ANITA BORG INSTITUTE
FOR WOMEN AND TECHNOLOGY

SENIOR TECHNICAL WOMEN: A PROFILE OF SUCCESS

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INTRODUCTION

A growing body of research has documented the underrepresentation of women in technical positions in US companies.[1] Women hold 24 percent of technology jobs, yet represent half the total workforce.[2] This underrepresentation persists even though the demand for technical talent remains high: computer occupations are expected to grow by 32 percent between 2008 and 2018.[3] Companies are increasingly aware of the benefits of diversity for innovation, and are looking for solutions to recruit, retain, and advance women.

A combination of factors helps to explain the dearth of women in technical positions:

- A shortage of women graduating with degrees in technical fields. Women earned 18.6 percent of Computer Science bachelor's degrees in the US in 2007, and 18.5 percent of engineering degrees. For computer science, this represents a sharp decline from the 37 percent of women graduating with a bachelor's degree in 1985.[4]

- For women who do enter technical careers in industry, persistent barriers to retention and advancement have been documented, including: isolation and lack of access to influential social networks and mentors;[5] unwelcoming cultures;[6] work-family conflict and family configurations that differ from male colleagues;[7] organizational cultures that do not reward mentoring and employee development;[7] and hidden bias and stereotyping that become embedded in organizational processes.[8]

- The mid-career level has been identified by researchers as an especially difficult juncture,[9] when 56 percent of technical women leave their companies, representing twice the turnover rate of their male colleagues. Furthermore, half of those women leaving their companies end up leaving technical fields entirely.[10]

What about the women who persist and advance past the mid level? Little is known about the women who defy these trends and achieve senior level positions on the technical track. In 2008, the Anita Borg Institute for Women and Technology and the Clayman Institute for Gender Research at Stanford University conducted a

survey of 1,795 technical men and women at seven high-technology companies in Silicon Valley. In this paper, we focus on senior technical women, who at only 4 percent of our sample represent a rarity in the technology industry.[11] Senior technical women are critical because they have broken down barriers to advancement and have persisted; their profile can provide companies and individuals with critical insights on the paths to success within existing organizational structures that can be leveraged to further advance greater numbers. Furthermore, these senior technical women are a part of the highest source of technical human capital for high-tech companies – they represent the most likely opportunity for advancement to executive-level positions, enabling the field to truly reap the benefits of diversity on innovation at the highest levels of decision-making.

We ask the following questions:

- What are the characteristics of these senior women?
- How do they perceive themselves on top attributes of success?
- Which organizational practices do they most care about? What can companies do to retain them?
- What do these findings tell us about advancing women in technology generally?

> Diversity matters in that it's a reflection of the organization. I think if you look at the organization and everyone who's in a senior management role is a white male, it doesn't reflect very well on the organization. – high-level technical man

Definition of "high level"[12]

In the process of data collection,[13] researchers worked with companies to define entry, mid, and senior levels. The "high level" category includes positions both occupied by Individual Contributors and senior level managers and executives involved with technical management.[14]

Sixty-five of our 1,795 survey respondents are technical women who hold senior-ranking positions at their respective organizations. **Technical men are significantly more likely than women to be at the high level** (24.6% of men v 10.9% of women).

Significant Technical Experience

Senior women have a wealth of technical experience. Their median age is 45 years old. High-level technical women typically have 20 years of expertise in their technical field, have been at their companies 7 years, and in their current positions 3 years. Their profile is identical to the profile of high-level technical men, who have a median age of 45, 20 years of technical expertise, 7 years of tenure at their company, and 3 years in their current position. Across gender, these employees are a part of a highly mobile and experienced workforce in Silicon Valley.

Table 1: Mean and median age and experience of senior technical women

	Age	Years of technical expertise	Years at company	Years in position
Mean (standard deviation)	44.7 (8.4)	18.4 (7.2)	8.7 (7.8)	4.4 (4.4)
Median	45.0	20.0	7.0	3.0

Individual Contributor versus Manager

In most of the companies that participated in our survey, the technical career structure categorizes positions in terms of whether they are "individual contributors" (IC) or "managers."[15] This dual-ladder structure became widely adopted in the 1950s by companies heavily dependent on technical and scientific talent, in order to provide advancement opportunities and increase retention of high-performing technical employees who did not have managerial aspirations.[16] While this dual-ladder structure has proven beneficial to technical employees and the companies they employ, it involves a choice for employees, usually at the mid level or at the beginning of the senior level, on whether they will seek further advancement on one or the other path.

These career paths involve different career demands, skills, and specialization. Advancement through management involves

being accountable for a group's performance, leading a group's timely delivery of a technology product, motivating others, resource allocation, and interfacing with customers within and outside the organization. Performance evaluation depends on group and project outcomes. Advancement as an individual contributor involves deep technical specialization, setting the technical direction of company products, and patenting or publishing/documenting activities. Performance evaluation is contingent on one's own technical contribution.

We find that senior technical women are significantly more likely to be in a manager position (36.9%) than are men (19%); conversely, men at the high level are significantly more likely to be in an individual contributor position (80.6%) than are women (63.1%). At the mid level, there are no gender differences between men and women in these positions. This suggests that men and women are starting to "track" differently at the senior level.

In our interviews with 27 technical men and women at all levels, there was a common feeling that women advance at a greater rate in management positions over time than they do within the individual contributor path, and that women were absent from the highest IC positions.[17]

"At a certain level [in our company] you have to choose whether you will be an engineer or a manager. And I cannot name you a single female [top level] technical leader that I know of at this company. I will tell you that there are more great first-line and second-line female managers that I know of than the equivalent grade in engineering, and that's disappointing because men don't always give the right answer." - mid-level technical man

"[At the highest level] we don't have women technical Fellows or anything like that, we have women VPs" mid-level technical woman

"Fellow is the equivalent of "Technical God." There are no women. Then there are [top level engineers], one step lower, and I think that one is a woman. It makes me so mad." – mid-level technical woman.

This lack of representation of women in the highest IC positions is a substantive loss for companies. Top IC positions contribute significantly to the Research and Development direction of these companies, and an absence of a diversity of thought in the innovation process can hinder companies' ability to innovate.[18]

What accounts for these differences?

Previous research on dual-ladder systems involving scientists and engineers has shown that social networks within organizations, and especially supervisory relationships, are a strong predictor of whether engineers will pursue advancement in management versus as an individual contributor, even after considering experience and educational background.[19] **The difference in representation of men and women in IC and management positions suggests that women are more likely than men to be encouraged by supervisors and other network connections to pursue advancement as managers.** These findings echo previous research on STEM industry careers, where 45 percent of women technologists felt like women were being "pushed" into execution roles, and 42 percent of women reported that women do not have equal access to technology creation roles.[10]

Interviews further suggest that ICs at the highest levels are often not actively enrolled in developing the next generation of ICs within companies. One male Fellow we interviewed deplored the absence of women at this level and described his attempts to engage his colleagues in change. *"We (Fellows) hardly ever see each other. I actually tried, at one point, to kick off a little discussion amongst the fellows about how we could help as a group and help the company [develop future Fellows]. And man, the pushback was amazing.… Banding together and being supportive and helpful, it doesn't happen. And I have been told quite firmly, this review cycle, that I am working on that too much, because nobody else is going to make it [get the promotion to Fellow]. What do we do?" – high-level technical man (Fellow).*

More research is needed to understand the factors influencing the choices of men and women on the dual-ladder hierarchy, as well as the barriers to attaining the highest IC positions for women. Where relevant, the remainder of this paper reports differences between senior technical women in IC versus management positions to broaden insight into these different pathways.

