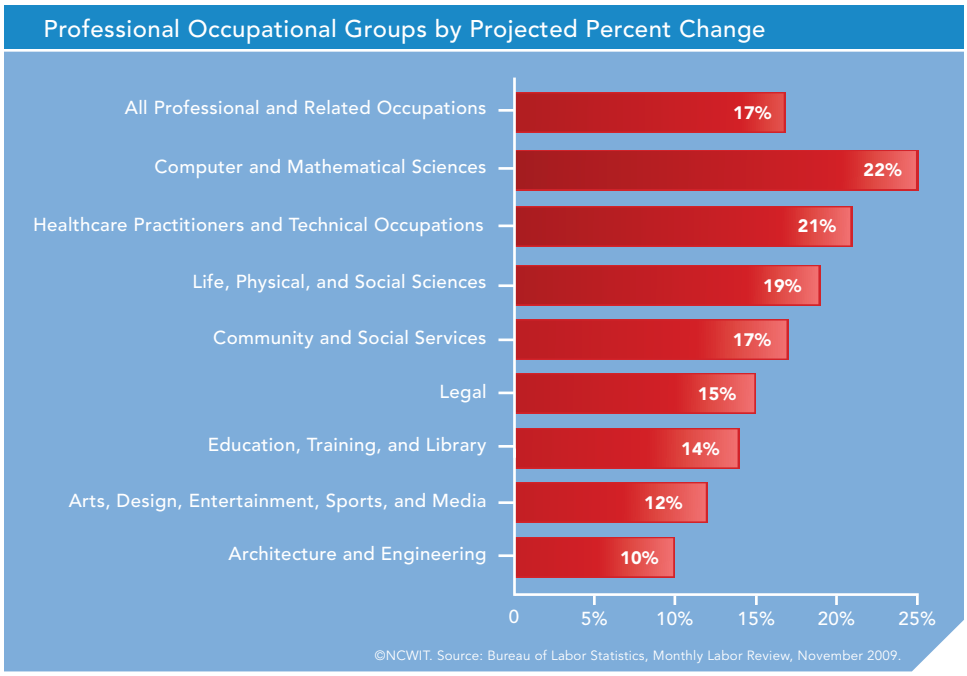
TABLE OF CONTENTS

EXECUTIVE SUMMARY

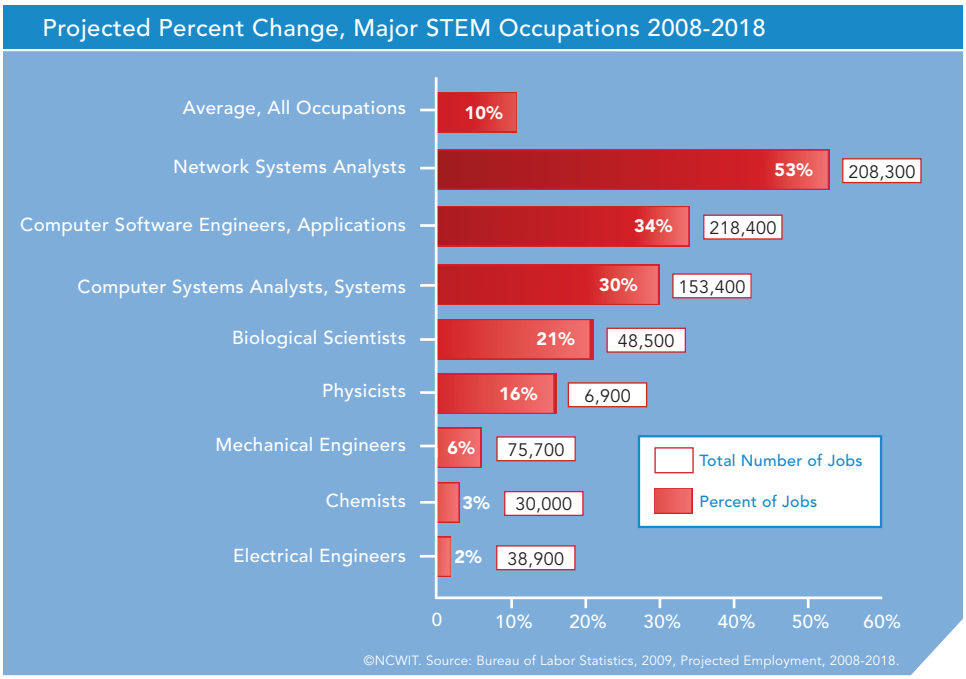
Women in IT – The Business Case: Why should companies care?

The Opportunity: Information technology is one of the fastest-growing U.S. industries.

As technical innovation plays an increasingly critical role in virtually every sector of the U.S. and global economy, computing occupations consistently rank among the top 10 fastest-growing occupations in the U.S. Many of the fastest-growing computing occupations also are among the occupations expected to produce the most growth in raw numbers of jobs. Overall, as the chart below illustrates, the computer and mathematical sciences occupational subgroup is the fastest growing of all the professional groups.

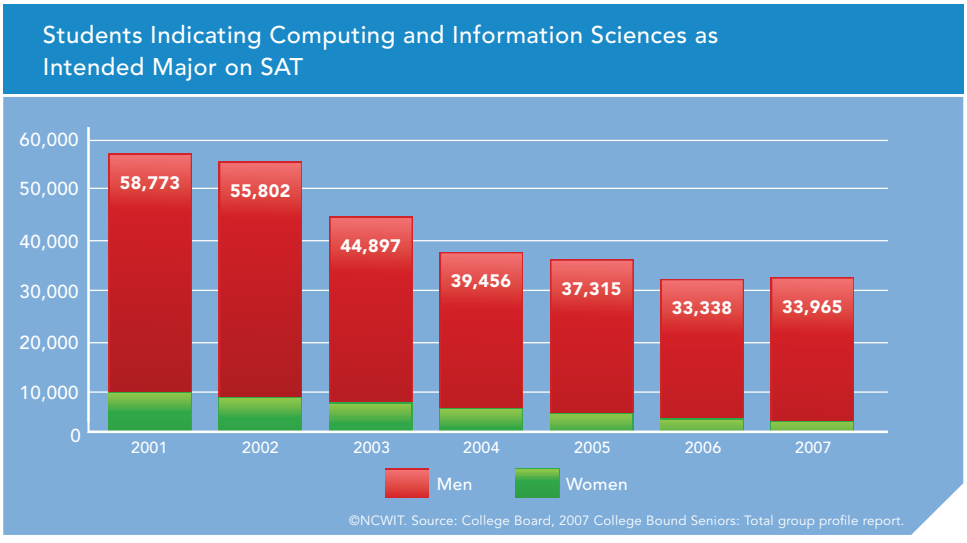


Computing professions also are growing more than twice as fast as the average for all occupations and significantly faster than most other STEM occupations. The U.S. Department of Labor predicts that there will be more than 1.4 million computing jobs available by 2018.



The Threat: Meanwhile, interest in computing is significantly declining.

Despite the increasing number of computing jobs, interest in these majors and careers has steadily declined over the past decade. Fewer students also are enrolling in computer science and graduating with computer science degrees. If current trends continue, by 2018 the industry will only be able to fill half of its available jobs with candidates holding computer science bachelor's degrees from U.S. universities.[2]



This creates at least three significant risks:

Risk 1: A shortage of talent

While interest in computing is declining among all potential candidates, the decline is more significant among women.

- In 2008, women earned 57 percent of all bachelor's degrees, yet they only earned 18 percent of computer and information science bachelor's degrees — down from 37 percent in 1985.[3]
- Similarly, in 2008 women held 57 percent of all professional occupations in the U.S. workforce but only 25 percent of all professional IT-related jobs — down from 36 percent in 1991.[4]

In short, the industry increasingly fails to capitalize on the talent of a vast majority of women — a population that makes up more than half of the U.S. workforce. This is a devastating loss of capital, particularly in the face of an impending shortage of workers.

Risk 2: Reduced innovation, productivity, and competitiveness

The lack of diverse talent in the technology industry is particularly troubling given recent research showing that diverse perspectives increase innovation, productivity, and competitiveness.

- A recent NCWIT study shows that teams comprising women and men produce IT patents that are cited 26–42 percent more often than the norm for similar types of patents.[5]
- In a study of more than 100 teams at 21 companies, teams with equal numbers of women and men were more likely (than teams of any other composition) to experiment, be creative, share knowledge, and fulfill tasks.[6]
- Additional studies indicate that, under the right conditions, teams comprising diverse members consistently outperform teams comprising "highest-ability" members.[7]

Realizing the benefits of this diversity is important for companies that want to retain and improve their competitive edge.

Risk 3: Financial losses and decreased customer satisfaction

A lack of diverse perspectives also means that those inventing the technology do not reflect the customer base. This is especially the case when women are absent. In 2007, women were responsible for 45 percent of and influenced up to 61 percent of all consumer electronics purchases.[8]

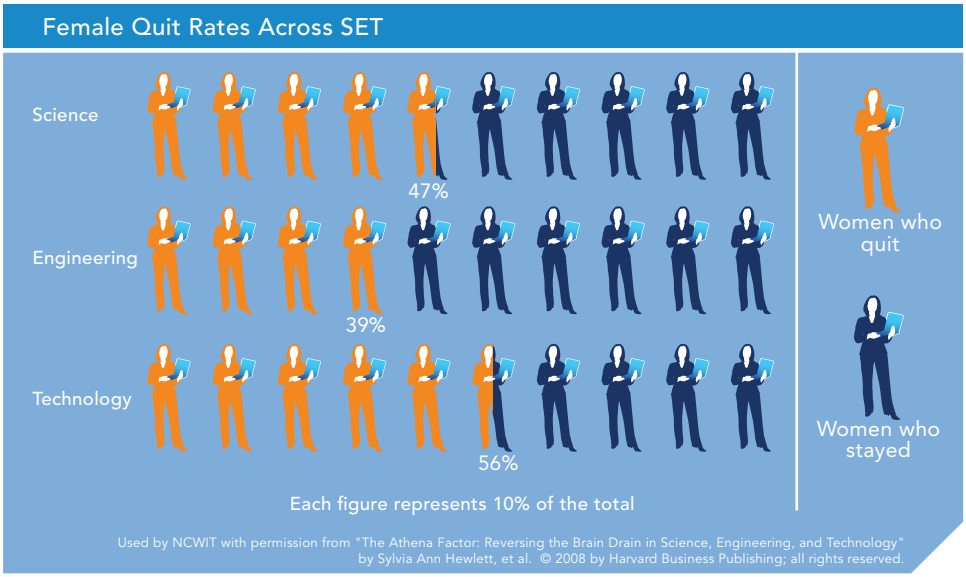
Additional research shows that companies with the highest representation of women in their senior management teams had a 35 percent higher return on equity and a 34 percent higher return to shareholders.[9]

The Threat Increases:

Not only is the industry failing to attract *new* talent, it is also losing talent *already* interested in technology

In 2003, only one-third of women with a computer science bachelor's degree were still employed in a science, engineering, or technical (SET) job two years after graduation.[10]

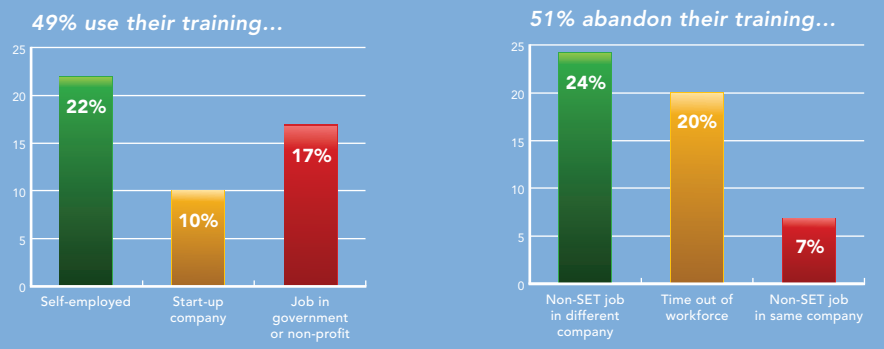
According to a study by the Center for Work-Life Policy, 74 percent of women in technology report "loving their work," yet these women leave their careers at a staggering rate: 56 percent of technical women leave at the "mid-level" point just when the loss of their talent is most costly to companies. This is more than double the quit rate for men. It is also higher than the quit rate for women in science and engineering.[11]



Half of the women who leave the private science and technology workforce will continue to use their training…just not for the company they leave or the private sector.[12]

As the chart on the following page illustrates, these women will move on to start competing companies or seek out government or non-profit jobs.

