The latest catchphrase in corporate circles depicts the numerous ‘invisible’ roadblocks keeping women from moving to top executive positions. Many of these barriers can be broken, however, by considering these insightful solutions for success.

Recently, there has been a dramatic increase in attention to the glass ceiling—barriers that block the advancement of women. Although the literature specifically pertaining to this phenomenon in the computer industry is not extensive, what there is indicates that it is not any better than other industries. An analysis of the literature provides the following perspective on problems throughout industry in the U.S. (see sidebar by Ellen Isaacs):

- Women are consistently underrepresented at the highest ranks even
when you factor out age, experience, quality of credentials, proportion of women graduating at the relevant time, and current proportion of women in the industry.

- Women are paid less than men in the same positions, and the disparity grows as individuals progress in their careers.
- Subtle forms of discrimination that block women's advancement may be largely accidental, unintentional, and unrecognized.

We identified some natural consequences of human nature that may contribute to the glass ceiling, based on published psychological research and on anecdotal reports about the glass ceiling. They are described here as a set of forces, together with the psychological research that reveals them. The same research implies a set of counterforces — actions that executives, technical leaders, and members of technical staffs can take to help eliminate the glass ceiling.

**Forces**

**Force 1: Social stereotypes conflict with professional stereotypes**

Although role models such as Hillary Clinton, Janet Reno, and Jocelyn Elders may affect major changes in popular images, cultural stereotypes in the U.S. and elsewhere provide an image of women that is much less similar to the image of a successful career person than is the image of men. This is particularly true in the scientific and engineering disciplines [18]. Conflicting stereotypes can lead to a lose-lose situation for women: On the one hand, women who have traditional female work styles, focusing on consensus-building and teamwork, may be seen as less confident and capable. Their style may be undervalued by groups with which they work. On the other hand, women who have more masculine styles may be disliked for seeming masculine [23]. A recent Catalyst study found that the type of personality that can succeed in many engineering organizations is far more aggressive than the men in the organization were willing to tolerate in a woman [3].

For example, one specific characteristic that often differs between men and women, and that is subject to stereotypes, is conversational dominance. Whereas some men try to "score points" in a conversation, many women treat conversation as a cooperative, equalizing endeavor [20]. In a recent study of the glass ceiling in science and engineering, the conversational style of some men was cited as one of the top barriers for women in those disciplines [5]. A woman who finds herself in a group conversation with such men may lose the competition without knowing she was participating in one. Also, participants in a conversation who are unintentionally affected by these stereotypes may be subject to a sort of gender-based deafness, where they only hear ideas that are stated by men. And when men are allocating rewards, and basing rewards on perceived competence and capability, their judgments may be biased by stereotypes of conversational styles.

Another inappropriate appearance of stereotyping in the workplace is in paternalism. Managers may be protective of women, and as a consequence they may not give women challenging assignments or expect them to work hard [23]. Managers may implicitly assume that women are not ambitious, and consequently providing women with opportunities for advancement is not a priority. Women, for their part, may act out the results of their upbringing insofar as their behaviors are based on the traditional female model of "silent virtue rewarded" [19]. For example, women may want to be offered rewards for accomplishments whereas men aggressively seek and even demand the rewards. This may result in disparities in job level at time of hiring, since men may be far more aggressive in seeking a high rank and high pay.

The evidence indicates that social stereotypes affect both boys and girls from a very early age, and that as adults both genders perpetuate the stereotypes. For example, there is evidence of bias in the behaviors of elementary school teachers: unknown to them, teachers call on boys in class much more frequently than they call on girls, and they are more likely to follow up when a boy answers a question correctly to verify that his reasoning was accurate [14]. The implication is that just as schoolteachers treat boys and girls differently, both men and women in the workplace may be biased in their treatment of male and female coworkers.

Social psychological studies show that stereotypes affect everything from judgments about the ability of a job applicant, to job performance, raises, and starting salaries [10, 22]. Researchers gave people information about fictitious job candidates and employees, giving some people the information associated with a female name, and giving others the same information associated with a male name. In one study, the people evaluated resumes where the name on the resume was either obviously male or obviously female, and decided whether to invite the applicant to an interview. For resumes containing average credentials, men were much more likely to get interviewed than women, whereas for superior candidates gender was irrelevant.