Differing Perspectives

'I've never seen barriers to technical women at all" – mid-level technical man

Anybody who thinks that women are completely equal to men in the workplace is just not really paying attention. – mid-level technical woman

Educational Background

Significant human capital

Technical women in high-level positions not only have substantial technical experience, but also possess significant human capital: 56 percent of senior technical women have graduate degrees, a rate similar to senior technical men and to technical women in entry and mid-level positions. **The difficulties women are experiencing in advancement in technology cannot be attributed to a lack of educational attainment.** These data are consistent with major shifts in the educational attainment of women in the US since the 1950s, with women now earning 59 percent of master's degrees.[20]

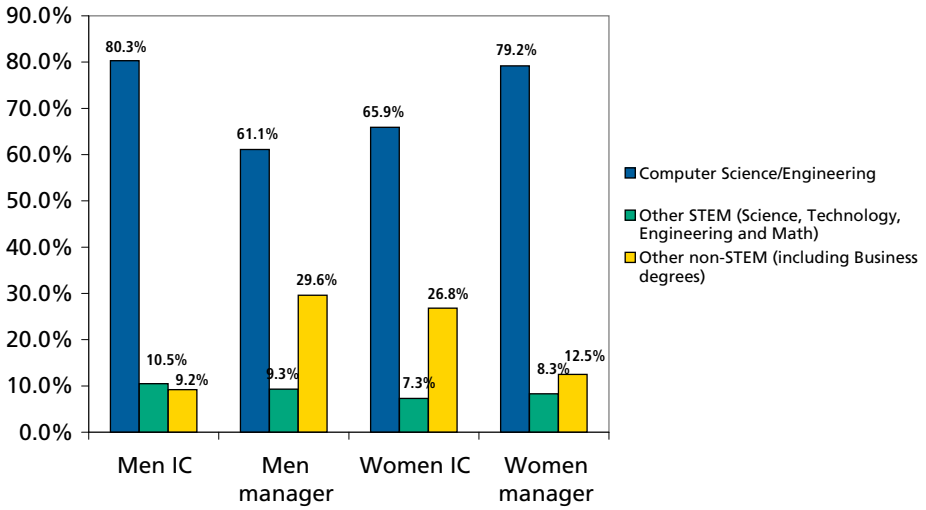
Technical degrees are the majority

A majority of senior technical women earned their highest degree in computer science or engineering. A computer science degree is more likely for women at the high level than for women at the entry/mid level. The gender gap in the proportion of technical degrees present at the entry and mid-levels (75.9 percent of men versus 62.3 percent of women) narrows at the high level: 76.6 percent of senior men and 70.8 percent of senior women hold their highest degree in a technical field. These findings suggest that a technical degree (especially in computer science) is related to advancement.[21]

Nearly 42 percent of senior women earned their highest degree in computer science, compared to 27.5 percent of entry/mid-level women (and 44 percent of senior men). Just under a third of senior women and men (and 34.8 percent of entry/mid-level women) have a degree in engineering.

Senior women are more likely than men to be in management roles, regardless of whether they have a technical degree. One might expect to find more technical degrees in IC positions, and a greater proportion of non-STEM degrees in manager positions (such as advanced management degrees

Chart 1a. Field of Highest Degree at the High Level, by Gender and Individual Contributor/Manager status



like MBAs). For men at the high level, this is indeed the case: we see a greater concentration of non-technical degrees for men in high-level management positions. For women, however, the trend is reversed: while most women in both tracks have technical degrees, we see a larger concentration of technical degrees in management roles, suggesting that **women's decisions to pursue management positions may have little to do with their technical human capital.** Senior technical women, despite equal levels of technical educational background, are more likely than senior men to advance through management, whereas men are more likely to advance through individual contributor positions. More research is needed to understand the consequences for R&D innovation.

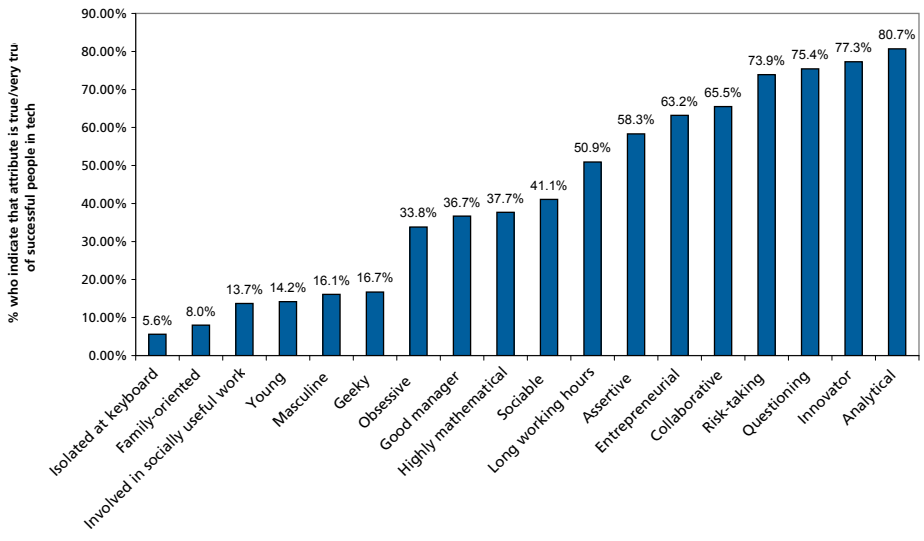
> I've been on teams where I've been the only one with a certain viewpoint. I don't know if it's just me, or if it's the fact, that I just came from a different space because they were all men. But sometimes the solutions are not completely thought out when you don't have that diverse input. – senior technical woman

Our study explored perceptions of key attributes of success in technology, and women's and men's self-perceptions on these same measures. The following eight attributes were named as most descriptive of "people who succeed in technology" by all technical men and women across all levels: analytical, innovator, questioning, risk-taking, collaborative, working long hours, entrepreneurial, and assertive.

Senior women's perceptions of successful attributes in technology are quite similar to those of senior men. One exception is "masculine"—26.6 percent of senior women report that this is characteristic of success, as opposed to 6.5 percent of men, a significant difference. This suggests that senior women, even while they are models of success themselves, are more likely to perceive that success is defined in masculine terms, which is consistent with a work environment where men are twice as likely as women to be in senior level positions.

How do senior technical women perceive themselves on the "top" attributes of successful people in technology? We discuss each attribute below.

Chart 2a. Attributes of Successful People in Technology, All Respondents (N=1795)



Analytical

The majority of senior technical women (77.8%) perceive themselves as analytical, just as do their male colleagues (84.6%). In fact, all technical employees tend to see themselves as possessing this attribute. Indeed, technical careers tend to first and foremost look for analytical and problem-solving skills, which are heavily developed in STEM fields of study. For instance, problem analysis and solving has been identified as a critical component of computer science education[22] and a top skill of computer professionals.[23]

Innovator

We find a significant difference between senior women and senior men on how likely they are to perceive themselves as being an "innovator." **60.2 percent of senior men describe themselves as an "innovator," versus just 38.1 percent of senior women.**

Looking at women individual contributors versus managers at the senior level, we find that **women in IC positions are more likely to perceive themselves as an innovator, but this perception fails to match men's self-perceptions on the same attribute.**

Why are women at the senior level less likely than are men to perceive themselves as innovators? Existing social-psychological research on self-efficacy and stereotype threat may help to explain these findings:

- Self-perceptions tend to be directly shaped by experience and behavior.[24] If women are not feeling included in the innovation process or do not have significant exposure to technological innovation creation early on in their studies and careers, they are then less likely to develop a self-perception as an innovator.
- Innovation tends to be perceived as stereotypically masculine,[25] especially when it comes to technical innovation. This may lead to stereotype threat, where women are less likely to perceive themselves as competent in stereotypically masculine domains, and might see their own performance undermined.[26]
- "Innovation" in the science and engineering profession is often described as "hard" (as opposed to "soft") skills, and although there is no implicit connection between technical skills and "hardness," this language distinction further construes innovation in masculine terms within organizations.[27]

Chart 2b. Self-Perception on Attribute of Success: Innovator, by Gender and Level