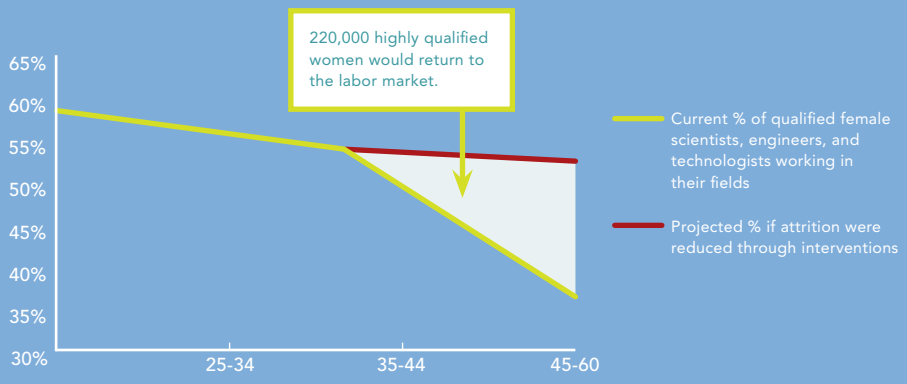
Women who leave the private SET workforce – Where do they go?



The Solution: What companies can do to optimize performance with top talent

The good news is that companies CAN reverse these dangerous trends, but a new approach must be taken to recruit, retain, and advance diverse talent. Simply reducing female attrition by one quarter would add 220,000 workers to the science, engineering, and technology talent pool.[13]

Intervening at the Fight-or-Flight Moment



The Bottom Line – Summing It All Up: What companies will gain from attracting and retaining female technical talent

Companies that attract and retain women can realize the following benefits:

- A stronger workforce and lower attrition costs
- Increased innovation and efficiency
- Products and services that reflect the consumer base
- Financial gains

“Simply reducing female attrition by one quarter would add 220,000 workers to the science, engineering, and technology talent pool.”

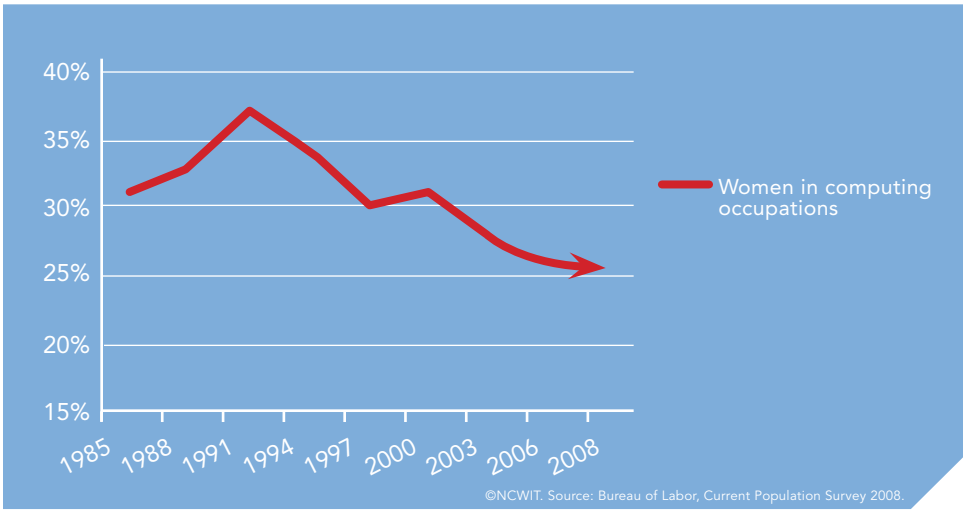
01 WOMEN IN TECHNOLOGY:
What is the current state of affairs?

- Overall Participation: How many women are in technical occupations? What are the trends for these numbers?
- The "Fight or Flight" Moment: How many technical women leave their positions and when? Where do they go when they leave?
- Salaries: How much do technical women make?
- Leadership: How many women hold leadership positions in technology?
- Innovation: How are women participating in technological invention?

Overall Participation: How many women are in technical occupations? What are the trends for these numbers over time?

The percentage of computing occupations held by women has been declining since 1991, when it reached a high of 36 percent. Meanwhile, the percentage of jobs held by women in almost all other sciences has increased significantly.[14]

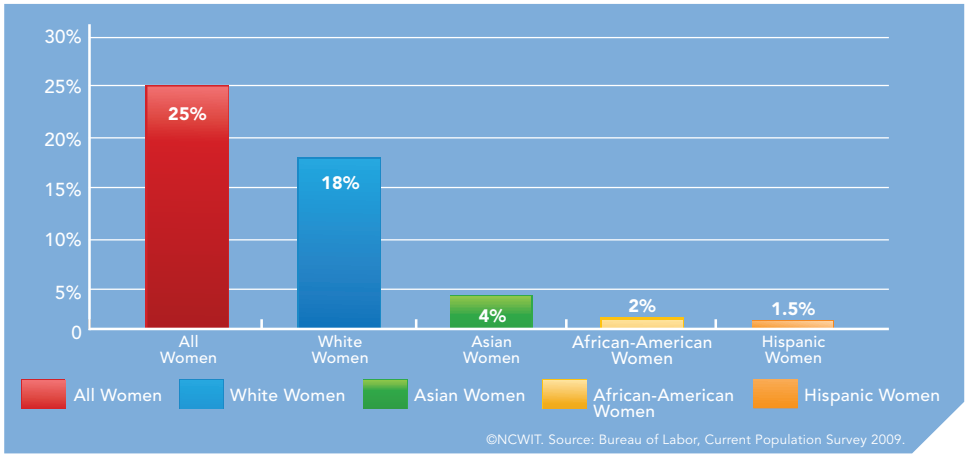
The percentage of computing occupations held by women has been declining since 1991



 Source: Bureau of Labor, Current Population Survey 2008.

In 2009, women made up only 25 percent of the IT workforce. Women's representation also varies by race/ethnicity.

Percentage of computing occupations held by women, 2009[15]



It's not that women "just aren't interested in technology and computing."

The technology industry not only fails to attract women in general, it also fails to attract a significant number of women with enough interest in technology or computer science to actually hold a degree in it.

In 2003, nearly half of all women who held a computer science B.S. were not employed in a *science, engineering, or technical (SET)* job two years after graduation. Just over one-third of women with a computer science B.S. were still employed in an SET job two years after graduation.

These numbers are reversed for men: half of all men with a computer science B.S. were still employed in an SET job two years after graduation, while one-third were not employed in an SET job.

While a number of recruitment efforts aim to increase girls' and women's interest in technology, this finding suggests that even when women are interested and accomplished in computer science or technology, they often choose other careers.[16]

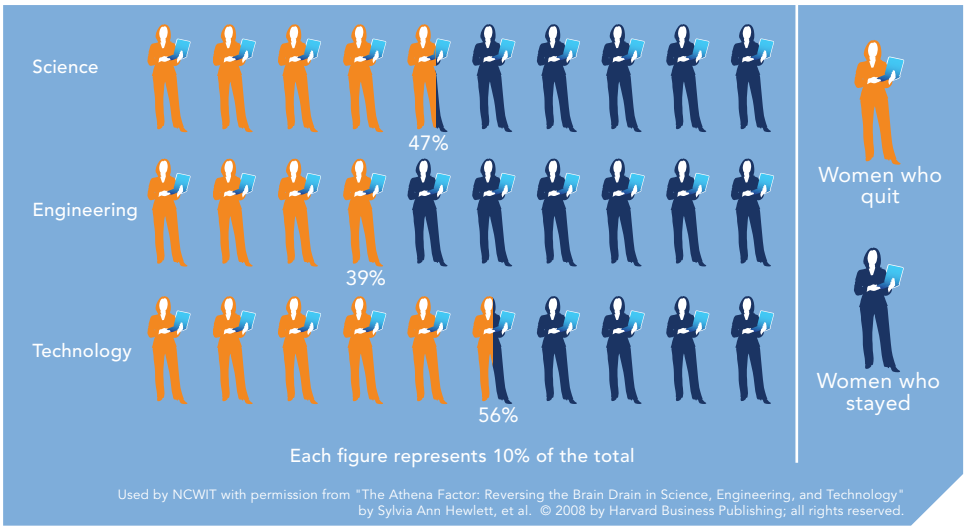
74%

of women in technology report "loving their work," yet women leave technology careers at a staggering rate.[17]

The "Fight or Flight" Moment: How many technical women leave their positions and when? Where do they go when they leave?

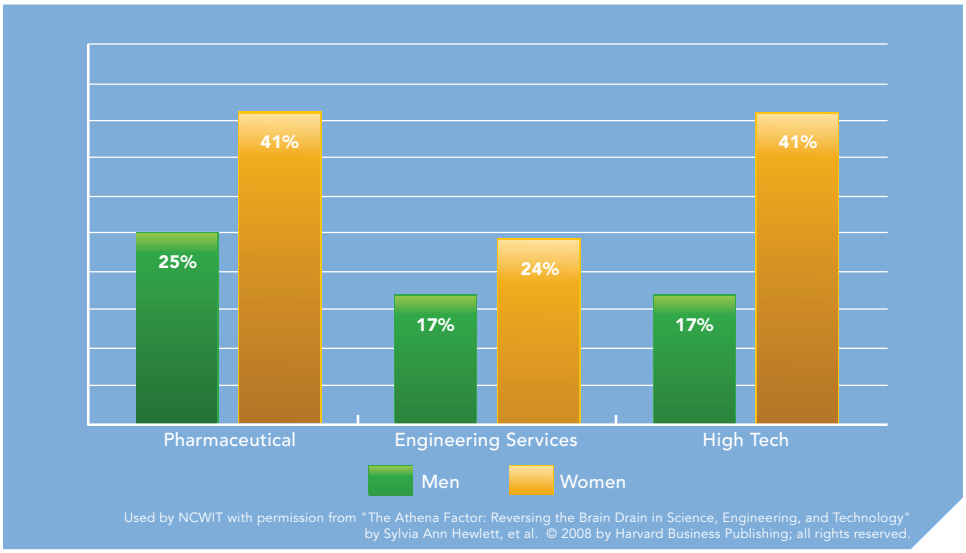
According to a study by the Center for Work-Life Policy, 74 percent of women in technology report "loving their work," yet women leave technology careers at a staggering rate.[17] As the chart on the next page illustrates, female attrition is higher in technology than in science and in engineering, but across all three climates, it is considerably higher than men's attrition.

Female Quit Rates Across SET



Some industrial sectors are particularly hard-hit. For example, the female quit rate in technology and in pharmaceuticals is double that of engineering services.[18]

Quit Rates for Select Microclimates



Mid-Career Level: The "fight or flight moment"

The mid-career level seems to be a breaking-point moment when attrition spikes. The mid-career level typically involves employees with considerable work experience but who have not reached senior leadership positions. In general, these employees usually have 10-20 years of experience.[19]

Forty-one percent of women leave technology companies after 10 years of experience, compared to only 17 percent of men.

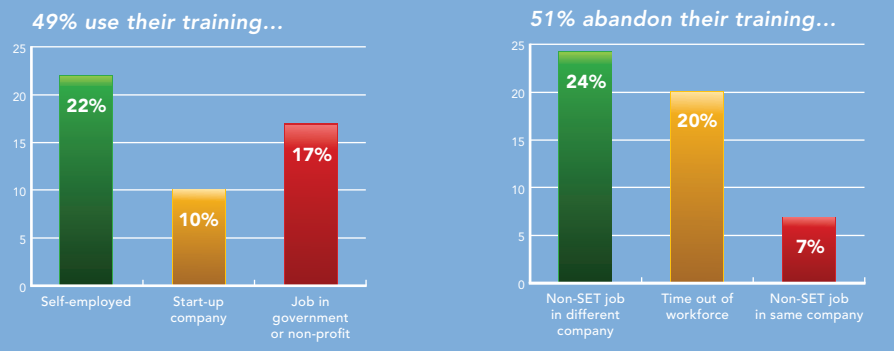
Fifty-six percent of women in technology companies leave their organizations at the mid-level point (10-20 years) in their careers.[20]

The mid-level is also a point when the loss of women's technical talent is most costly to technology companies. This evidence suggests that companies would do well to focus retention efforts at this level.

Where do women go when they leave?

Nearly half of women who leave the SET sector continue to use their training in other sectors — just not for the private sector or the company they leave. They move on to start competing companies or seek out jobs in the government or non-profit sectors.