In another study, researchers asked people to assign a starting salary to male and female new-hires, to assign them a raise a year later, and to assign tasks to them. Women were given lower starting salaries, smaller raises, and more routine tasks. In a third study, researchers found that when a woman was successful at a masculine task, people attributed her success to luck, whereas when a man was successful it was more likely to be attributed to ability.

Based on established social psychological phenomena, Terborg [21] explains how these differences in the treatment of men and women occur. First, most of us think that people should be rewarded commensurate with their accomplishments. In trying to allocate rewards to men and women, a manager attempts to determine the magnitude of their accomplishments and to match that to rewards. However, in assessing the accomplishments, the manager is making judgments under uncertainty, which are subject to a variety of heuristics and biases [9]. In this case, the bias that comes into play involves preconceptions about men and women. While managers are trying to
Social psychological studies show that stereotypes affect everything from judgements about the abilities of a job applicant, to job performance, raises and starting salaries.

evaluate accomplishments objectively, they may be subconsciously affected by preconceived notions that cause them to devalue women's contributions.

Evidence confirming the effects of uncertainty biases is provided by studies that show that when there is little or no uncertainty, gender is irrelevant. For example, there is no effect of the gender of the name on a resume when the resume describes a superstar [10]. Also, in a recent survey, employees rated female managers higher in competence than male managers, but rated the female managers' long-term potential lower than the male managers'. Since there is more uncertainty about future performance than about past performance, stereotypes come into play more in judgments of potential.

Force 2: Birds of a feather flock together

Social psychological research has shown that in business and social interactions, opposites do not attract; rather, birds of a feather flock together. When people are similar in interests and attitudes, they naturally tend to gravitate to one another [1]. Consequently, when you have management and technical ranks that are filled largely with males (and most often, Caucasian males of Protestant, Catholic, and Jewish descent), there is a natural human tendency for those males to prefer others like them to join their ranks. Not only do they often share interests, they have had similar prior experiences that provide familiar models for work relationships [8, 19]. Whereas everyone knows that discrimination based on gender or race is illegal, and most believe that it is morally wrong, that intellectual knowledge is often insufficient to counteract basic psychological tendencies that may be entirely subconscious.

The tendency to flock together affects women in the workplace in a variety of ways. First, this tendency affects an employee's access to informal channels of communication. People talk to people they like. Frequently, when there are few women in an organization, they tend to be left out of the "old boy's network" [13]. Surveys show that access to information from people other than one's immediate supervisor is key to advancement, because it helps one understand the culture and political situation, as well as providing exposure to a breadth of technical issues and keeping one up to date with what's going on in the organization. Throughout industry, women tend to have much less access to this kind of information than do men, but the disparity is particularly acute in engineering because the numbers of women are especially low [3].

Second, the tendency to flock together affects who gets mentored. When a male manager or senior engineer comes into contact with a talented junior person, he is more likely to see the potential in the junior person if that person is another man, and similar to the senior person in other ostensibly irrelevant ways. Differential mentoring can impact career progress: research and anecdotal evidence strongly suggest that the availability of mentors is essential to career advancement [15, 23].

Third, this tendency may affect how career opportunities are allocated. When trying to think of an employee to fill a position, managers typically scan their mental networks of employees, in an effort to recall possible candidates from memory. Due to familiarity biases in memory, this process retrieves people the manager is most familiar with [3]. This is what we call the "But Who? Phenomenon," and it may affect distribution of opportunities to internal candidates as well as searches for candidates from outside a company. And, naturally, it may apply to promotions and to other opportunities for career advancement.

Force 3: Mental models

A third aspect of human nature that can contribute to career barriers for women is also an established characteristic of human cognition: we synthesize our notions of concepts by generalizing based on examples [17]. In other words, when you are trying to figure out what a Vice President or a Distinguished Scientist or Fellow is, you generalize based on the similarities and differences among the examples you know. Although intellectually you may know that things like gender and race are irrelevant, that knowledge does not stop your mind from implicitly generalizing based on similarities in those irrelevant features. In other words, if all the Distinguished Scientists you know are white males, some part of your mind determines that Distinguished Scientists are likely to be white males. At some subconscious level, you may mentally file away the information that whiteness and maleness are attributes of Distinguished Scientists, so that when you think about the people who have potential to become Distinguished Scientists, you tend to think of white males.