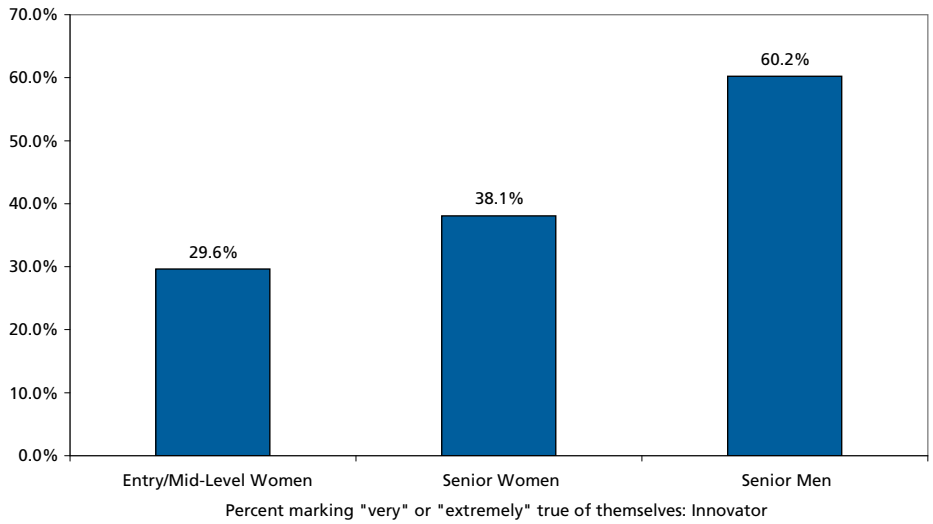
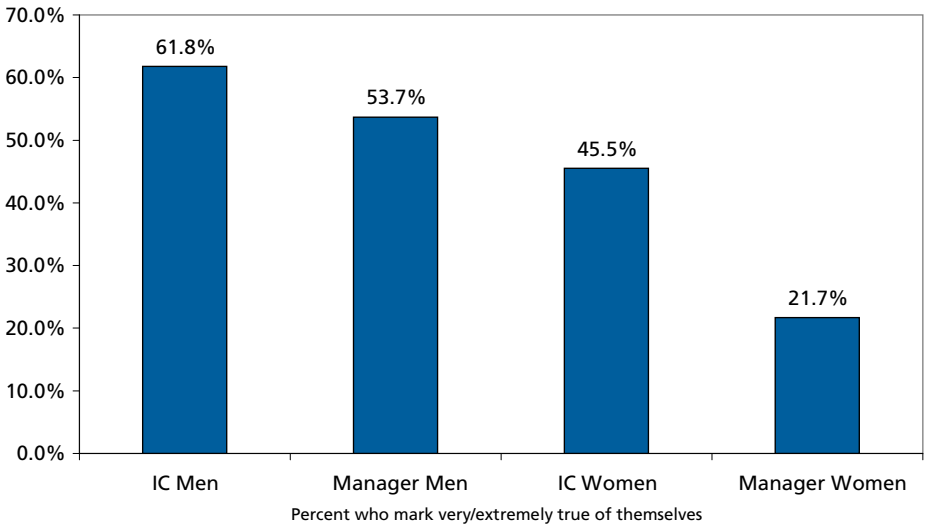


Chart 2c. Self-perception on Attribute of Success: Innovator, Senior Level, by Gender and Job Type



This gap in self-perception in innovation represents a critical point of intervention for women and the companies that employ them, and warrants further research. A loss of diverse ideas in the innovation process represents lost business opportunities for companies.

Questioning

A majority of senior technical women (77.8%) perceive themselves as questioning – just as their male counterparts do (77.1%). The ability to ask the right questions is critical to problem solving. Questioning is critical to not only learning and problem solving, but what psychologists call a "growth mindset," which is a predictor of success across professions.[28] Being inquisitive is necessary to continuous learning, which in turn enables one to learn from mistakes and advance. Inquisitiveness has been found to be a predictor of academic success in engineering,[29] and is identified here as a critical attribute for professional success.

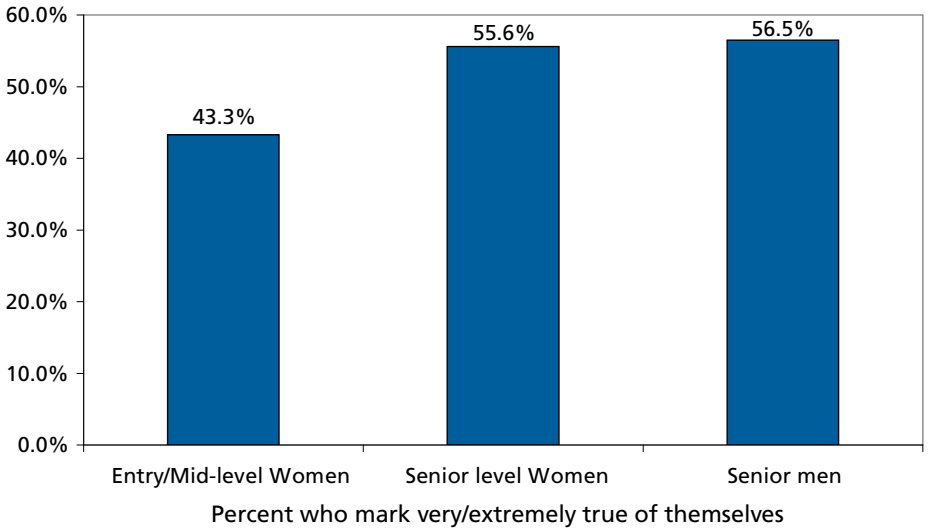
One senior technical woman discussed how she has advanced through her career through her passion for continuous learning: *"what gives me the most job satisfaction is the ability to do something different every year. There's not been a year where I've done the same thing. One year, they'll put me on owning one domain, and I will become an expert [of that domain]. And the next year, they'll put me on [another domain], like, I'm currently involved in security. I'm gaining significant domain expertise, with just evolving different projects and different responsibilities, so it just keeps it fresh and new."* – *senior technical woman*

Risk-Taking

More than half of senior women view themselves as risk-takers. **We also find that senior women and men are equally likely to perceive themselves as being risk-takers,** one of the top 4 attributes of success identified by technical employees.

The absence of a significant difference between senior men and women echoes existing research showing that the propensity to take risks among men and women has reached similar levels over time.[20] The current wisdom about men being more willing to take risks than women may be nothing more than a well-publicized gender stereotype based on research more reflective of previous generations.[30] Moderate amounts of risk-taking, or "reasonable" risk-taking, as opposed to large amounts of risk-taking, is an important part of leadership.[20]

Chart 2d. Self-Perception on Attribute of Success: Risk-Taking, by Level and Gender



Collaborative

Senior technical women are collaborators – 84.1 percent perceive this attribute as being very or extremely true of themselves. Research on women and leadership has found that the propensity to have a collaborative work style historically varied along gender lines.[20] The difference between women and men in our study, while present, does not reach statistical significance.

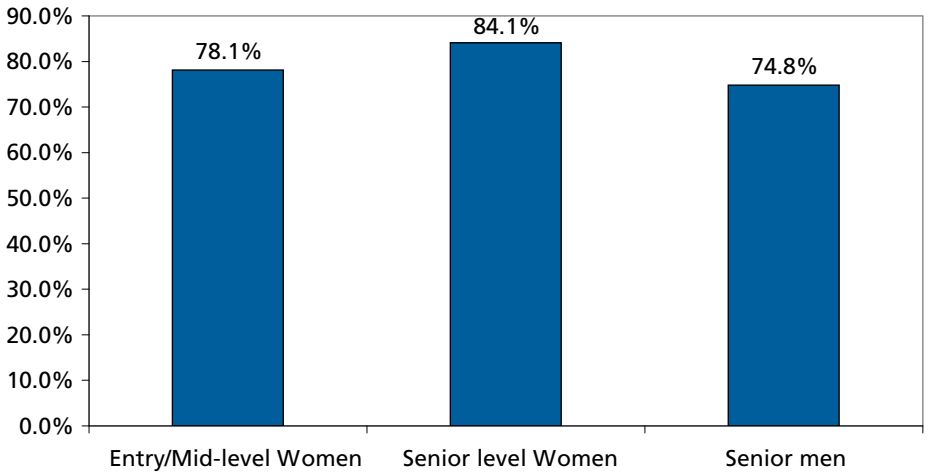
The reason for this narrow gap may rest in the technical enterprise itself. Historically, leadership and success have been construed in terms of "command and control" and autocracy, styles that are thought of as stereotypically masculine. The most current thinking on innovation in high-technology environments places collaboration as central to successful leadership[31]– for example, new Open Innovation paradigms draw on the collaboration and broad knowledge sharing among a variety of stakeholders, spanning internal and external networks.[32] Collaboration is a theme that permeates our interviews with technical men and women as both a critical source of success and a great source of career satisfaction – one mid-level woman said: *"I get a lot more job satisfaction out of collaboration with good engineers. To me that's really important."* A senior male engineer explained how collaboration, effective communication, and maintaining positive relationships across groups and departments were at the core of his ability to succeed as a technical contributor tasked with identifying and fixing potential defects in software:

"Relationship building [is very important] … part of what we have to do is make sure [those we work with] don't feel like what we're working on is threatening to them. So, for example, one of the projects that I had to do was analyzing one of our products and try to find all the weaknesses in it. Now that's the kind of thing where if I do that and I'm not careful about how I do it, the person who designed the product might be very upset and say 'who does this guy think he is?'