Women who leave the private SET workforce – Where do they go?



Salaries: How much do technical women make?

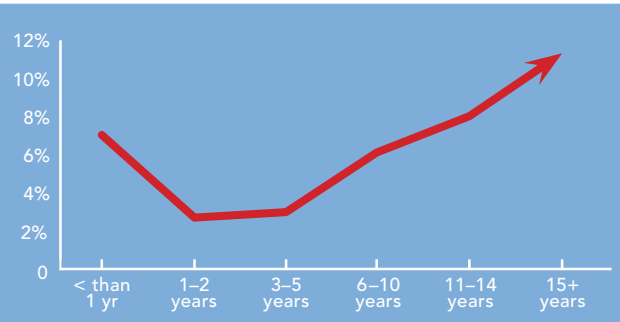
Dice (www.dice.com) is one of the leading providers of data on salaries in the technology industry. The findings below come from Dice's 2008 online survey of nearly 20,000 technology employees.

In 2008, technical women earned an average salary of $70,370.[21]

Over the same time period, men's salaries averaged $80,357. Consequently, the gender gap widened to 12.43 percent, a slight increase from 11.9 percent the previous year and nearly a 3 percent increase from 2006 when the gap was at 9.7 percent.

The good news is that this gap disappears when controlling for comparable levels of experience, education, and job title. While this is encouraging news for women who manage to advance in their careers, it does not account for the barriers and biases that prevent many women from advancing to these levels.

Salary Gap between Men and Women



©NCWIT. Source: Dice Holdings, Inc.

The salary gap between women and men declines slightly in the first 5 years of their careers, then spikes for the next 5-7 years.

Salary gap between men and women by years in career

The gap:

- Is almost 7 percent for those with less than a year's experience
- Falls to approximately 2 percent between 2-5 years of experience
- Increases to nearly 7 percent by 11-14 years, precisely during the "flight or fight moment" when women are most likely to leave
- Continues to increase to more than 11 percent after 15 years

Salary gap by industry

The highest-paid industry for technical women was banking and finance, where the average female salary ($80,342) mirrored the national salary average for men. Technical men in banking and finance, however, averaged salaries higher than the national average ($89,549), making the gender gap for the industry approximately 10%. Computer software ($76,921) and telecommunications ($74,733) round out the top three highest-paying industries for technical women. The computer software gender gap approximated the national average while the telecommunications gap was one of the lowest gaps by industry.

Industry	Salary gap between men and women
Bank / Financial / Insurance	10.28%
Computer Hardware	10.15%
Computer Software	10.93%
Govt/Defense	15.70%
Internet Services	13.53%
Manufacturing	12.90%
Medical / Pharmaceutical	13.25%
Retail / Mail Order / E-Commerce	8.42%
Telecommunications	9.44%

©NCWIT. Source: Dice Holdings, Inc.

Salary gap by occupation

Wide variation in the salary gap also exists by occupation, with web developers having the highest gap while, interestingly, both IT management positions and technical support positions have the lowest salary gaps.

IT Occupation	Salary gap between men and women
Web Developer/Programmer*	14.05%
Developer: Applications	12.92%
Software Engineer	12.91%
Database Administrator*	11.98%
Project Manager	9.81%
Programmer Analyst	9.05%
Systems Administrator	7.43%
Business Analyst	4.28%
Quality Assurance (QA) Tester	4.02%
Help Desk*	3.27%
IT Management: CEO, CIO, CTO, VP, Dir. Strategist, Architect	2.28%
Technical Writer*	1.64%
Technical Support	1.40%

* These results may not be indicative of the broad market due to a small sample size for this job title. ©NCWIT. Source: Dice Holdings, Inc.

Leadership: How many women hold leadership positions in technology?

Women hold 10 percent of corporate officer positions and make up 11 percent of board of directors in Fortune 500 technology companies.[22]

In one study, the odds of being in a high-level position are 2.7 times greater for men than for women.[23]

In another study of Silicon-Valley technology startups, women accounted for only 4 percent of senior management positions in technical/R&D departments. They accounted for 14 percent of senior management when including non-technical departments.[24]

Women account for 9 percent of IT Management Positions *(defined as CEO, CIO, CTO, VP, Director, Strategist, Architect).*[25]

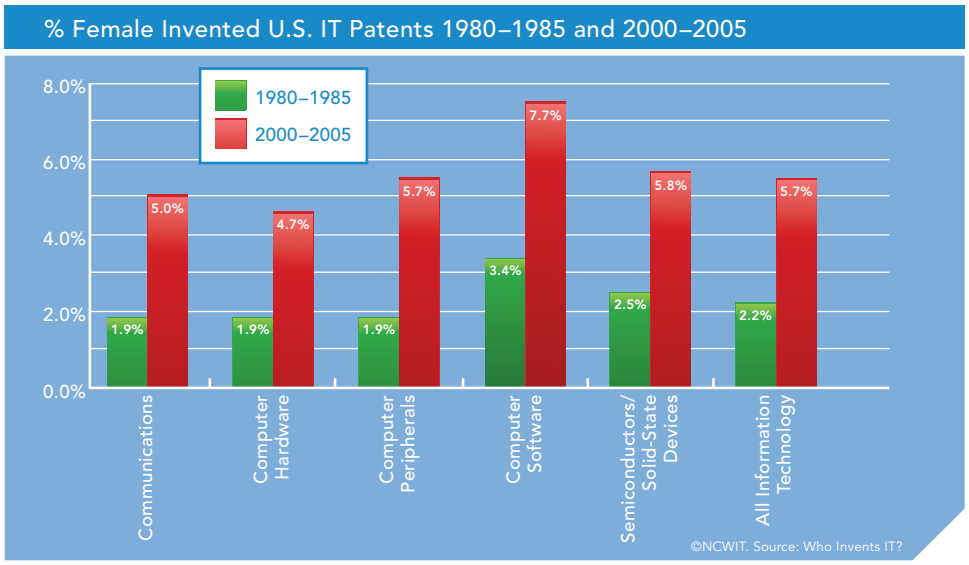
In a study of 198 public companies with at least $6 billion in revenue, 5 chief executives were women. Of the 22 technology comp anies, none had chief executives who were women.[26]

Innovation: How are women participating in technological invention?

Understanding women's participation in innovation is important for helping us understand *how* women are participating in computing and information technology, not just *how many* are participating. While patenting is certainly not the only measure of innovation, it is one important and readily available measure of the extent to which women are involved in the recognized and rewarded aspects of IT innovation, research, and development. Documenting these trends in patenting also can provide a benchmark against which to measure future efforts to increase women's patenting activities. In addition, identifying differences in women's patenting across industry subcategories and across specific organizations is important for uncovering potential areas for future research—research into "what works" in those companies that may have higher rates of patenting for women.

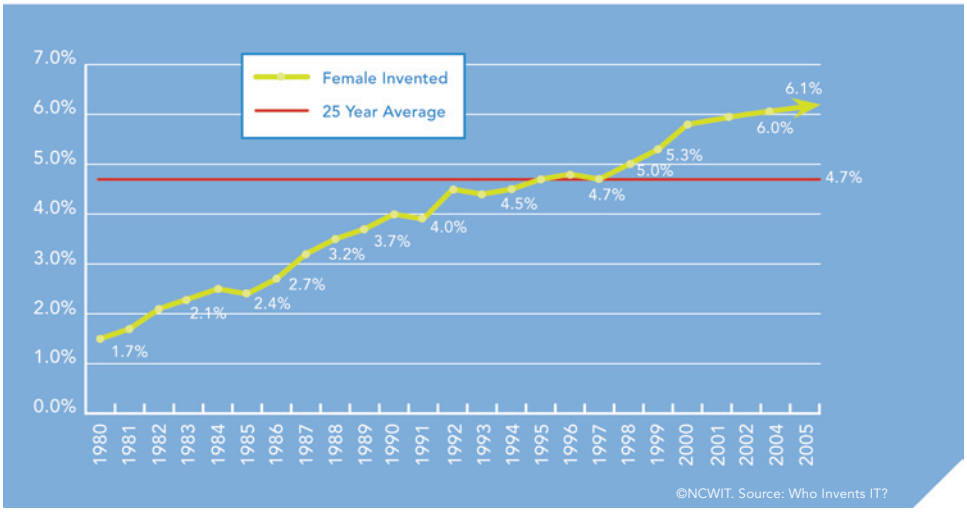
In general women's participation in patenting has been quite low for the past two decades. From 1980 to 2005, women account for about 4.7 percent of all U.S.-invented U.S. IT patents.[27]

These rates are relatively similar across IT subcategories, except for computer software where women's patenting rates reach 7.7 percent.



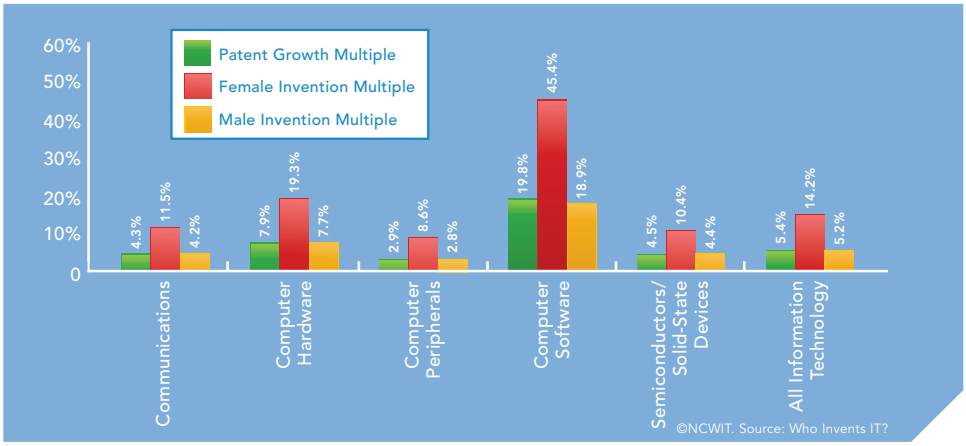
On the following chart, we see that while female rates of patenting remain quite low, progress has been made in the past 25 years. In 1980, female patenting rates were 1.7 percent, and they climbed steadily to 6.1 percent in 2005.

Female Patenting Rate 1980–2005



And progress is greater than it first appears. Overall patenting in all IT sub-categories grew substantially between1980-2005, but U.S. female patenting grew even more dramatically. All U.S. IT patenting grew from 32,000+ patents in the period from 1980–1985 to 176,000+ patents — a five-fold increase. For the same period, U.S. female IT patenting grew from 707 patents to more than 10,000 — a 14-fold increase. This is particularly noteworthy because the percentage of women employed in IT remained relatively flat, even declining slightly, during this same time period.

Growth in Female Patenting as Compared to Growth in Overall Patenting and Male Patenting



Female patenting rates differ widely from one organization to another. In some organizations the number of patents with at least one female inventor was 5 percent, while in other organizations it was as high as 30 percent.

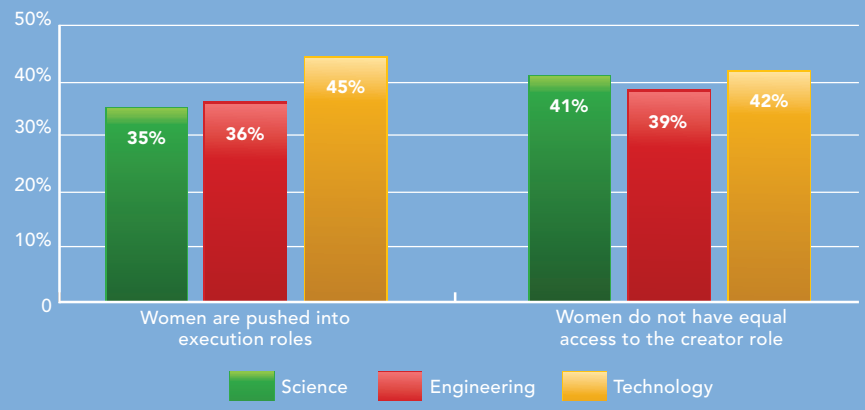
A number of companies have produced large increases in female rates of patenting. For example, 20 years ago, several companies had no female inventors; but by 2005, approximately 25 percent of these companies' patents had at least one female inventor.

Diversity fosters innovation: teams comprising men and women produced the most frequently cited patents—with citation rates that were 26 to 42 percent higher than the norm for similar patents. This finding points to the potential benefits of diverse teams for improving innovation and productivity.