The tendency to generalize based on examples also comes into play when we are evaluating our own potential. When setting our own aspirations, we think about the members of groups we might aspire to join, and if the group members are dissimilar from us in major—but ostensibly irrelevant—ways, that impacts our own assessment of whether we are potential members of the group, as well as impacting our desire to join the group.

In addition, lack of appropriate role models inhibits our ability as well as our desire to do anticipatory socialization, which is a process whereby a
Ellen Isaacs

Gender Discrimination in the Workplace: A Literature Review

Data collected from a wide array of sources reveal the following pattern with regard to gender discrimination in the U.S. workplace. In general, the proportion of women employed as computer scientists appears to reflect the proportion of women graduating with degrees in that area. However, when women are hired, they tend to start at lower positions and/or earn lower starting salaries than men. Over time, the gap between men's and women's salaries and promotion rates grows at an increasing rate. The salary gap is found even in studies that equate years of experience, level of education, and industry.

This survey was prepared for an industry task force report on women in software engineering. It was intended to supplement that report by providing context on gender discrimination in the workplace with a focus on software engineers.

Hiring

There is some evidence that the proportion of women computer and mathematical scientists hired into industry jobs reflects the proportion of women graduating with degrees in those areas. Data from different sources indicate that women made up about 30% to 35% of all computer and mathematical scientists between 1988 and 1990 [2]. This figure is somewhat higher than the proportion of women graduating with computer science (CS) degrees over the past 10 to 20 years. According to the U.S. Department of Education, women earned between 30% and 37% of the bachelor's degrees in CS during the 1980s, up from 14% to 28% in the 1970s [11–13]. As for higher degrees, women earned between 21% and 30% of the CS master's degrees in the U.S. between 1980 and 1989 [12], and they earned between 9% and 14% of the CS Ph.D.s in the U.S. and Canada between 1978 and 1990 [3].

Promotion

In almost every industry, women occupy a very small proportion of the higher-level positions. For example, a 1988 study found only three chief executive officers among the Fortune 1,000 were women, and only 1.7% of the chief operating officers, chief financial officers, and executive vice presidents were women [14]. In a 1993 study of Stanford MBAs, graduates from the class of 1982 were tracked over time. It was found that 71% of the men are currently in the top four rungs of management, whereas only 34% of women had reached those positions [10]. A study of the ten largest makers of weapons found that women made up 5.3% of the senior management positions [9]. Business Week did a report in 1987 in which they tracked 100 women executives who were on the fast track from as far back as 1976. They found that none of those 100 women had made it to the top position in a public corporation unless they started the business or inherited the position [14].

Data from the computer industry in particular were not available, but the same pattern appears in the academic world. Women make up 10% of both assistant and associate CS professors but only 4% of the full professors, a rank that generally takes about 10 years to achieve [3]. (Recall that women have been earning between 9% and 14% of computer science Ph.D.s since 1978.)

As discussed earlier, the problem is not that larger proportions of trained women are not available. Women are not represented at the highest ranks of companies and academia because, for some reason, their rate of progression is halted somewhere along the way to the top.

person who aspires to join a group adopts characteristics of that group (such as dress, grooming, and mannerisms). When women do not perform the anticipatory socialization that implicitly may be expected of aspirants to a position, that failure may be viewed as evidence they are not qualified or interested.

Force 4: Male-culture behaviors

Many successful corporations have a distinctive personality. When a corporation has many more men than women (or vice versa) in influential positions, the culture tends to adopt attributes that favor the dominant gender. This can result in the presence of male-culture behaviors that make women feel left out and unwelcome. These behaviors include the following:

- remarks that devalue women;
- bullying;
- sexist jokes;
- locker-room-caliber conversation;
- a focus on male-oriented activities and widespread use of metaphors from these activities;
- display of images, either on walls or computer monitors, that portray women as sex objects or otherwise devalue them.