And so a pretty big key [to our success] is really making sure that we build the relationships with people and we actually start that early on, and then slowly but surely we establish ourselves as experts in particular areas, and people now can trust us as experts in those areas and rely on our judgment." – senior technical man.

Another experienced technical woman who had held several senior positions in her career stated: *"I have a marriage of soft and hard skills which is the key to my success. Success is not about being right – people need to feel like they are heard."*

Chart 2e. Self-Perception on Attribute of Success: Collaborative, by Level and Gender



Entrepreneurial

Being "entrepreneurial" was identified by respondents as an important attribute of successful people in technology. Indeed, the image of success in high technology is often tied to entrepreneurship in the form of starting a company to bring an innovation to market, or "intrapreneurship" in the form of designing and bringing a technology to market within a corporation.

We find that less than half of high-level technical employees in large companies perceive themselves as entrepreneurial. (31.7 % of women and 40.5 % of men). Relatedly, entrepreneurial self-efficacy is a strong predictor of a future entrepreneurial career,[33] and less than 10 percent of senior men and women in our sample say that they will start their own company in the next 12 months. Entrepreneurialism, while important to success, requires resources, networks, and energy that may be challenging to amass even at the highest level of technology positions.

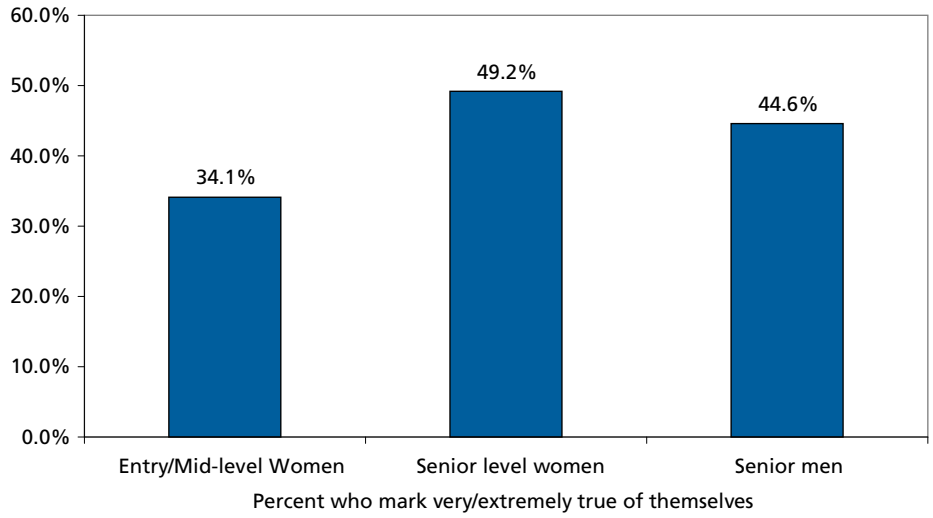
Works Long Hours

Advancement for senior women comes with long working hours, as it does for their male colleagues. Senior women are significantly more likely than women at the entry and mid- levels to perceive themselves as working long hours.

One senior woman we interviewed emphasized "hard work" as one of the most critical factors in her own success: *"I work hard and take a lot of pride in my work and it's very important for me that nobody can say this doesn't work well or this is crap…[To be successful] you have to work hard, you have to be proud of what you're doing and if your heart and mind is not into it… it doesn't matter how good you are."* This finding is consistent with a culture where advancement is tied to increased availability, which we found was a potential barrier for women who seek advancement while juggling family responsibilities in dual-career couples – research finds that cultures that equate advancement with constant availability is particularly problematic for workers with significant family obligations.[34]

A culture of flexibility can significantly help women at the mid and high level meet the demands of their work load their family responsibilities. A senior-level woman we interviewed discussed how she was handling work and family responsibili-

Chart 2f. Self-Perception on Attribute of Success: Long Working Hours, by Gender and Level



ties through a full-time flexible schedule involving significant telecommuting. However, she also revealed that she had to be extremely proactive about remaining visible to her peers and manager while on a flexible schedule: *"I do think it's worth it [the flexible schedule], but at the same time, I'm pushing my management. I have that flexible schedule, and in my view I'm kicking butt, and so I went to my managers and said, "You need to promote me." So it didn't hold me back from getting promoted." – senior technical woman.*

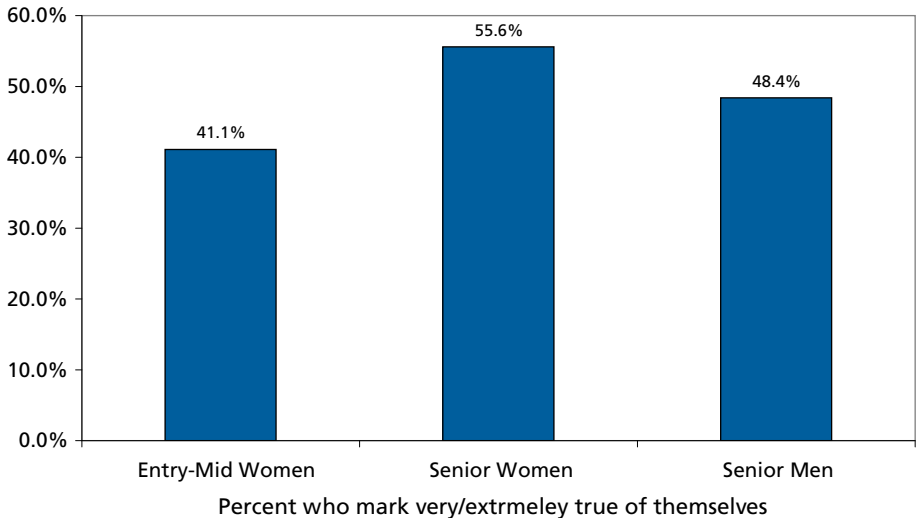
Assertive

A majority of senior technical women describe themselves as assertive—significantly more so than women at the entry and mid levels.

In a professional culture that rewards speaking up, self-promotion, and ambition, senior women we interviewed uniformly said they had to learn to be assertive and promote themselves in order to advance: *"I've had to ask for it. If I was just complacent and I just did my work … I wouldn't be where I am. I've had to be very aggressive, and basically say, "Hey, I'm ready for a promotion. Let's sit down and talk about this, I should be at a higher level." – high-level technical woman.* The same senior woman actively mentors younger women in being more assertive and self-promotional, attributing much of her own success to mentors who had taught her how to embrace this behavior: *"My self-evaluations are glowing, I mean, I am so good at putting it on paper, and saying, "Look at what I've done, I'm a shining star." When I look at the other [women's] self-evals, mine's two pages long and theirs are two paragraphs long. So, I will sit down with them and we'll actually expand it, to the point where they're like, "Wow, this is totally different from what I would have given my manager," after we're done with it. They don't know how to promote themselves."*

One mid-level woman said that in a male-dominated engineering culture, being assertive is a necessary condition for success, even if it doesn't come naturally to many women: *"There are certain behaviors that are required of women in technology because of the behaviors that male engineers display. There's a way of communicating where male engineers communicate in such a way that it sounds like they know what they're talking about and they are right. And you know, sometimes it comes across as arrogant and annoying, but it's effective. And I think that often women don't learn to do that in technical careers. They never sort of advance up the*

Chart 2g. Self-Perception on Attribute of Success: Assertive by Gender and Level



technical ladder."

The propensity to be assertive also varies along cultural dimensions. A senior woman described how she had had to significantly change her communication style to fit the North American technical culture: *"I was raised to not be aggressive, be very modest, don't go about tooting your own horn. I think in America you need to be a little more assertive. You often have to sell yourself, promote yourself. Let people know what you've done, what you're capable of doing." high-level woman*

Assertiveness thus emerges as a common trait of successful women in technology, consistent with other research on women in leadership roles in the US.[20] However, research also shows that women have less freedom than men in assertive behavior. Because women's assertiveness defy long-standing gender stereotypes, women often experience a "likeability penalty" when they are assertive. This is especially true in male dominated domains such as science and engineering.[35] Indeed, one technical woman described assertive communication as a "Catch 22" – whereby women are labeled as weak if they are not assertive, and labeled aggressive when they are, consistent with existing research: *"It is a Catch-22…if you don't do it, then they say 'She's so quiet, or she's so timid.' If you do, then you are the other label, which we are quite aware of."*

Success being tied to assertiveness is also a Catch-22 for organizations – it can lead to women either "opting out' of advancement or leaving organizations if they do not feel they can fit that "mold" or if they feel they do not want to assume the "likeability penalty."