Other measures of innovation

In addition to patenting rates some other measures of how women are participating in technology are emerging. In *The Athena Factor,* women report that men more frequently occupy the "creative" and "producer" spaces while women are more frequently pushed into execution.[28]

Creator versus Executor Roles



Other studies have looked at women's participation in open source as a potential measure of innovation.

While women's representation in technology is low, it is even lower in open source computing – only 1.5 percent of all Open Source Software (OSS) developers are women.[29] Research aimed at understanding these reasons is relatively new but some studies have begun to explore these issues. One such study posits that women are excluded implicitly and explicitly from becoming Free Libre Open Source Software (FLOSS) developers, and that their needs as users are not addressed. The author suggests that the long hours necessary for coding, a lack of female role models and mentors, users' discriminatory language online and offline, the prevalence of text-based coding systems (as opposed to graphic coding environments), and the FLOSS community's male-centric competitive world-view are all factors hindering women's participation.[30]

Another study using extensive survey and interview data concluded that women are deterred from entering FLOSS because of the combative hacker ethic, including "flame wars," and the difficulty of receiving adequate recognition for their contributions. This report also suggests that women are hindered from joining FLOSS communities because they are less likely than men to have the level of computing expertise the FLOSS community expects of new entrants; women generally first engage with computers at a later age or at a less advanced level compared to men.[31]

The innovation metrics in this chapter are a useful start in measuring women's participation in the creative and innovative aspects of technological development. This type of participation is difficult to measure, however, and further research is needed to identify other measures of innovation and to help us understand barriers to and solutions for women's participation in innovation.

This chapter has presented a snapshot picture of the current state of affairs for technical women in terms of their overall participation, attrition rates, average salary levels, and their participation in leadership and in innovation. The next chapter examines some of the factors that contribute to this current state of affairs, identifying key barriers for technical women.

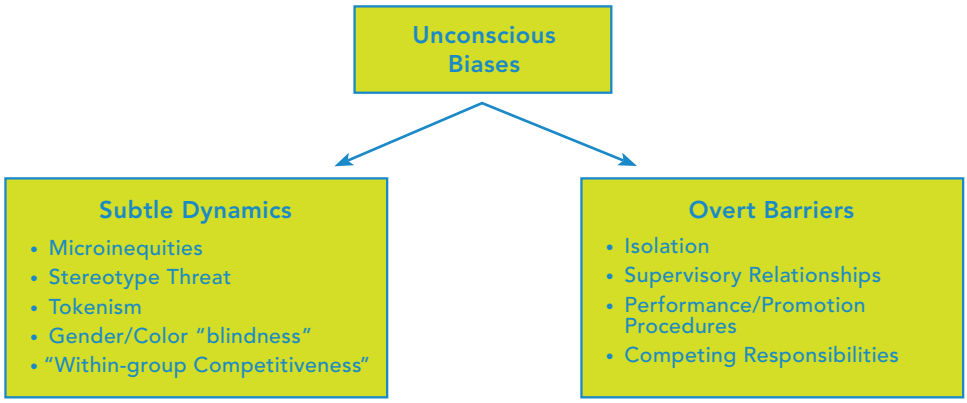
02 IDENTIFYING BARRIERS:
Why the current state of affairs?

- Unconscious Bias: What is it and how does it affect turnover in technical companies?
- Isolation: Lack of role models/mentors/sponsors
- Supervisory Relationships: "Employees leave managers, not companies"
- Promotion Processes: Bias in task assignment, performance evaluation, and advancement
- Competing Life Responsibilities: Consequences for ALL employees but especially women

Research has identified a number of key barriers to women's participation and advancement in technology. These include a lack of role models, mentors, and sponsors; problems with supervisory relationships; inequities in performance and promotion procedures; and inflexible work policies that make it difficult to manage competing responsibilities (e.g., family, elder care). Unconscious bias plays a role in these barriers and in creating other institutional barriers for technical women. This chapter provides a look at each of these barriers, how they are shaped by unconscious biases, and the effects on technical women.

Unconscious Bias: What is it and how does it affect turnover in technical companies?

Unconscious biases result when our pre-existing beliefs and attitudes about particular groups of people subtly influence behaviors and decisions. Unconscious bias poses problems for all workplaces, but it typically poses even bigger problems in workplaces or industries dominated by a single gender or group. In these workplaces, practices, cultures, and systems naturally emerge to reflect and meet the needs of this population. These systems inadvertently disadvantage employees from underrepresented groups who later enter the field with different needs.



As illustrated in the above figure, these dynamics then result in a number of subtle dynamics and more overt barriers. Sometimes these problems may be isolated to specific individuals, teams, or isolated interactions. When they become more systemic or subtly encoded in company policies or practices, they result in institutional barriers. It is important to remember that these barriers naturally arise in any majority-minority situation and are not necessarily the result of any ill intentions. If these policies or systems do not change with the times, however, they can inhibit the success of new members. Addressing the barriers is the goal, *not* finding fault or assigning blame.

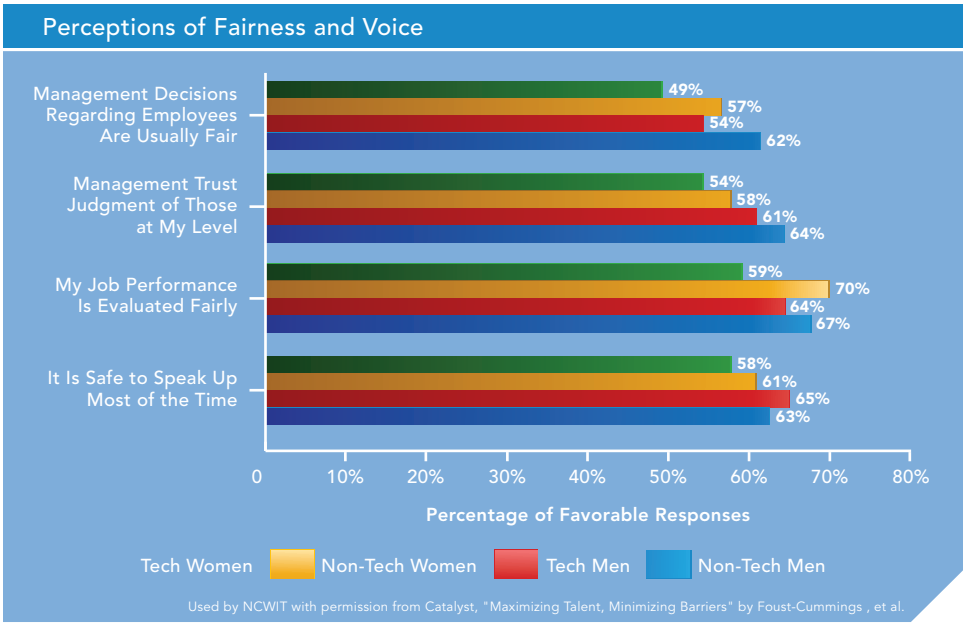
The rest of this section explores some of the subtle dynamics that play a key role in women's decisions to leave or stay. The remaining sections in this chapter explore some of the more overt institutional barriers to women's participation in IT and the role unconscious bias plays in creating these barriers.

Hidden biases and barriers cost corporate America $64 billion per year in employee turnover — and that is a *conservative* estimate.[32]

- This estimate accounts for the annual cost of employee turnover due *solely* to unfairness. This turnover disproportionately includes employees from underrepresented groups.
- When considering other intangible factors, such as the cost to company reputation and ability to recruit new talent, the price tag soars even higher.
- Additional intangible costs result when unconscious biases silence the employees who *do* stay or prevent them from contributing their best ideas.

Technical companies may be at increased risk

In general, unconscious bias tends to play a bigger role in companies where the workforce is dominated by a single gender or group. Consistent with this trend, recent research by Catalyst indicates that problems associated with unconscious bias and fairness may be exacerbated in technical companies and departments. As the chart on the following page illustrates, technical women were less satisfied with their companies' approaches to fairness and voice than all other employees: women in non-technical roles, men in technical roles, and men in non-technical roles.[33]



Research shows that employees are more likely to leave when they feel that their ideas and opinions are not taken into account or when they feel like they have little say in performance evaluations. Unconscious bias and problems with fairness negatively affect employee engagement, turnover, and, ultimately, the company's bottom line.

Subtle Instances of Unconscious Bias

This section focuses on how unconscious bias plays out in subtle, everyday instances. The remaining sections of this chapter will look at some of the more overt institutional barriers women face. Subtle instances of unconscious bias are extremely important because they are much more difficult to detect but often build upon each other, creating environments that force underrepresented employees out the door. The following are some concrete examples of how these dynamics play out in companies.

Microinequities: "My manager always lists me last toward the bottom in email to the team, unless there is a problem. THEN I'm first in the list. What's up with that?"

Microinequities[34] — closely related to and often caused by unconscious bias — are subtle, cumulative messages that devalue, discourage, and impair performance in the workplace. These messages include looks, gestures, or tone of voice, and often accumulate in ways that lead employees to underperform, withdraw from co-workers, and ultimately leave the workplace.

Examples of Microinequities

Failing to recognize an idea when expressed by one employee but acknowledging it when paraphrased by another employee.

Looking at the clock, answering the cell phone, or other subtle behaviors that indicate a manager or supervisor is not interested in the conversation with an employee.

Subtle norms that make it acceptable for heterosexuals to talk about what they did on the weekend with husbands, wives, or family but not as acceptable or comfortable for GLBT employees to do so.

Stereotype Threat: "Great job! You're living proof that women really do have technical minds!"

Even when said in jest, these kinds of comments (or more subtle comments) can invoke *stereotype threat* — the fear or anxiety that our actions will confirm negative stereotypes about our "group" or about ourselves as members of a group. These fears and anxieties reduce feelings of competence and trust, and can negatively affect performance, confidence, and risk-taking behavior.[35] Recognizing stereotype threat is important; otherwise employers, supervisors, or coworkers might incorrectly assume that these behaviors or lack of confidence are the result of personal characteristics of the employees themselves. This will leave the conditions that create stereotype threat unaddressed, ensuring that these employees are not able to live up to their full potential and most likely will leave the company.

46%

of Fortune 1000 women named gender-based stereotypes and biases as a barrier.[39]

Research on Stereotype Threat

White male engineering students get lower-than-usual test grades when told in advance that Asians typically score higher than any other group on math tests.[36]

Other experiments have shown that African Americans underachieve on academic tests when told racial stereotypes about intelligence prior to testing.[37]

Women underperform on math tests when gender is called to their attention.[38]

Tokenism: "We're so excited to have you on board, and we've really needed someone like you to help us understand the Asian market."

Tokenism often occurs when only a few employees belong to a particular identity group (e.g., in terms of gender, race, age). These "token" employees experience a number of difficulties.

Examples of Tokenism

Members from diverse groups are often expected by others to "speak for" or "represent" the group as a whole.

Diverse members are expected to be able to "relate to" customers or clients who are also members of the same or similar identity group/s.

Diverse members are asked to take responsibility for a larger share of "diversity" work. This frequently prevents them from putting as much time into other aspects of their jobs, often negatively affecting job performance, evaluations, and advancement.

"I don't see color or gender; you do your work well on my team and you'll succeed!"

These behaviors ignore the reality that a wide range of variation exists within any identity group and that it is unreasonable to expect one person to represent this within-group variation (for example, rarely do we expect a white person to speak for all whites or a man to speak for all men).

Gender- or Color-blindness: "I don't see color or gender; you do your work well on my team and you'll succeed!"

Individuals frequently make well-intentioned assertions such as these in an effort to combat prejudice and treat employees equitably. A gender- or color-blind stance might be appropriate if the larger society also was gender- and color-blind. Since this is not the case, holding such a stance at this point in time ignores important realities. Women and people of color often have experiences that shape their lives differently, (e.g., women more often than men have to think about or are asked to explain how they balance work and family responsibilities). These individuals also face different prejudice and inequities. "Treating everyone the same" ignores these realities and the fact that existing workplace conditions do not meet these employees' needs. It also ignores the fact that current work-place conditions are not natural; they have subtly evolved to meet the needs of the original population. For example, when most employees have a stay-at-home-spouse (typically a wife) taking care of the children, flex time does not

become a norm because these employees do not need it. If most employees were single parents or had dual-working relationships, different systems would most likely have evolved.

The Glass Cliff: "Well, we've been getting pressure to diversify management, so we better give her a shot even if she's not quite ready."