Individually these behaviors are not often actionable offenses, but collectively they can damage women's self-esteem [19]. These sorts of insensitive behaviors are an unnecessary burden for women who are already coping with the delicate process of balancing career and family, and with managing their self-images as competent females in a male-dominated culture. To avoid them, many women retreat to the safer, less challenging support functions—the "female ghettos" [3].

At the extreme end of the spectrum are behaviors that are actionable offenses, such as sexual harassment. Studies indicate that more than half of all working women will be sexually harassed at some point in their careers, and that very few of them will report it to a superior or file a complaint or lawsuit [4, 11].

Whereas at a minimum these behaviors hurt individual women and damage morale, their effects may actually be much more damaging to a company. They contribute to a reputation as a hostile environment for
Salaries

The salary picture for women is even more inequitable than that for promotion. Women consistently make less money than men in almost every industry, even when they first start their jobs ([5, 8]). An American Demographics study found that women working full time with two or fewer years of experience earn 72% of what men with the same experience earn ([8]). In the computer and mathematical sciences, women's wages as a percentage of men's has fluctuated between 74% and 86% between 1983 and 1992, although on the whole it has grown from 75% to 85% (U.S. Department of Labor statistics).

As women get older, they make less as a proportion of men's salaries. Although the gap has narrowed somewhat in the past 14 years, this trend is due to a drop in men's inflation-adjusted salaries, not a rise in women's ([6, 7]). And the gap has not been steadily decreasing. In 1967, women earned more of a percentage of men's salaries than they did in 1987. 63.9 cents vs. 63.7 cents ([5]).

Part of the reason for the wage gap is that women do not get promoted as quickly as men. However, even when equating for rank, a gap appears. A 1993 ComputerWorld survey of information systems (IS) managers' salaries showed the wage gap widened as the management level increased ([1]). For example, among programming managers, women made 98% of men's salaries, but among IS directors or managers, women made 82% of men's salaries. Other common explanations for the increasing wage gap are that women choose professions that pay less, and they have less experience than men of the same age because they take time off to raise children. However, Business Week reported on a study that compared the salaries of single white men and women between the ages of 20 and 40 ([4]). When they factored out schooling, industry, skill level, and work experience, the women still earned 91% of men's salaries. (Without factoring these out, women earned 86% of men's salaries.)

Another researcher analyzed the credentials of 194 corporate managers randomly chosen from 800 people who took a leadership course. He found that "if women were men with the same credentials, they would earn about 18% more" ([7]). These figures are the closest estimate we have of the wage gap that can be explained only by discrimination.

References


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women, which makes it harder to recruit top women. They also decrease productivity, as women must spend time and energy on professional survival.

Counterforces

Until they are identified and eliminated, subtle forms of discrimination will continue to undermine the advancement of women. Changes in corporate culture that eliminate discrimination are the key to turning around the situation.

The counterforces are things that we—as managers, technical leaders, and individual contributors—can do to counteract the forces, helping to erode the glass ceiling.

Counterforce 1: Education and awareness about gender equity

The first step toward controlling an undesirable tendency or habit, such as the tendency to consider irrelevant characteristics when evaluating a person's potential, is to recognize its existence. Consequently, a major counterforce is education that makes people aware of what they may be doing unwittingly. Since much of the bias that occurs is a result of behavior that accidentally occurs in specific types of situations, education about the situations and how they result in unintentional biases can be effective in changing behavior. For example, teaching a manager about the biases inherent in free recall from memory help the manager learn to avoid the "But Who? Phenomenon."

Also, once education makes gender biases an acceptable topic of conversation, employees will feel more confident about bringing biases to their managers' attention when they occur. This will give the managers the opportunity to adjust their behaviors or correct misunderstandings.

In addition to making both men and women aware of subconscious biases, women (and some men) should be educated in behaviors that are conducive to career advancement, including techniques for self-promotion.