One woman described deciding to not seek advancement because she refused to conform to the prevailing communication style in her company: *"It seems to me [that to succeed] you have to be able to blow your own horn. You have to be convinced that you're way smarter than everybody else, and everybody should listen to you, which is a certain ego trait that I don't think is rewarded in women. … So women just tend to not only do they not develop that kind of skill, but even if they have it, they tend to suppress it, because it's labeled "bitchy" and "pushy"…. Whereas those same personality traits in a man are somewhat admired. I just found that when it's necessary to go head to head against other architects that might disagree with you, I didn't want to be that way. I perceived those men as being somewhat unreasonably egotistical, and didn't want to develop that trait any further myself, so it kind of stopped me from advancing beyond a certain level in architecture. … Because it's really necessary. I mean you have to really believe that your ideas are better than anybody*

else's and then you have to sort of kind of want to pontificate. It's a requirement."– mid-level technical woman.

Another described leaving her company to join one where non-assertive communication styles were valued: *"…I was constantly getting interrupted, even from people who I didn't consider to be jerks….And then I would suggest something and people would be talking over me, and then a guy would suggest the same thing and of course people weren't talking over him."– mid-level technical woman.*

Research shows that in the US, leadership is typically associated with agentic behaviors such as assertiveness, ambition, and self-confidence [36] – traits that are associated in our culture with "male" characteristics. In this culture, assertiveness becomes a necessary behavior to be perceived as a leader – and this is especially the case in male-dominated environments. However, the likability penalty that comes with success can put significant pressure on successful women.[37]

Work-family conflict: more than a woman's issue

We need to change the work environment to support families. We seem to admire our companies that support reserve soldiers that go off for two years, especially if they pay the guy and make up wages, right? So why shouldn't we support people who need to go and spend some time raising a family? I mean, it's of vital national importance. I think the attitude has to change. – mid-level technical man

I think I've probably been fairly fortunate being a white male as far as advancement goes. I would say the only barriers I've really faced have been more humanistic ones. Unless there's a good reason, I'm not one who's prone to ask people to work excessive amounts of time. I do value other people's having balanced lives as well and I think at times in my career that has been detrimental to me – high-level technical man

Paternity leave is almost non-existent – high-level technical man

Alongside the rewards and demands of high-level positions are the rewards and demands of partnerships, children, and household responsibilities. A majority of senior women (79.7%) have a spouse or partner. Senior women are significantly more likely to have children than are entry and mid-level women (76.9 % vs 58.9%). Nearly 50 percent of senior women who are currently single have children.

Senior women's households differ from senior men's in important ways.[38] Senior men and women have comparable rates of partnership and children (women are only slightly more likely to be single than are men—20.3% vs 11.7%). However, 50.8 percent of senior men report that their partner "has primary responsibility for the household and children", compared with 23.5 percent of senior women. .Senior men are three times as likely as senior women to have a partner who is not employed (41.1% v 13.7%). Senior women, by contrast, are more than twice as likely as senior men to have a partner who works full-time (74.5% v 31.5%). Among those employees who have working partners, three quarters of senior women's working partners are in technology, versus about a third of senior men's working partners. **Thus, senior women are much more often in dual-career households, and tend to face the "household load" on different terms than do their male colleagues.**

Differences in households translate into different questions regarding work-life balance. In our interviews, technical women across levels were aware that their family configurations differed than that of their male colleagues: *"I've noticed lately how there really is a difference between the stuff that's going on with me and the guys. They're talking about how their wife is taking care of kids and I'm talking about finding child care. I'm definitely noticing that there's that difference."* – *mid-level technical woman*

Chart 3a. Household Charateristics of Partnered High-Level Technical Workers by Gender

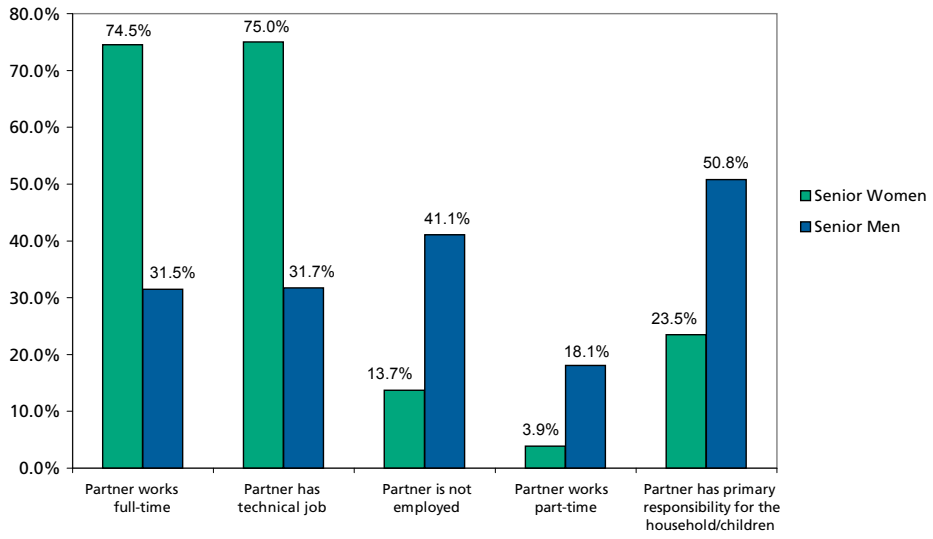
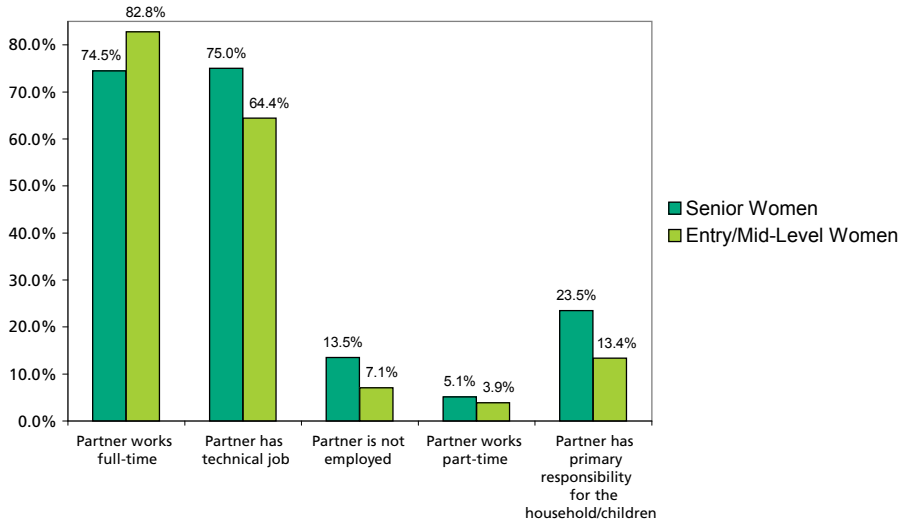


Chart 3b. Household Characteristics of Partnered Technical Women by Level



However, nearly a quarter of senior women rely on a spouse who has primary responsibility of the household. Although this doesn't reach statistical significance at the $p<.05$ level, we see a trend by which a greater proportion of senior women have a partner who has primary responsibility for the household/children (23.5% of partnered senior women) than entry/mid level women (13.4%). More senior women than other women are relying on the support of a partner who has primary responsibility of the children/household.