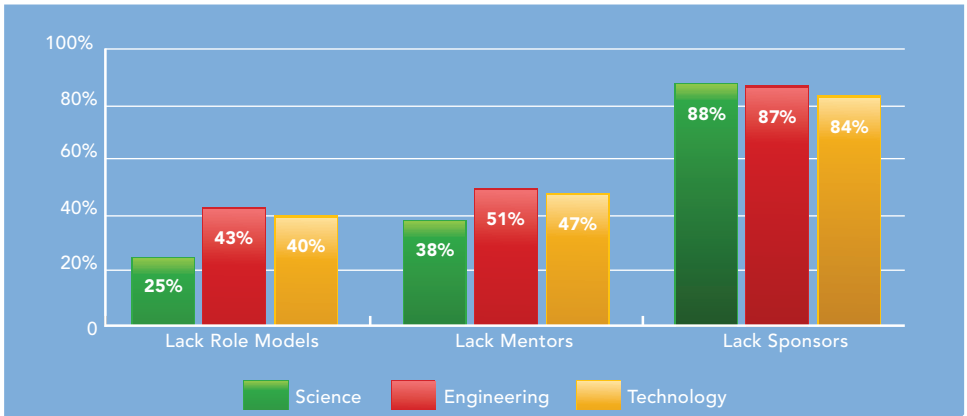
This phenomenon occurs when members from underrepresented groups are promoted too early or put in charge of tasks they do not yet have the expertise or the authority to carry out. Similar to tokenism, this often happens as supervisors, managers, or company leaders try to meet diversity requirements. Meeting these requirements in this way, however, unwittingly sets these employees up to fail and is detrimental to the long-term interest of the company, to the employee's own interest, and to future efforts for hiring and retaining diverse employees. Supervisors need to be keenly aware of whether or not they are hiring and promoting members of underrepresented groups simply to fill a "diversity requirement" and, in the process, setting them up to fail or fall off the "glass cliff."

For more information on these subtle dynamics and how to address them, see NCWIT's Supervising-in-a-Box series, available at **www.ncwit.org/supervising.**

Isolation: Lack of role models/mentors/sponsors

Technical women identify isolation and the lack of appropriate mentorship or sponsorship as one of the key barriers to their retention and advancement. In *The Athena Factor,* one-third of women in private-sector SET jobs said they felt extremely isolated at work. In the same study, 40 percent of technical women reported lacking role models, while nearly half reported lacking mentors, and 84 percent reported lacking sponsors or someone who would help make their accomplishments visible throughout the organization.[40]

Lack of Role Models, Mentors, and Sponsors Across SET



Similarly, in *Climbing the Technical Ladder,* more than one-third of women perceived that the following affected their advancement to either a "great" or "very great" extent:[41]

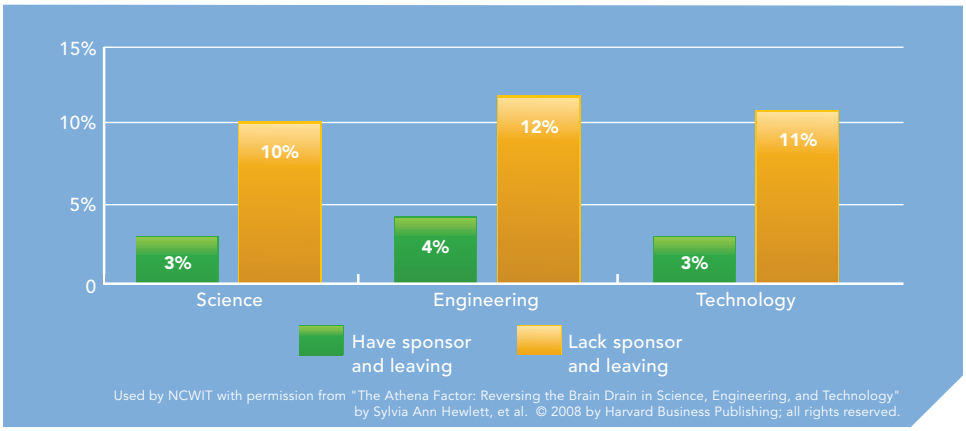
- a lack of role models
- a lack of mentors, sponsors, or champions who make their accomplishments visible
- being excluded from the networks of key decision-makers

More than 1 in 5 technical women also felt that the following factors – closely related to having few mentors or sponsors — hindered their advancement to a "great" or "very great" extent"[42]:

- having a limited number of important or special job assignments that are highly valued by higher-level managers
- not understanding the "unwritten rules" or norms of my company or department

This isolation often translates to attrition. As one managing director noted, "people with mentors receive more promotions and higher compensation, and tend to have higher job satisfaction and career commitment than those without such advisors."[43] In fact, women who are isolated are not only less committed, but are 13 percent more likely than women who do not report isolation to also report being unsatisfied with their job. Women who are not satisfied with their jobs are 22 times more likely to leave than women who are satisfied. Likewise, women without mentors or sponsors are also more likely to leave their companies.[44]

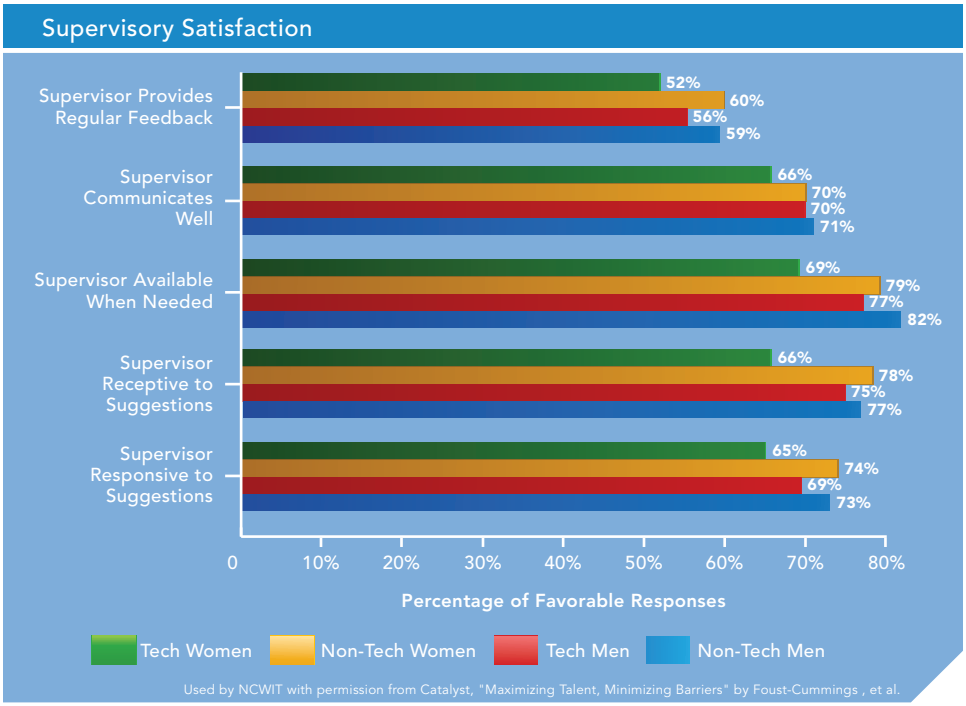
Women with Sponsors Are Less Likely to Have One Foot Out the Door



While isolation is a common experience throughout their careers, as technical women get closer to the top, they are an increasingly smaller minority. Indeed, they are often the only woman at the meeting, on the team, or on the floor. Furthermore, the even more extreme absence of underrepresented minority women role models in high level positions increases the possibility that minority women will experience workplace isolation and, eventually, consider leaving their companies.[45]

Supervisory Relationships: "Employees leave managers, not companies"

Research illustrates that the quality of the supervisory relationship is one of the primary factors in employees' decisions to stay with or leave a company. In general, technical women are less satisfied on a number of measures with their supervisory relationships than women in non-technical roles, men in technical roles, and men in non-technical roles.[46]



The supervisory relationship is important, in part, because it influences so many aspects of an employee's work life. Because of this, supervisors also have the power to exacerbate or remedy many of the barriers technical women face. For example, supervisors can have a profound impact on reducing isolation, recommending mentors, functioning as sponsors, providing access to flexible schedules, and reducing bias in performance evaluations and promotion procedures — all key barriers to technical women's advancement.

Technical Companies and Departments Face Unique Supervisory Dilemmas

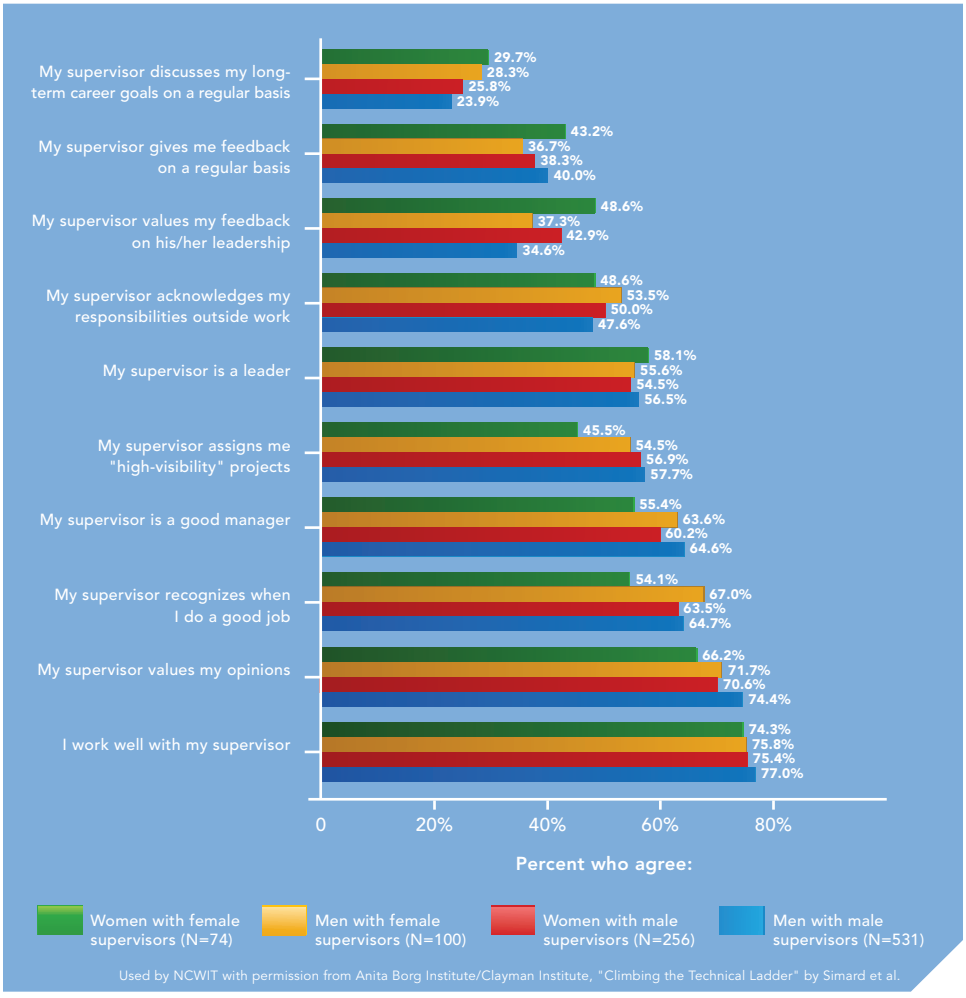
Failing to adequately train supervisors is particularly problematic in technical companies as these managers may be advanced into supervisory roles for their technical expertise rather than their managerial or supervisory capabilities.[47]

In addition, many mid-level men and women explained that rapid turnover in the technical industry meant that they had been through several different managers. As a result, most technical men and women simply do not expect to have a long-term relationship with their managers.[48]

Companies need to take steps to address these dilemmas if supervisory relationships are to improve in ways that retain women and *all* technical talent.

In particular, supervisors need to improve efforts at developing their employees, discussing employee career paths and goals, and giving regular feedback to their employees. Again, while this is true for female employees, it is also true for male employees. As illustrated in the chart below, only about 1 in 5 mid-level women and men report that these issues are regularly discussed with their supervisors.[49] Improving these discussions would help make the most of all employees' talent, but would especially help companies retain and advance women who report mysterious career paths and a lack of mentors as key barriers to their advancement.

Perceptions of Supervisors Among Mid-Level Technical Workers, by Gender of Respondent and Gender of Supervisor



Used by NCWIT with permission from Anita Borg Institute/Clayman Institute, "Climbing the Technical Ladder" by Simard et al.