Counterforce 2: More systematic identification of candidates and evaluation of qualifications

While none of us can alleviate our natural human tendencies to like
Once education makes gender biases an acceptable conversation topic, employees will feel more confident about bringing biases to their manager’s attention when they occur.

people who are similar to us, and to create mental models based on irrelevant as well as relevant characteristics, we can learn to rely on strategies for handling specific situations that help us avoid accidental bias. Among the specific situations for which alternative techniques can be particularly effective are the hiring and promotion processes. Relying more on systematic, merit-based techniques for identifying and evaluating candidates can help us overcome our biases. Suggestions include the following:

- When you have a job opening for external candidates, do systematic searches of women’s organizations (such as the Society of Women Engineers, the Society of Black Women Engineers, WEPAN, and so forth).
- Keep a list of top women in the field and actively pursue them when opportunities arise.
- Keep lists of people in the company who are promotable.
- Systematically search relevant organization charts when looking for internal candidates for an opening.
- When top women become candidates, make their resumes broadly accessible to organizations that may have job openings.
- Use objective leveling criteria when evaluating candidates for promotion and at the time of hiring.

Counterforce 3: Systematically identify and correct inequities

Many companies have barely begun to collect the data and do the statistics that will enable them to identify possible inequities. Reports showing the numbers of men and women involved in important personnel events (such as new-hires, promotions, and terminations) can be excellent eye openers for management.

For each job position, quantitative reports should show:

- relative numbers and percentages of men and women;
- comparative performance rankings of men and women;
- comparative salaries and bonuses for men and women;
- relative time-in-grade for men and women;
- current promotable men and women;
- year-to-date numbers and percentages of men and women promoted out of each grade.

Naturally, care should be taken not to violate individuals’ privacy, particularly for the positions with small numbers of women.

Counterforce 4: More role models and mentors for women

Female role models are essential for women’s advancement. Since the numbers of female role models are relatively small, many women will not come into contact with them during the ordinary course of doing business. To make the most of available role models and to facilitate networking among women, technical women’s organizations have been formed at companies such as Apple, Hewlett-Packard, and Microsoft. These organizations hold conferences, provide recognition and awards, and perform community service. (See sidebar by Pavan Diwanji.)

While female role models are necessary, it is unlikely there are sufficient numbers of them in most companies to serve all the junior women. Since cross-gender mentoring is a relatively rare phenomenon for a variety of reasons (including fears of the appearance of sexual harassment), it is important to set up processes that encourage inter-gender mentoring in a safe context.

Counterforce 5: Rewarding pro-diversity behaviors

Rewards and recognition for pro-diversity actions can be a powerful incentive. As a routine part of performance review, employees should be rewarded for the following:

- mentoring and developing women;
- proactively seeking top women as job candidates;
- taking measures to ensure the retention and advancement of top-performing women.

Counterforce 6: Better channels for reporting gender-biased behaviors and sexual harassment

By institutionalizing access to employee advocates, we can make it easier for women to confront cases of gender-biased behaviors and sexual harassment. This will help root out behaviors that may damage women’s morale and productivity, and will help change corporate culture.

Traditionally, this role is filled by an ombudsperson, who serves as a confidential sounding board and advisor. In talking to the ombudsperson, employees have the opportunity to sound out a knowledgeable senior person about problematic situations before going on record. At the employee’s request, the ombudsperson may also take a more active role in resolving problems, by intervening with management and human resources personnel.

Conclusion

Through an understanding of the underlying forces that serve as mainstays of the glass ceiling, and by taking proactive measures to counteract those forces, we can begin to remove the barriers that block the advancement of women in our companies. With some proactive effort, the situation will improve. Considering the shift underway in the demographics of the U.S. workforce that is making women and minorities a much larger portion of the workforce every year, the success of many of our companies may depend on it.
Acknowledgments
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Tracy Camp

Diversity Recruiting

Due to the higher percentage of men with computing backgrounds, employers often find it difficult to locate qualified female computer professionals, particularly senior professionals. Several resources have recently been made available to help employers find these professionals. Therefore, employers who are concerned with the lack of diversity in the workplace now have a means to make changes.

Systers. Systers is a private mailing list that brings together professional women in the field of computing in order to discuss issues of mutual interest. Systers was created in 1987 by Anita Borg of Digital Equipment Corporation. As of September 1994, over 1700 women in 18 countries (representing over 170 companies and 220 colleges and universities) are on the Systers list.

Posting an available position to Systers is a simple means to get an announcement into a large women's network. Systers comprises a diverse mixture within the computing field including eminent computer scientists, industry executives, system administrators, programmers, computer science faculty, and computer science students. Therefore, posting an announcement to Systers will ensure that it will be seen by many viable candidates. In addition, if specifically designated, many members of Systers will pass the announcement on to contacts (men and women) not on the Systers list, thus increasing the possible pool of applicants.