One mid-level woman we interviewed, a single mother, lamented the ongoing message that advancement is contingent

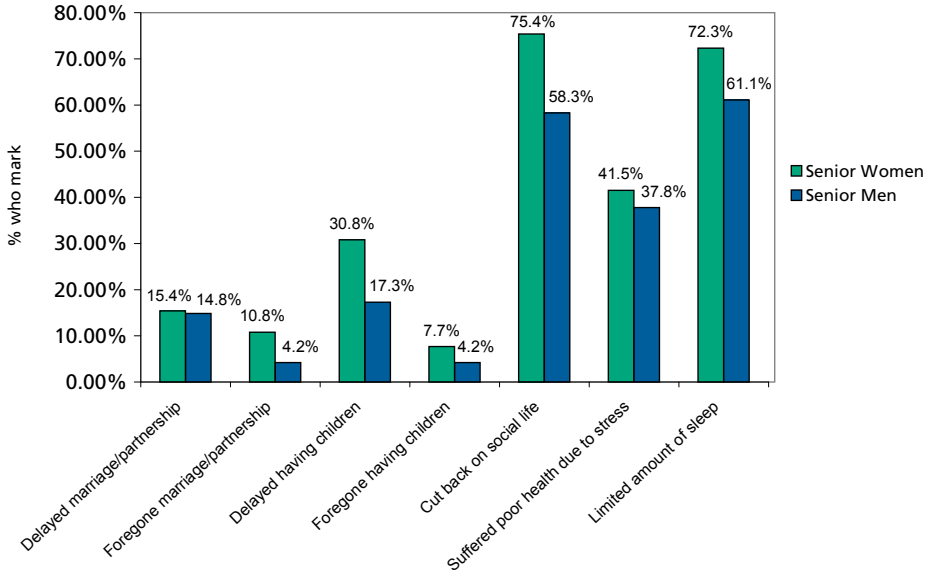
on having additional support at home: *"You go to these business women conferences and [successful] women will say, 'We are successful because of our husbands, because of my mother, because I had family support.' I'm feeling, it means I can never be successful. I have no husband. I have no mother. Okay? I'm on my own. So my chances of success are not clear… We have to really think about how can we take these other people who are capable neof success, but who have no social structure that helps them, you know? That was actually, for me personally, that was a big, big drawback in my career that affected where I think I could have [advanced]. – mid-level technical woman*. The needs of women across levels in terms of family responsibilities will also vary along cultural dimensions. High-tech companies in the US have significant proportions of non-white technical women, and the gender division of labor and family configurations are often culturally prescribed. For example, the same mid-level woman who did not have external support was Indian and had gotten a divorce, which carried significant social stigma in her community, leaving her with limited options to deal with work-family conflict.

Combining high-level positions and family responsibilities comes with tradeoffs. Senior women are making significant concessions to achieve career advancement in high-technology. Senior women are significantly more likely than senior men to report that they delayed having children in order to achieve career goals, and are significantly more likely to report that they cut back on their social life in order to achieve career goals. Senior women's rate of "forgoing" partnership and children altogether is almost two times the rate of men; these latter differences may be small by statistical standards but are notable nonetheless.

One senior woman we interviewed discussed her choice to have children later in life for career reasons: *the fact that I didn't have kids until later, it was better for me for my career 'cause I was able to work later, there was none of this 'I got to get home, the kid has a baseball game' type of thing going on. I think that that would have been a challenge." – senior technical woman*.

Another senior woman discussed deliberately not letting family "get in the way" of her career goals: *"I didn't change my career plans when I had kids. They were irrelevant [to my goals]."* Still, she lamented the fact that many women at the mid-level leave because of the tension between work and family: *"What you find happening, even though our company hires a right rate of women, you find, and I say that as a manager, you find that oftentimes women in [specific technical field] will drop out after some period of time, four to ten a year, and a lot of them are dropping out because they — this is just evidence I've collected — they decide that they*

Chart 3c. Sacrifices to Achieve Career Goals, High-Level Technical Employees, by Gender



want to have a family and they find it's too difficult in this environment because it is seven by twenty-four, it's too difficult [in this field] to balance the need to be good and responsive seven by twenty-four and then be a responsible parent as well. – high-level technical woman.

And yet, while women are reporting greater tradeoffs in terms of delaying having children and cutting back on social life, *both* senior men and women are making significant concessions in terms of sleep, social life, and health consequences from pursuing their career goals in high technology.

Companies' awareness of senior technical women's work values is critical to their ability to retain top female technical talent. By providing work environments that meet the values of technical women, companies can maximize employee engagement.

Teamwork: 92.3% of senior women value teamwork, as do 82.9 percent of men.[39] Several interviewees discussed finding significant passion and satisfaction in teamwork. One senior woman directly attributed her success to her ability to work effectively within a team and communication skills and getting to "win-win" solutions: *"I'm relatively articulate …I understand what people want and need. This goes from a personal level to what they may want and need for their team, what they may want and need for their organization or may want and need to deliver to the corporation. I'm always looking for matches so that when people come, I'm always trying to see what's the best in it to get everybody what they need. I have strong relationships with people that I work with so I can call [on them]. I don't do it very often but, hey, you know, remember I helped you this time? This is what I need. I think actually that's important too." – senior technical woman*

Working on cutting-edge technology: seventy one percent of high level women and 79.1 percent of high level men say that they value working on cutting-edge technology. Despite different "tracking" at the senior level, men and women show similar interest in working on new technology that pushes the boundaries in their companies.

Innovative work: Despite being less likely to rate themselves as an "innovator", women in high-level positions are equally likely as men to value doing innovative work (86.2 % of women and 89.4 % of men). **Technical women are driven by much of the same values as technical men: innovation, cutting-edge technology, and teamwork.** Yet, the self-efficacy of women on innovation is suffering, suggesting a disconnect that needs to be addressed by organizations.

Being seen as a technical expert: Seventy-two percent of senior women they value being seen as an expert in a technical area. **Senior men are significantly more likely than senior women to value recognition as an expert (85.8% versus 72.3%),** following the finding that men are more likely to be in individual contributor positions. Still, being recognized as a technical expert is critically important to growing a technical career. One senior woman we interviewed discussed how being acknowledged as a technical expert opened several doors in her career: *"I'm really, really strong at testing. I can do it in my sleep. Basically, I can turn out a quality piece of software very, very easily. And so, once I was a recognized expert, and I gained respect on the team of being that recognized expert, I was always the go-to person. That opened some doors for being able to do new and better things." – senior technical woman*. Putting women in positions where they are experts in specific technical areas is another point of intervention for companies, and women seeking to advance should pursue these opportunities.

Opportunities to update technical skills is a critical work value for senior women operating in companies with constant technological change. Eighty three percent of senior men, 80 percent of senior women and 84.8 percent of entry/mid-level technical women share this value. Regardless of the fact that women are more likely than men at the high level to be in management positions, senior technical women know that their ongoing advancement is contingent upon being technically up to date.

Understanding contribution to team/organization: Seventy eight percent of senior technical women place a high value on understanding the impact of their work on their team and organization. Again, there is no difference between senior men and women on this value.

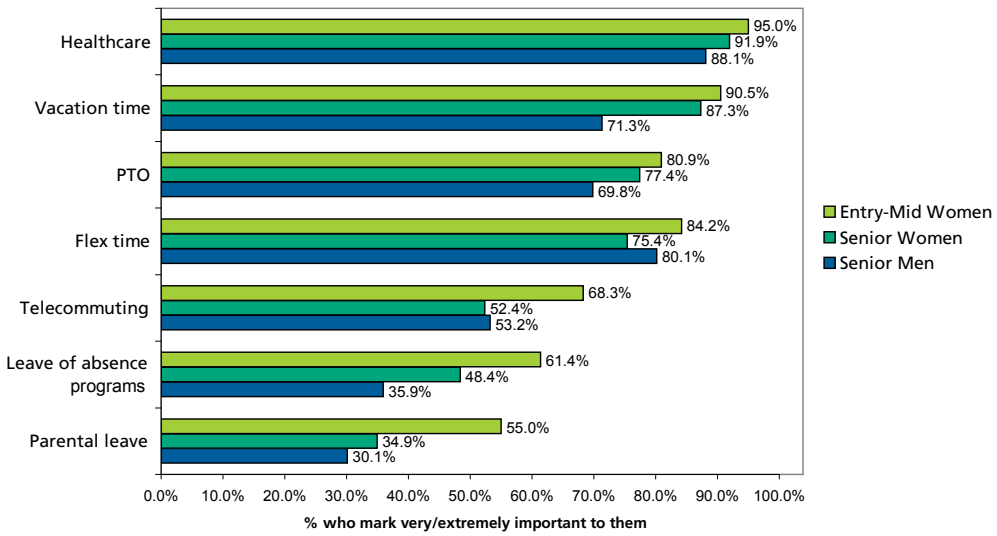
Professional identification: sixty four percent of senior women strongly identify with their technical profession, as do 69.9 percent of men. **Technical women strongly identify with their profession and the cutting-edge work it entails.** Lower proportions of senior technologists identify with their companies: 52.3 percent of senior women and 46.8 percent of senior men identify with their companies.