In short, managers need to be able to be champions for developing employees. As one female employee noted, "I need honest advice on how to take the next step in my career, and my manager is not in a position to do that — he has made it clear that he wants me to stay put."[50] In this way, managers can become deliberate or unintentional roadblocks to the success of their employees.

Promotion/Performance Review Processes: Bias in task assignment, performance evaluation, and advancement

Gender bias permeates the promotion and performance review process. Almost half (46 percent) of technical women report that gender bias influences performance evaluations.[51] Similarly, one in four technical women reports that women are often seen as intrinsically less capable than men in their companies. This also is higher than in sciences overall where only 16 percent report this phenomenon.[52] In general, technical women are less satisfied with their companies' approaches to fairness and voice than women in non-technical roles, men in technical roles, and men in non-technical roles.[53]

Almost half

(46 percent) of technical women report that gender bias influences performance evaluations.[51]

Research on recommendation letters and performance evaluations confirms the prevalence of gender bias in these processes.

Recommendation letters for men (written by both men and women) were longer and contained more "standout" language (excellent, superb) than letters for women.[54]

In contrast, letters for women included "doubt-raisers" ("she had a somewhat challenging personality") and "grindstone" adjectives that made a woman seem like a conscientious secretary (meticulous, reliable).[55]

Subtle gender bias can permeate performance evaluations. Men's accomplishments are attributed to effort and individual skill, while women's accomplishments are more likely to be attributed to luck and easy assignments.[56]

Research into talent systems in a wide range of corporations also illustrates that bias pervades talent management systems in companies.[57] Rarely do organizations explicitly state the requirements for promotion to leadership. This leaves employees looking to senior leaders for cues. Since senior leadership is predominantly male, talent management systems more commonly include masculine stereotypes when characterizing senior leaders, suggesting that masculine norms are embedded in the system.[58]

Results from a survey of talent managers confirm that the majority of talent managers evaluated their senior executives as primarily displaying stereotypically masculine characteristics and competencies. The three most popular characteristics were all stereotypically masculine (action-oriented, drives results, and problem-solving).[59] Conversely, the top stereotypically feminine characteristic (collaborative) was indicated by less than one-half of the talent managers and teams that completed the online survey. These norms are reinforced in a vicious cycle of who is seen as a leader, who gets selected for development as a future leader, and how employees are evaluated on a regular basis.[60] These kinds of gender biases are even more likely in technical companies or departments where the environment is even more predominantly male than in many other kinds of corporate environments.

Gender norms and biases also play out in specific ways in technical companies. Many women report that a single assertive communication style is rewarded, rather than truly rewarding employee performance. As one woman put it, "You have to be able to blow your own horn. You have to be convinced that you're smarter than everybody else and everybody should listen to you. This is a certain ego trait that I don't think is rewarded in women. It is certainly not seen as feminine...Whereas those same personality traits in men are somewhat admired."[61]

This norm also encourages an environment where employees with less-aggressive communication styles are seen as less technically competent. This disadvantages *all* talented employees with these less-aggressive styles, but it has the potential to particularly disadvantage women who often perceive themselves or are perceived by others as having less-aggressive styles. In addition, research has also shown women face a significant "double-bind," where they are penalized whether they exhibit less-aggressive styles or more-aggressive styles. The former clash with the culture and the latter are (often unconsciously) seen as inappropriate or inconsistent with stereotypical or "appropriate" feminine characteristics.[62]

Establishing Fair and Clear Promotion Criteria Is Key for Retaining ALL Technical Employees

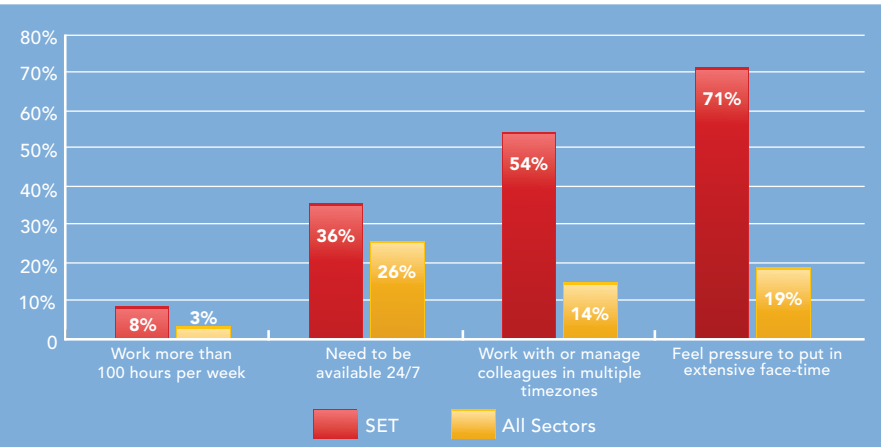
Characteristics that many mid-level technical men and women value as important for success are not rewarded or seen as important for promotion. Both mid-level men *and* women strongly value teamwork and perceive that collaboration is important for success. The majority of interviewees, however, also described highly competitive evaluation processes, where they were judged "on a curve" or placed on rank-lists. These processes force managers to fight it out if they wish to receive higher rewards for their employees.[63]

While women are more likely than men to view clear and balanced promotion criteria and processes as important to retention (68.7 percent), a high proportion of men (61.3 percent) also see fair and transparent promotion practices as essential to retaining technical employees.[64]

Competing Responsibilities: Consequences for ALL employees but especially women

Women in SET report experiencing significantly more pressure to put in "face time" and to be "available 24/7" than do women in other sectors.[65]

Extreme Job Pressures: Women in SET Compare with All Sectors



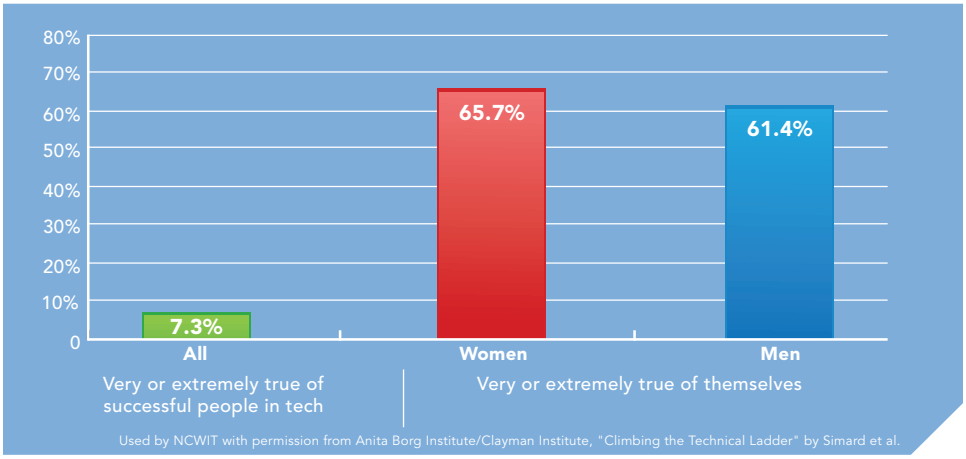
These pressures often make it difficult for employees to access flexible work schedules and manage competing responsibilities such as family care.[66]

Interestingly, both men and women believe that being family-oriented is not associated with success in technology. Many mid-level women report experiencing a "family penalty" where supervisors assign them less important or fewer high-visibility tasks. Likewise, many men also experience family responsibilities as a potential roadblock to advancement.

In fact, as the chart on the following page illustrates, only 7.3 percent of mid-level technical employees agreed that successful technologists are family-oriented. At the same time, however, more than 60 percent of these same women and men described *themselves* as family-oriented. This disconnect can have very real consequences for all employees and for the company that risks losing their talent.

All data here and for the rest of this chapter is from Simard et al,* Climbing the Technical Ladder *unless otherwise noted.

"Family-Oriented": Attribute of Success Versus Self-Perception Among Mid-Level Technical Men and Women



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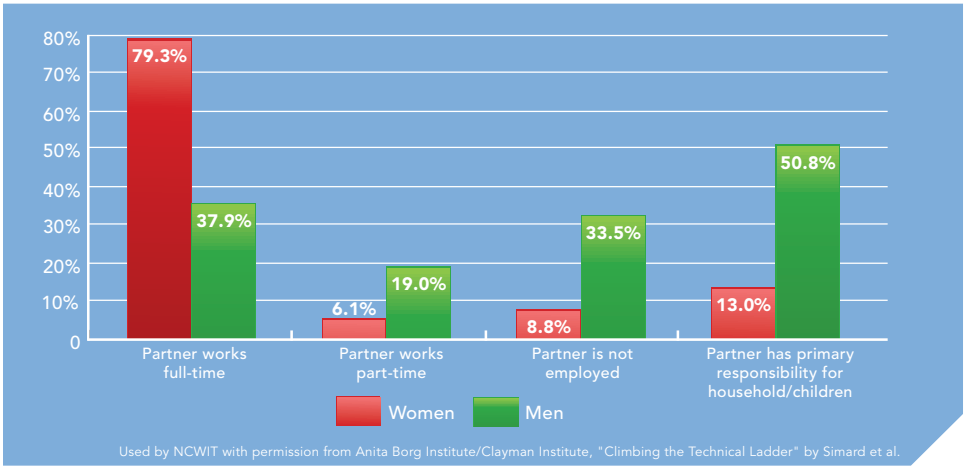
As the figure below shows, among mid-level technical employees who are married/partnered:

- Mid-level women are more than twice as likely as men to have a partner who works full time.
- Mid-level men are almost four times more likely than women to have a partner who assumes the primary responsibility for the household/children.

Many mid-level women commented that the "motherhood assumption" was a barrier to their career success, while some male interviewees perceived motherhood as a barrier to women as well.

Mid-level women are more than twice as likely as men to have a partner who works full-time.

Household Characteristics of Partnered Mid-Level Technical Workers, by Gender



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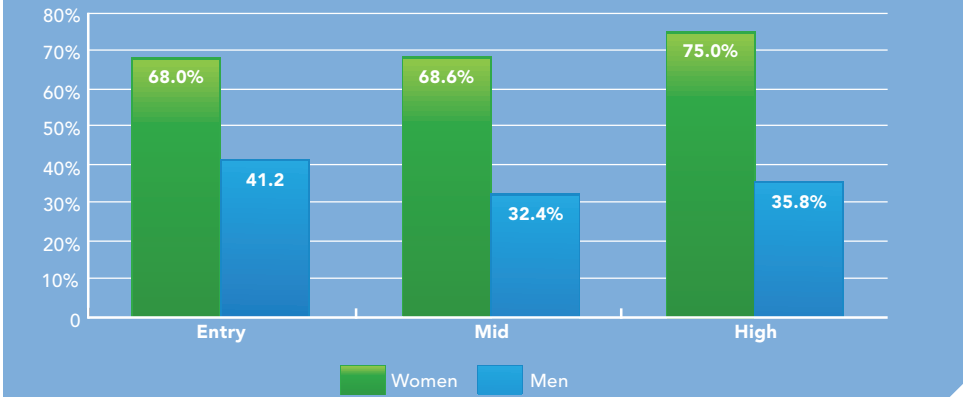
Dual Tech Career Households: Competing Responsibilities, Competing Careers

Nearly 70 percent of partnered mid-level technical women (vs. 33 percent of men) have partners who also work in technology.

Thus, not only do women at the mid-level work and live in dual-career households, but both partners often work within the constraints of technology careers. This means these constraints are more likely exacerbated for women.

Percentage of Partnered Respondents in Dual Technical Career Households, by Gender and Level



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Interestingly, mid-level employees more often reported that *informal* company practices — not *formal* company policies — made securing a flexible schedule difficult. For example, while flexible work schedules are often "technically" available, managers make accessing these schedules difficult, either through their authority or through informal comments. Women and others who take advantage of flexible scheduling often experience subtle reminders that they have been given "special treatment" and, as a result, end up working extended hours. These comments, combined with the lack of a "family-oriented" workplace culture, lead many women or others who temporarily take part-time positions to believe they are taking a "step down" on the career ladder.

Sometimes seemingly unrelated aspects of a company's culture also make it difficult to take advantage of flexible work schedules. For example, some technology companies' use of a single "head count" method makes it difficult for technical managers to offer employees flexible schedules in practice, even though they are available in theory. This method involves determining and distributing workgroup resources by using a "head count" that measures whether each employee is part-time or full-time. Therefore, a manager who allows an employee to work a 60 percent schedule will not realize the additional 40 percent as a resource allocated back to his or her group. This deters many managers from agreeing to part-time arrangements.