Because Systers is a private mailing list, only members of the Systers list may send a message to Systers. Those who are not members should ask a member to post the available position. If locating a member of the list proves impossible, send the job opportunity to systers-jobs@pa.dec.com; the moderator of Systers-Job will then consider including the announcement. (No announcements will be accepted from headhunters.)

Available positions can be posted on this women's network in any form. The Systers list, however, does request that each post include whether the announcement can be shared with others not on the list. That is, in order to allow members of the list to forward the available position to others (male and female) in the job-search process who are not on the Systers list, public distribution is permitted must be explicitly stated in the announcement. The default is do not distribute. We recommend that members of Systers be allowed to share the job opportunity with others, thus increasing the number of people that will see the available position.

CRAW Database. The Computing Research Association Committee on the Status of Women (CRAW)1 maintains a database of Ph.D.-level computer scientists and engineers in North America. Although representation is voluntary, as of September 1994, over 700 women have entered their records in the CRAW database. The database is used to find appropriate job candidates; it is also used for statistical queries and to find invited speakers, program chairs, committee members, journal editors, and panel members. CRAW member Joan Feigenbaum of AT&T Bell Laboratories is the database project leader. To use the database, contact her at jfe@research.att.com.

GEM. To increase the applicant pool of female minority candidates, employers should consider becoming employer members of The National Consortium for Graduate Degrees for Minorities in Engineering and Science, Inc. (GEM). The mission of GEM is to increase the number of minority students (both male and female) at the master's and Ph.D. levels. This goal is accomplished by offering graduate school fellowships to U.S. citizens with minority status. One of the requirements for receiving a fellowship is that the candidate work one summer for an employer member in the consortium. (As of September 1994, there are over 70 employer members in the consortium.) To apply for a fellowship, minority candidates submit their application to GEM. GEM then shares all the applications with consortium employers, regardless of whether the applicant receives a fellowship. Therefore, employer members in the consortium are made aware of every minority technical talent who applies to the GEM program. For additional information, contact GEM at GEM Central Office, P.O. Box 537, Notre Dame, Ind. 46556. (219)287-1097.

Student Organizations. Employers concerned about diversity among their employees should also become acquainted with the university-based student organizations that represent minority students in engineering. Student organizations, such as the Society of Women Engineers (SWE), the National Society of Black Engineers (NSBE), and Society of Hispanic Professional Engineers (SHPE) may already exist at the school where the employer recruits. These organizations often produce resumes books of their members (check with the Career Services Office at the college). In addition, a career fair can be organized to bring together the members of these diverse student organizations and possible employers.

TRACY CAMP is an assistant professor at the University of Alabama's Computer Science Department.

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Nominees for Elections and Report of the ACM Nominating Committee

In accordance with the Constitution and Bylaws of the ACM, the Nominating Committee hereby submits the following slate of nominees for the Western Regional Representative election. The terms of office are indicated below.

The names are listed in random order. The nominees are:

Western Region (7/1/95 - 6/30/98):

Peter Polson, University of Colorado
Penny Crane, California State University
Mark Scott Johnson, FirstPerson, Inc.

The Constitution and Bylaws provide that candidates for elected offices of the Association may also be nominated by petition of one percent of the Members, who as of November 1, 1994, are eligible to vote for the nominee. Such petitions must be accompanied by a written declaration that the nominee is willing to stand for election. The number of Member signatures required for the Western region is 136.

The Bylaws provide that such petitions must reach the Elections Committee before January 31.

Original petitions for ACM offices are to be submitted to the ACM Elections Committee, c/o Pat Ryan, ACM Headquarters, by January 31, 1995. Duplicated copies of the petitions should also be sent to Gerry Segal, Chair of Elections Committee, Bank Street College of Education, 610 West 112th Street, New York, NY 10025. All candidates nominated by petition are reminded of the requirements stated in the Policy and Procedures on Nominations and Elections that a candidate for high office must meet in order to serve with distinction (copies of this document are available from the Office of Policy and Administration, ACM Headquarters).

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