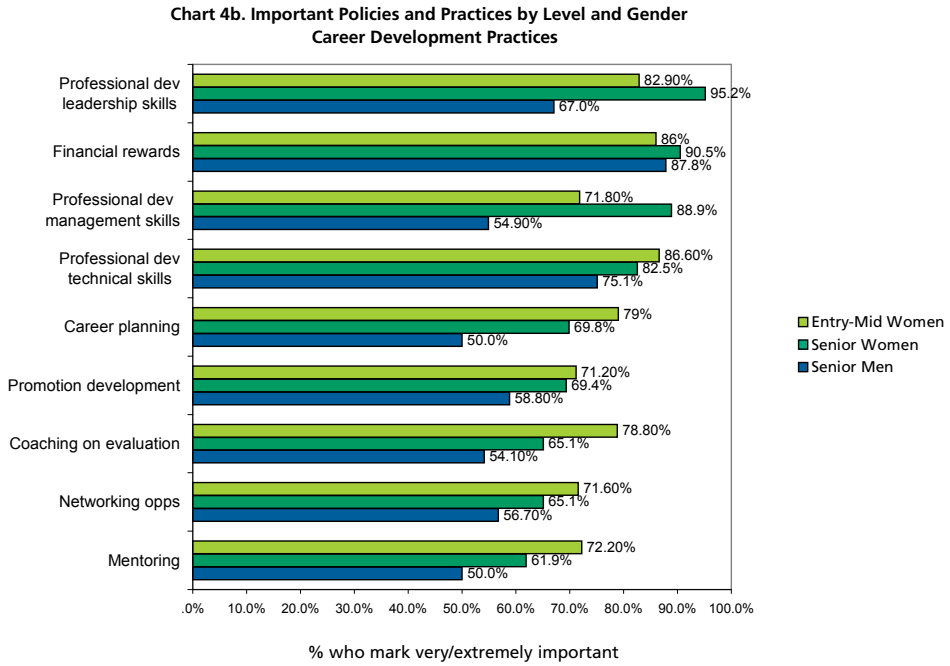
> If you want to do something for women, make sure there are enough senior women. By the way, there are very few. When it comes to technical women, I could probably count on my fingers. And I don't think there is enough happening. – mid-level technical woman

Organizational practices

Our survey instrument asked respondents to indicate how important several organizational practices were to them. We find that **in senior positions, technical women are relatively less concerned with work-life practices and more concerned with professional development.** Indeed, entry and mid-level women are significantly more likely than are high-level women to report that telecommuting, leave of absence programs and parental leave practices are important to them. One exception is flexibility, which is as likely to be valued by senior women, senior men, and entry and mid-level women.

Chart 4a. Important Policies and Practices by Level and Gender: Work-Life Practices





Senior technical women are looking for ongoing development opportunities above all else (after the basics of healthcare, compensation, and vacation). Among the most important are professional development opportunities for leadership, management, and technical skills. Senior women are significantly more likely than senior men and entry/mid-level women to value professional development for leadership skills and management skills. By contrast, entry and mid-level women are significantly more likely to seek coaching on evaluation practices than are women at the high-level.

Policy ratings

Even while high level technical women overwhelmingly value professional development opportunities, they give poor marks to their companies in terms of existing programs.

- 29.5% of senior women think that their company provides good/excellent professional development for management skills.
- 26.2% of senior women say that their company provides good/excellent professional development for leadership skills.
- 30.6% of senior women perceive their company's professional development for technical skills as good/excellent.
- Policy ratings are similarly low for other high-importance company practices such as mentoring (17.7% senior women perceive it as good/excellent), career planning (17.7% senior women rate it as good/excellent) and promotion development (13.3% of senior women rate this highly).

The gap between the perceived importance of these practices for technical women and how they rate them at their companies is another critical point of intervention for companies.

The high-importance practices senior women are most satisfied with at their companies are:

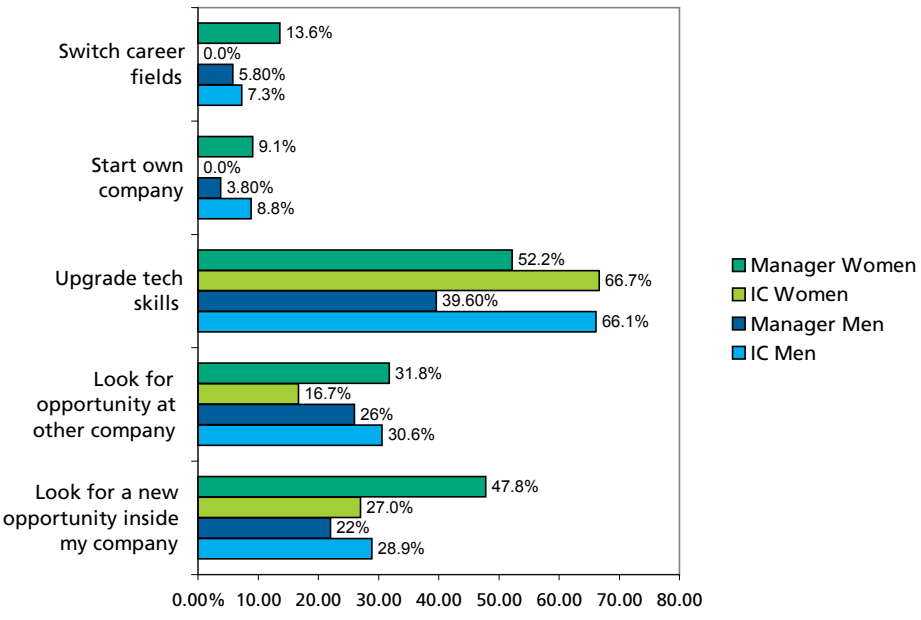
- Healthcare benefits, with 53.2 percent of high level women rating these as good/excellent.
- Personal Time Off (PTO), deemed good/excellent by 51.6 percent of high-level women.
- Flexibility, which 64.5 percent of high-level women perceive as good/excellent at their current company. However, senior men tend to give this practice higher ratings than senior women (80.4%), suggesting that existing flexibility practices may not be accounting for women's dual-career family configurations sufficiently.
- Similarly, senior men give their respective organization's telecommuting policies higher ratings than do senior women (65.1% of senior men versus 43.5% of senior women rate it as good/excellent), suggesting that existing telecommuting options are not meeting the flexibility needs of senior women at the same rate as men's.

Plan for the next 12 months

Overall, twelve month plans differ little along gender lines for senior men and women. However, when we look at gender by position type (manager versus individual contributor), some differences emerge.

Senior women in individual contributor roles are, like men in these roles, focused on updating their technical skills, and seem generally unlikely to turnover: they are not planning to switch career fields, start their own companies, or look for opportunities at other companies (only 16.7% of them do). Senior women in management positions, by contrast, are looking for new opportunities inside their companies, outside their companies, or starting their own companies. These data suggest that at the high level, women in management roles are actively looking for new opportunities and may be at heightened risk for turnover. However, the actual number of senior women managers in our study is small (n=24), and we interpret these trends cautiously. We encourage companies and researchers to take a closer look at the career satisfaction and plans of senior women in both IC and management positions to identify how and where retention efforts might be strengthened.

Chart 4c. Plans for the Next 12 Months Senior Technical Employees by Gender and Position Type



Based on the above findings, we make the following recommendations for companies who wish to retain senior technical women and further advance their careers.

1. Know your numbers. Companies should examine the gender distribution of technical employees by levels of advancement. Are men more likely than women to be in top level positions? Differential promotion rates throughout the career ladder whereby men get promoted in greater proportion than women result in an absence of women at the top, and signals the presence of hidden bias in promotion practices and a need to reform promotion processes.[20] Indeed, previous research has documented widespread favoritism and bias in performance evaluations of scientists and engineering whereby the dominant group (often white men) systematically received better performance reviews compared to minority group members.[40]

As a next step, companies should track these advancement metrics for technical women for both management and IC positions. Are women less likely than are men to advance as individual contributors? If so, a specific examination of the promotion process should be performed to identify and resolve the presence of bias on each track. Examine and address the presence of a club effect at the highest levels, especially at the Fellow/Architect levels. **An absence of diversity at the strategic IC levels represents a loss of innovation and a loss of business opportunities.** Participants in the 2009 Anita Borg Institute Technical Executive Forum reported that narrow advancement criteria heavily reinforced a club effect for the highest levels of individual contributor positions.