These difficulties in accessing flexible schedules result in serious consequences for women's retention and advancement.

03 ADDRESSING THE BARRIERS:

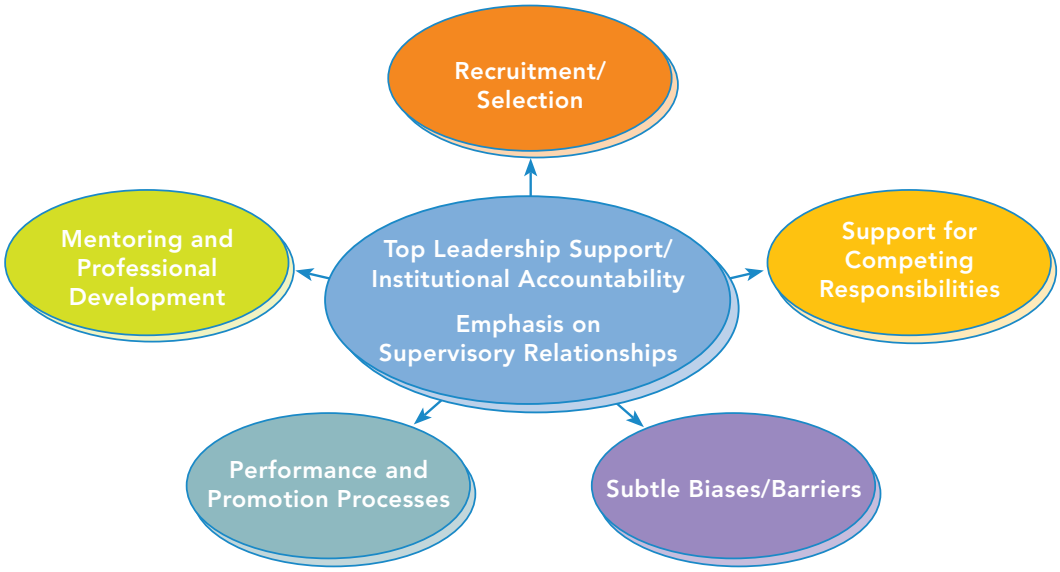
What can companies do to change the current state of affairs?

- It Takes an Ecosystem: A model for working on multiple levels at once
- Building the Foundation: Top leadership support and high-quality supervisory relationships
- Building the Ecosystem: Instituting multiple levels of reform
  - Recruitment and Selection: Addressing biases that prevent companies from hiring the best talent
  - Mentoring, Professional Development, and Learning Communities: Addressing isolation and unclear career paths
  - Performance Evaluation and Promotion Procedures: Examining biases and establishing clear criteria
  - Flexible Scheduling: Addressing competing life responsibilities

It Takes an Ecosystem: A model for working on multiple levels at once

Mainstream reforms for all employees. Ensuring that reform efforts target all employees is particularly important. Efforts that support women or other underrepresented groups alone often are effective only as long as funding or a champion is available—and are effective only for those employees who choose to participate. Sometimes employees are hesitant to participate in such programs because they believe they might be further marginalized by doing so. For sustained reform, effective practices must be mainstreamed into the experiences of all employees.

Creating an ecosystem. To realize the benefits of diverse talent, companies need to employ a multi-pronged approach. Instituting piecemeal practices may be helpful in some cases but will not result in sustained, systemic change. Drawing from the research on technical women, NCWIT Senior Research Scientist Ashcraft developed the following model for how companies might address key factors that affect women's participation in information technology. In this model, the two central ingredients are vital for the sustained success of all other efforts: **1)** establishing top leadership support and institutional accountability and **2)** improving the supervisory relationship. Without these foundational efforts, other reforms are less likely to have the desired impact.



Building the Foundation: Top leadership support and high-quality supervisory relationships

Leadership and accountability matter. Ensure that leaders of diversity efforts include high-level executives and senior employees who actually have the authority to make, carry out, and enforce necessary decisions. These leaders need to be visibly involved and hold diversity committees and other diversity efforts accountable for reaching their goals.

In one study of more than 700 private sector companies, the most effective strategy for increasing and advancing diversity was establishing diversity committees with senior leadership and holding them accountable for reaching clearly articulated diversity goals. This strategy increased the odds of holding management positions by 19 percent for white women, 27 percent for black women, and 12 percent for black men. The effectiveness of other efforts such as diversity training and mentoring also improved when used in conjunction with top leadership support and institutional accountability.[67]

For more information on how to go about establishing top leadership support and institutional accountability, see **www.ncwit.org/institutionalaccountability.**

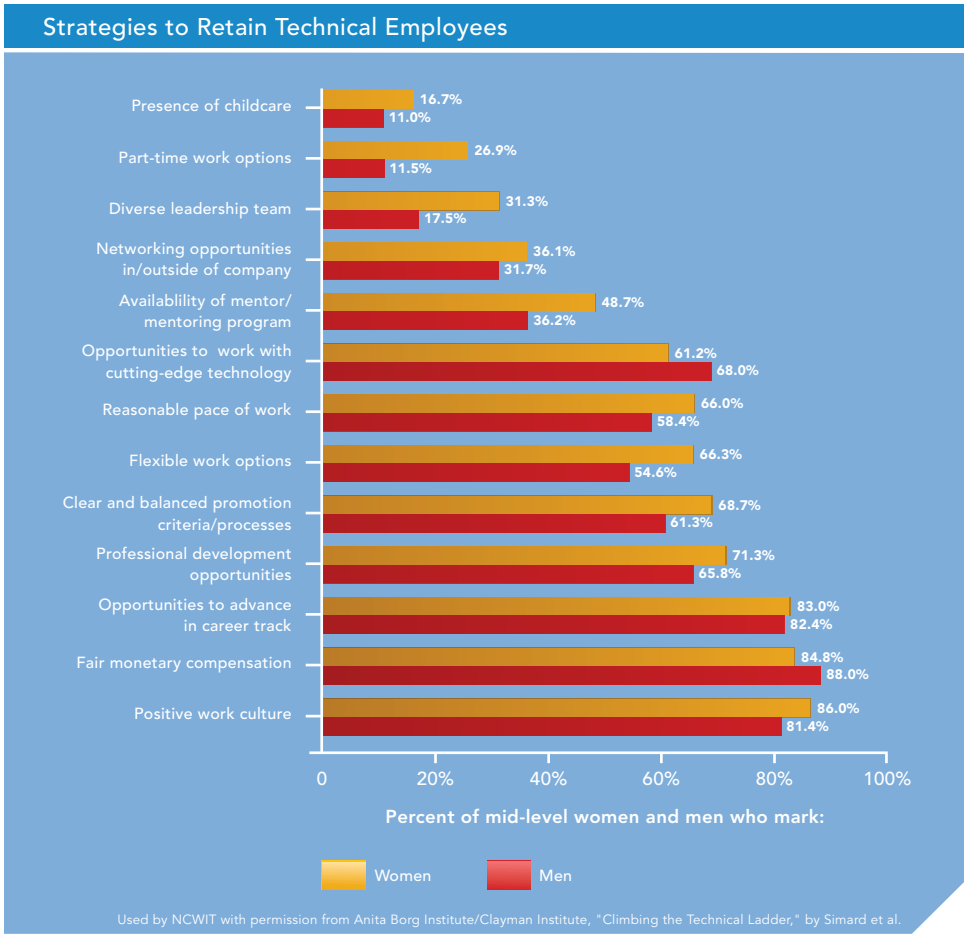
Supervisors matter. Focusing efforts on improving the supervisory relationship is crucial for two reasons: 1) the wealth of research that suggests employees leave supervisors, not companies, and 2) the supervisory relationship overlaps with and exerts significant influence on all of the other levels of reform, including employee development/mentoring, performance reviews and promotion, access to flexible schedules, recruiting/selection, and subtle biases that shape team interaction.

For concrete resources that help supervisors create high-performing, diverse technical teams, see **www.ncwit.org/supervising.**

Building the Ecosystem: Instituting multiple levels of reform

Companies need to implement a multi-pronged approach if they are to achieve sustained, systemic change. Interestingly, both men and women care about similar types of reform efforts.[68] In *Climbing the Technical Ladder,* both women and men report the following among the top strategies for retaining technical employees:

- Positive work culture
- Fair monetary compensation and promotion criteria
- Opportunities for advancement
- Opportunities for professional development
- Flexible work options



As the chart on the previous page illustrates, more than 80 percent of both men and women report that a positive work culture, fair compensation, and opportunities to advance are important for retention. Some meaningful gender differences emerge regarding some of the other strategies:

- Nearly half of women say mentoring would help retain technical employees, while one-third of men say the same.
- 66 percent of women want flexible work while 55 percent of men identify this as important.
- Having clear and balanced promotion criteria was cited as an important strategy by 69 percent of women versus 61 percent of men.
- Professional development opportunities are important to 71 percent of women versus 66 percent of men.

These differences suggest reforms that are particularly important for retaining technical women; however, these reforms still stand to benefit all employees, given the larger number of men who also say such reforms are important.

The remainder of this chapter briefly highlights key strategies for implementing reforms that address the key barriers to women's participation in IT. It also points to resources where more information can be found regarding each of these reform efforts.

Recruitment and Selection: Addressing biases that prevent companies from hiring the best talent

While this report focuses primarily on the experiences of women already in the technical industry, it is also important to improve strategies for recruiting and hiring women into technical companies or departments. Research suggests a number of problems with bias in interviewing and hiring procedures.

Research Highlights: Unconscious bias, interviewing, and initial impressions

In one study, candidates with résumés that had white-sounding names received 50 percent more callbacks than the exact same résumés with black-sounding names.[69]

In another study, both academic women and men were far more likely to say they would hire candidates with résumés that had male names rather than female names even though the résumés were identical. This effect is exacerbated when women make up a smaller proportion of the candidate pool, as is often the case in IT.[70]

In the Implicit Association Test, a test designed to measure unconscious bias, almost all test takers initially describe themselves as unbiased, yet 88 percent of white test takers show some bias against African Americans, and a majority of test takers show bias against photos of people who are overweight, gay, elderly, or Arab/Muslim.[71]

When shown pictures of people of the same height, study participants over-estimated the height of males and underestimated the height of females even though the photo included a reference point, such as a doorway.[72]

Implementing strategies for reducing bias and diversifying the candidate pool is important if technical companies are to have many women to retain and advance. The following are some tips and resources for doing so.

Systematically **track demographics** of candidate pools and successful hires.

Tips and Resources

Examine job announcements and criteria for bias. Job announcements that allow for the greatest amount of flexibility in screening candidates are important. Also examine the language in the announcement for potential bias. Consider the following kinds of questions:

- Are all of the criteria listed relevant for the job or do some criteria reflect biases about the kind of skills needed to do this job well?
- Could additional criteria be included that would open up possibilities for a wider range of candidates who might still do an excellent job?
- Does the language subtly reflect stereotypically masculine or feminine characteristics?
- Do you include criteria such as "ability to work on diverse team or with a diverse range of people?"

Advertise and recruit in a variety of venues that target diverse audiences.

Create and promote alternative pathways to technical careers. Implement policies or programs that make it possible to recruit and hire internally from non-technical positions, a diverse range of institutions, and alternative programs such as military spouse programs. Advocate for these policies company-wide if possible.

Educate interviewers and/or search committees about unconscious bias and ways to reduce it.

For more information and concrete resources, see www.ncwit.org/supervising and www.ncwit.org/practices.

Mentoring programs should be made available to all employees, not just women or underrepresented groups.

Mentoring, Professional Development and Learning Communities: Addressing isolation and unclear career paths

Both technical men and women report valuing opportunities for technical professional development above and beyond other work benefits. Technical men, however, report being able to find more informal professional development opportunities than do women (82 percent versus 62 percent, respectively).[73] This is likely due, in part, to the fact that a lack of mentors, isolation, unconscious biases, and other subtle dynamics make it more difficult for women and other underrepresented groups to access these informal opportunities. This gap could also result from the fact that, as seen in the previous chapter, competing life responsibilities still fall more heavily on women who may have less time to access these opportunities outside of work. Providing formal opportunities is particularly important then for retaining and advancing underrepresented employees.

Make **promotion coaching** a part of company mentoring programs and supervisory training.

Tips and Resources

Providing access to a diverse range of mentors — mentors who are both similar and different from the employee — is helpful.

See www.ncwit.org/imentor for free mentoring resources.