2. Increase the awareness of managers and influential gatekeepers within the organization. Previous research suggests that social networks play a critical role in the decision to advance as an Individual Contributor or as a manager.[41] Technical women should have a clear perspective of career options on both the IC and management paths. Supervisor-employee relationships should involve regular career development conversations and involve guidance and development for both individual contributor and management options. Our interviewees overwhelmingly notice the absence of female role models sat the highest levels of IC promotion structures. Women in technology, faced with an absence of role models in these positions and more visible role models in management, are likely getting the message that the only path for advancement is in management.

3. Early intervention is needed for career development on the IC track. At the entry and mid level, women who are excelling as individual contributors should be provided with ample mentoring, networking, and professional development opportunities. Enlist existing top ICs such as Fellows, Architects, and Principal/Distinguished Engineers to act as sponsors for high-potential women. Indeed, executive participants in the Anita Borg Institute's 2009 Technical Executive Forum pointed to a critical need to address an absence of a mentoring culture in individual contributor work values.[42] Align the reward structure of top level individual contributors to ensure that mentoring mid-level women for advancement is a rewarded behavior.

4. Companies (as well as educators from the K-12 level on) should **actively engage women at the entry and mid level in R&D activities, such as patenting.** Technical women highly value working on cutting edge technology and doing innovative work, yet they are entering a field where innovation has traditionally been a male domain with an acute lack of role models, mentors to engage them in the innovation process, and a structure that may be encouraging them to pursue managerial positions. An example of intervention involves Patenting Learning Communities, where women get exposed to a corporation's innovation process from early own, access mentoring from experienced women innovators, and establish a supportive network of fellow innovators.[43]

5. Consider onramps and offramps for the individual contributor and management paths to offer different points of entry for technical employees on each path. The mid-level, where employees are typically asked to choose whether to enter the IC and manager "tracks" in many companies, also coincides with the time where technical women are experiencing significant demands on their time in terms of combining work and family and are at significant risk for turnover.[7] One solution is to provide more opportunities for movement along the technical career path between management and individual contributor positions to reflect a diversity of work lifecycles and family configurations. Women's decisions to advance through management are not tied to a lack of technical human capital– previous research, and our interviews, suggest that some women are feeling pushed out of opportunities for advancement as individual contributors.

6. Be aware of the diversity of family configurations and responsibilities of the technical workforce. Beyond gender, a dimension of diversity is differing life stages, partnering status, and family responsibilities that can vary not only across gender and age dimensions, but across cultures. Advancement practices should be examined to reward accomplishments over "face time." The 2009 Anita Borg Institute Technical Executive Forum discussed the prevalence of a "hero" culture in high-tech companies,[44] whereby those who come and save a project in extremis through 24/7 work get disproportionately rewarded when compared to those employees who prevent problems from occurring in the first place. Work-family practices in high-tech companies are of critical importance. However, even more important is aligning the advancement and reward structures so that there isn't an advancement penalty associated with participating in these programs.

7. Companies should consider communication styles as part of diversity dimensions. The current high-technology culture overwhelmingly rewards assertiveness. The senior women in our sample are assertive, and many of them described having had to overcome their own communication styles to become assertive. However, women are not on an equal playing field when it comes to assertiveness – while it is an ingredient of success, it comes with a significant likeability cost for women. Companies should invest in raising the awareness of managers for unconscious bias associated with gender and communication styles and should examine the presence of such bias in recruitment and advancement processes. For example, women who are being told they are "difficult to work with" or "aggressive" in an evaluation may be suffering from the double standard research shows women suffer from in assertive communication.

8. A critical point of intervention for companies lies with senior women managers. Examine turnover ratios for technical women in senior positions in management versus individual contributor roles to uncover significant differences. Providing pathways to advancement through management is good, but is not a "simple fix" to increasing the representation of women at the top. If some technical women are feeling "pushed" into managerial careers in order to advance, their career satisfaction is likely suffering. The loss of these senior women represents an incredible loss of talent for companies – both in terms of their leadership experience and in terms of their technical human capital. Senior technical employees are among the greatest source of human capital for a high-technology company, and their retention should be a chief concern. **Provide senior technical employees with ongoing internal mobility opportunities to increase retention.** For senior women, ongoing professional development for managerial, leadership, and technical skills is also likely to enhance satisfaction and retention.

CONCLUSION

This paper has offered a snapshot of a rarity in technology: senior technical women working at prominent Silicon Valley technology companies.

Successful women in technology show the same attributes of success, the same human capital, and the same work values as senior level men. Senior technical women are collaborative, assertive, and moderate risk-takers who work long hours. They have made significant concessions to advance. Women who are seeking to advance need to consider their own self-efficacy on all these attributes. Longitudinal research is needed to establish the causal mechanisms that lead to advancement for technical women. Despite these similarities, our data suggest that companies are not fully capitalizing on their talent, resulting in lost opportunities for innovation and business success. First, with equivalent levels of education and experience, women are not advancing to senior level positions at the same rate as men. When they do advance, they are more likely than men to do so through management, even though their technical credentials are equivalent to men's. More research is needed to understand exactly why women are not as likely as men to advance in individual contributor positions.

While the dual-ladder has yielded benefits for companies and R&D employees, it may not be adapted to the needs of a diverse and globalized workforce. Given that the technical and organizational conditions facing companies are more complex than ever before, traditional training and tracking structures are increasingly becoming obsolete. New models of organizing the work of scientists and engineers involve project-based assignment and frequent rotations between technical and managerial roles.[45] Research on the careers of scientists and engineers shows that increasingly, technical employees grow effectively by doing work on cross-functional teams and rotating between management and technical positions, even taking on rotations outside of the technical career track – the traditional tracking structures may not be accounting for the career needs of a diverse and globalized workforce.

Endnotes

1 Hewlett, S. A., Buck Luce, C., Servon, L. J., Sherbin, L. S., Shiller, E., & Sumberg, K. (2008). *The Athena factor: Reversing the hidden brain drain in science and technology*. Harvard Business Report; Simard, C., Davies Henderson, A., Gilmartin, S.K., Schiebinger, L., and Whitney, T. (2008). *Climbing the technical ladder: Obstacles and solutions for mid-level women in technology*. Anita Borg Institute for Women and Technology and Clayman Institute for Gender Research at Stanford University; Foust-Cummings, H.; Sabatini, L., & Carter, N. (2008). *Women in technology: Maximizing talent, minimizing barriers.* Catalyst; Ashcraft, C. & Blithe, S. (2009). *Women in IT: The facts*. National Center for Women in Information Technology.

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7 Simard, C., Davies Henderson, A., Gilmartin, S.K., Schiebinger, L., and Whitney, T. (2008). *Climbing the Technical Ladder: Obstacles and Solutions for mid-level women in technology*. Anita Borg Institute for Women and Technology and Clayman Institute for Gender Research at Stanford University.

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11 This represents a relatively small number of senior technical women (65), limiting the power of our statistical analyses. However, a dearth of existing research on this group of women warrants examination.

12 In this paper, we use the terms "senior level" and "high level" interchangeably, and "senior technical women" and "high-level technical women" interchangeably.

13 For a full methodology discussion, please refer to Appendix A of Simard, C., Davies Henderson, A., Gilmartin, S.K., Schiebinger, L., and Whitney, T. (2008). *Climbing the technical ladder: Obstacles and solutions for mid-level women in technology.* Anita Borg Institute for Women and Technology and Clayman Institute for Gender Research at Stanford University.

14 Examples of positions include: Principal Engineer/Scientist; Chief Architects/Fellow; Director/Senior Director of Engineering; Director of QA; VP/SVP of Engineering.

15 If a company participating in the study did not have such a dual-ladder structure (true of 1 out of 7 participating companies), respondents were asked themselves weather they considered their position to be one of "individual contributor" or "manager".

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21 Since our data are cross-sectional, we cannot determine causal effects predicting advancement.

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38 For this and all work values, the percentages represent those who indicated the value is very or extremely descriptive of them.

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