Create company-wide opportunities for all technical employees to participate in technical professional development on company time. Also create specific opportunities for *leadership and management* development. Adjust workflow to allow employees to take advantage of these opportunities since many employees cite a lack of time due to work responsibilities as the number one barrier to updating technical skills.[74]

Implement learning communities such as patenting or innovation communities. These communities can provide networks, support, role models, and professional development. Build in time for employees to meet in their learning communities. For more information on these kinds of learning communities see **www.ncwit.org/patentinglearning.**

Educate supervisors about the importance of mentoring and professional development and provide appropriate budgets for such development. Ensure that managers encourage their employees to take advantage of these opportunities.

Performance Evaluation and Promotion Procedures: Examining biases and establishing clear criteria

Tips and Resources

Examine your company's tools and criteria for performance evaluation for bias.

Examine and update your company's promotion criteria. Ensure that measurable steps for promotion are clearly articulated.

Value mentoring and employee development as a performance evaluation or promotion criteria. Reward supervisors for being actively engaged in the career advancement of their employees. Reward employees for engaging in mentoring activities.

Examine your task assignment processes for bias. Educate supervisors and others about how bias shapes who gets assigned to what tasks and what teams.

Create company awareness about diversity of communication styles. Ensure that a variety of communication styles are represented in the executive ranks in order to foster company-wide diversity.

See **www.ncwit.org/supervising** for concrete resources to examine these biases.

Reward employees for engaging in mentoring activities.

Flexible Scheduling: Addressing competing life responsibilities

Flexible scheduling is a crucial practice for retaining mid-level women. These women often face unique work/life challenges, especially as they more often find themselves in households with dual-tech careers. Technical companies need to do more than just formally offer these programs. They also need to actively encourage both women and men to actually *take advantage* of these schedules.

Tips and Resources

Make flexible scheduling and work-life programs a norm and promote these within the company and externally. Develop a reputation for being a company that acknowledges the well-being of its employees.

Account for flexible schedules in promotion decisions. Adjust evaluations and promotion practices to acknowledge part-time, flexible, or telecommuting schedules so that these practices do not negatively affect employees' careers.

Examine resource allocation policies to see if they unfairly penalize flex-time workers or teams with flex-time workers.

Create on- and off-ramp opportunities. Experiment with promising new practices such as on-ramp and off-ramp programs that make it easier for employees to take time off and return to work. Companies also can significantly increase retention by providing extended parental leave options and including both women and men as eligible for parental leave.

Model flexible practices at the executive and supervisory levels. This helps make these practices culturally acceptable.

For more information and concrete resources, see **www.ncwit.org/supervising** and **www.ncwit.org/practices.**

Conclusion

The coming decades present grand challenges and exciting opportunities for the technology industry. Technological innovation will play a crucial role in almost every facet of society and the global economy. Meanwhile, women and other groups currently underrepresented in technology will increasingly influence technological purchases and consumption. Companies that capitalize on diverse perspectives to improve technological invention will be well-poised to benefit from the perspectives of a diverse range of talent, to appeal to diverse markets, and ultimately to become and remain leaders in the technology industry. Realizing these benefits, however, requires careful planning and attention to reform. Such reform may not be easy, but it is necessary and well worth the effort.

“Companies need to implement a multi-pronged approach if they are to achieve sustained, systemic change. Interestingly, both men and women care about similar types of reform efforts.”

References

Aronson, J., Steele, C.M., Brown, J., Lustina, M.J., Good, C. & K. Keough (1999). When white men can't do math: Necessary and sufficient factors in stereotype threat. *Journal of Experimental Social Psychology 35,* 29–46

Ashcraft, C. & Breitzman, A. (2007). *Who Invents IT? An Analysis of Women's Participation in Information Technology Patenting.* Boulder, CO: National Center for Women & Information Technology. Available at http://www.ncwit.org/pdf/PatentExecSumm.pdf

Banaji, M. R., & Hardin, C. D. (1996). Automatic stereotyping. *Psychological Science 7*(3), 136-141.

Baron & Hannan (2007). *In the company of women: Gender Inequality and the Logic of Bureaucracy in Start-Up Firms. Work and Occupations,* 34, No. 1, 35-66 (2007)

Bertrand, M & S. Mullainathan (2004). Are Emily and Greg more employable than Lakisha and Jamal? A field experiment on labor market discrimination? *The American Review,* 94, 4, 1-31.

Biernat, M., M. Manis & T. Nelson. (1991). Stereotypes and standards of judgement. *Journal of Personality and Social Psychology, 66:* 5-20.

Bureau of Labor (2009). *Current Population Survey,* Annual Averages 2009.

Bureau of Labor (2009). *Monthly Labor Review,* November 2009.

By the Numbers (2009). National Center for Women & Information Technology.

Catalyst (2004). *The Bottom Line: Connecting Corporate Performance and Gender Diversity.* New York: Catalyst.

Catalyst (2008) *2008 Census of Corporate Officers and Top Earners of the Fortune 500.* New York: Catalyst

College Board, *2007 College Bound Seniors: Total group profile report.*

Correll, S. (2001). Gender and the Career Choice Process: The Role of Biased Self-Assessments. *American Journal of Sociology, 106(6),* 1691–1730.

Dice Holdings Inc, *2008-2009 Tech Salary Survey Results.*

Equilar, Inc. 2009. *The Pay at the Top.* Available at http://projects.nytimes.com/executive_compensation?ref=business

Foust-Cummings, H., Sabattini, L., & Carter, N. (2008). *Women in Technology: Maximizing Talent, Minimizing Barriers.* New York: Catalyst.

Hewlett, S. A., Buck Luce, C., Servon, L. J., Sherbin, L., Shiller, P., Sosnovich, E., et al. (2008). *The Athena Factor: Reversing the Brain Drain in Science, Engineering, and Technology:* New York: Center for Work-Life Policy

Hewlett, S. A., Jackson, M., Sherbin, L., Sosnovich, E. Sumberg, K. (2008). *The Under-Leveraged Talent Pool: Women Technologists on Wall Street.* New York: Center for Work-Life Policy.

Kalev, A., Dobbin, F. & Kelly, E. (2006). Best practices or best guesses: Assessing the effectiveness of corporate affirmative action and diversity policies. *American Sociological Review,* v. 71, 589–617.

Kapor Klein, F. (2008) *Giving Notice: Why the Best and the Brightest Leave the Workplace and How You Can Help Them Stay.* San Francisco: John Wiley & Sons.

London Business School (2007). *Innovative potential: Men and women in teams.* Executive summary available at http://www.london.edu/assets/documents/Word/Innovative_ Potential_NOV_2007.pdf

Nafus, D., Leach, J., & Krieger, B. (2006). *Free/Libre and Open Source Software: Policy Support* (Integrated Report of Findings). Cambridge.

National Science Foundation (2003). National Survey of Recent College Graduates, Characteristics of Recent Science and Engineering Graduates: 2003.

Page, S. (2007). *The difference: How the power of diversity helps create better groups, firms, schools, and societies.* New Jersey: Princeton University Press.

Simard, C., Davies Henderson, A., Gilmartin, S., Schiebinger, L., & Whitney, T. *Climbing the Technical Ladder: Obstacles and Solutions for Mid-Level Women in Technology.* Palo Alto, CA: Anita Borg Institute and Clayman Institute, Stanford University.

Steele, C. M., & Aronson, J. (1995). Stereotype threat and the intellectual test performance of African Americans. *Journal of Personality and Social Psychology,* 69 (5), 797–811.

Steinpreis, R.E., Anders, K.A. & D. Ritzke (1999). The impact of gender on the review of the curricula vitae of job applicants and tenure candidates: A national empirical study. *Sex Roles, 41, 7/8,* 509-528.

Warren, A. (2009). *Cascading gender biases, compounding effects: An Assessment of Talent Management Systems.* New York: Catalyst.

Young, Stephen. Microinequities the Power of Small website. http://www.insighteducationsystems.com/faqs.htm

Endnotes

1 Bureau of Labor Statistics, *Monthly Labor Review.*

2 NCWIT, *By the Numbers 2009.*

3 NCWIT, *By the Numbers 2009.*

4 NCWIT, By the Numbers 2009.

5 Ashcraft & Breitzman, *Who Invents IT?*

6 London Business School, *Innovative potential: Men and women in teams.*

7 Page, S. *The difference.*

8 Consumer Electronics Association, *10th Annual Household CE Ownership and Market Potential Study.*

9 Catalyst, *The Bottom Line.*

10 National Science Foundation, *National Survey of Recent College Graduates 2003.*

11 Hewlett et al, *The Athena Factor.*

12 Hewlett et al, *The Athena Factor.*

13 Hewlett et al, *The Athena Factor.*

14 Bureau of Labor, *Current Population Survey 2008.*

15 Bureau of Labor, *Current Population Survey 2008.* Numbers will not add up to total of "All Women" due to rounding and to the fact that persons whose ethnicity is identified as Hispanic or Latino may be of any race.

16 NSF, *National Survey of Recent College Graduates 2003.*

17 Hewlett et al, *The Athena Factor.*

18 Hewlett et al, *The Athena Factor.*

19 Simard et al, *Climbing the Technical Ladder.*

20 Hewlett et al, *The Athena Factor.*

21 All data in this section comes from Dice Holdings, Inc., *2008-2009 Tech Salary Survey Results,* unless otherwise noted.

22 Catalyst, *2008 Census of corporate officers and top earners of the Fortune 500.*

23 Simard et al, *Climbing the Technical Ladder.*

24 Baron & Hannan, *In the company of women.*

25 Dice Inc, *Tech Salary Survey 2008-2009.*

26 Equilar, *Pay at the Top.*

27 All data from this section is from Ashcraft & Breitzman, *Who Invents IT?*, unless otherwise noted.

28 Hewlett et al, *The Athena Factor*

29 Nafus, *Free/Libre and Open Source Software.*

30 Lin, *Gender Dimension of FLOSS Development.*

31 Nafus, *Free/Libre and Open Source Software.*

32 Kapor Klein, *Giving Notice.*

33 Catalyst, *Women in Technology.*

34 Young, *The Power of Small.*

35 Aronson & Steele, *Stereotype Threat.*

[36] Aronson, et al, *When White Men Can't Do Math.*

[37] Aronson & Steele, *Stereotype Threat.*

[38] Correll, *Gender and the Career Choice Process.*

[39] Catalyst, *Women in Technology.*

[40] Hewlett et al, *The Athena Factor.*

[41] Simard et al, *Climbing the Technical Ladder.*

[42] Simard et al, *Climbing the Technical Ladder.*

[43] Hewlett et al, *The Under-Leveraged Talent Pool,*10.

[44] Hewlett et al, *The Athena Factor.*

[45] Hewlett et al, *The Athena Factor.*

[46] Catalyst, *Women in Technology.*

[47] Catalyst, *Women in Technology.*

[48] Simard et al, *Climbing the Technical Ladder.*

[49] Simard et al, *Climbing the Technical Ladder.*

[50] Hewlett et al, *The Under-Leveraged Talent Pool*, 9.

[51] Hewlett et al, *The Athena Factor.*

[52] Hewlett et al, *The Athena Factor.*

[53] Foust-Cummings, et al, *Women in Technology.*

[54] Hewlett et al, *The Athena Factor.*

[55] Hewlett et al, *The Athena Factor.*

[56] Simard et al, *Climbing the Technical Ladder.*

[57] Warren, A., *Cascading Gender Biases.*

[58] Warren, A., *Cascading Gender Biases.*

[59] Warren, A., *Cascading Gender Biases.*

[60] Warren, A., *Cascading Gender Biases.*

[61] Simard et al, *Climbing the Technical Ladder.* 35.

[62] Simard et al, *Climbing the Technical Ladder.*

[63] Simard et al, *Climbing the Technical Ladder.*

[64] Simard et al, *Climbing the Technical Ladder.*

[65] Hewlett et al, *The Athena Factor.*

[66] All data from this section is from Simard et al, *Climbing the Technical Ladder,* unless otherwise noted.

[67] Kalev, A., et al, *Best practices or best guesses.*

[68] Simard et al, *Climbing the Technical Ladder.*

[69] Bretrand & Mullainathan, *Are Emily and Greg More Employable?*

[70] Steinpreis, et al, *The Impact of Gender on the Review.*

[71] Banaji & Hardin, *Automatic Stereotyping.*

[72] Biernat, et al, *Stereotypes and Standards of Judgement.*

[73] Simard et al, *Climbing the Technical Ladder.*

[74] Simard et al, *Climbing the Technical Ladder.*

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