

filling the void

To attract women to engineering in greater numbers, some suggest, they must be able to see how they are making a difference. By Barbara Wolcott



Gender stereotypes have been breaking down in the United States for decades. After all, this is a time when American servicewomen are taking positions alongside their male counterparts in many aspects of military operations, including the Army Corps of Engineers. Women have come under fire in Iraq.

Women also are entering many technical fields in unprecedented numbers. More than half the medical and law students enrolled today are women.

But there are some occupations where women still have not shown up in great numbers. The presidency, pro football, and heavyweight boxing come to mind. So do most fields of engineering and, especially, mechanical engineering.

What does that mean to a project manager or to the CEO of an engineering company? It's hard to predict the contributions that a larger presence of women can make in the engineering of products.

Women's experience in society differs from that of men. Women, therefore, may bring a different perspective to product design, for instance. What's more, in the United States, where companies face an increasing shortage of qualified engineers, women represent just over half the population, and the mechanical engineering profession has largely failed to recruit them into its ranks.

The population of female students in higher education has increased to the point where women make up more than 50 percent of the enrollment at colleges and universities in the United States.

According to statistics from the American Society of Engineering Education, women account for about 20 percent of the Bachelor of Science degrees in engineering each year. In mechanical engineering, women represent about 13 percent of the graduating class.

At a time when there is a shortage of homegrown engineers in the United States, some engineering schools are

seeing their student populations decline. In many classrooms, there is capacity to accommodate an increase in students. Empty chairs in freshman classes indicate that four years from now schools will not be graduating the numbers of qualified engineers that the country's industry will need. Some observers believe that convincing more women to enter engineering will fill some of those empty seats.

It has been suggested from time to time that product development could benefit from ideas that women collectively could contribute from their perspective. But that has to remain a matter of speculation because one cannot measure what has not been done.

a high rate of attrition

A new study jointly sponsored by the National Academy of Science and the National Academy of Engineering finds attrition high among women who express interest in academic science or engineering careers.

"With each step up the academic ladder, from high school on through full professorships, the representation of women in science and engineering drops substantially," the authors report. "As they move from high school to college, more women than men who have expressed an interest in science or engineering decide to major in something else; in the transition to graduate school, more women than men with science and engineering degrees opt into other fields of study; from doctorate to first position, there are proportionately fewer women than men in the applicant pool for tenure-track positions."

The report, which calls the situation an "underuse of precious human capital," was overseen by a committee chaired by Donna Shalala, president of the University of Miami and former U.S. Secretary of Health and Human Services.

The National Academies' study focuses on women with advanced degrees, and the difficulties they face in promotion and even in getting hired at colleges and universities. According to the study, it is only in the social, behavioral, and life sciences that the percentage of women faculty in leading research institutions reaches into the double digits.

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California Polytechnic State University in San Luis Obispo appears to be an exception. About a third of engineering faculty members are women. To encourage students, Cal Poly has a very active chapter of the Women in Engineering program, among the largest in the nation.

Working with the Society of Women Engineers to host regular meetings and community service activities, the group aims at building a network for female engineering and computer science students. The program hosts an annual banquet with industry representatives to give students direct contact with potential employers.

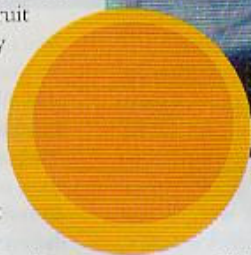
According to Helene Finger, director of the Women's Engineering Program at Cal Poly, "We have an advisory board with representatives from a variety of industries telling us they are desperate for engineers." Finger said that U.S. companies generally prefer to hire U.S. engineers, but can't find enough of them. They are forced to recruit them from other countries. Defense contracts may require that only U.S. citizens work on sensitive military projects. Finger said enrollment has reached a plateau for mechanical, civil, and industrial engineering students there.

ASME and other professional societies conduct diversity programs, and so do large companies that hire engineers.

The Extraordinary Women Engineers Project Coalition is a motivational group that is supported by numerous professional societies, including ASME, and by universities and other organizations. The group is closely associated with The American Society of Civil Engineers, and operates out of the ASCE world headquarters in Reston, Va. According to The Extraordinary Women Engineers' Web site, the group "is an integrated program designed to provide resources developed jointly by educators and engineers to inspire young women to enter the engineering field and to develop a new generation of role models for those in the field." Among its efforts, the group has published a book, *Changing Our World: True Stories of Women Engineers*.

A study by the Extraordinary Women Engineers Project Coalition found that more than 90 percent of high school girls are not even given the chance to consider engineering as a career choice. The study's final report highlighted that "girls and the people who influence them—teachers, school counselors, parents, peers, and the media—do not understand what a career in engineering looks like and therefore don't consider it as a career option."

The Extraordinary Women Engineers' Web site lists more than 60 participating organizations. One of them is WEPAN, or Women in Engineering Programs and Advocates Network. WEPAN, formed in 1990, describes itself as "a catalyst, advocate, and leading resource for institutional and national change that will result in the full participation of women in engineering."



If women make up more than half the population but only 13 percent of the engineering graduates, is U.S. industry missing out on talent?

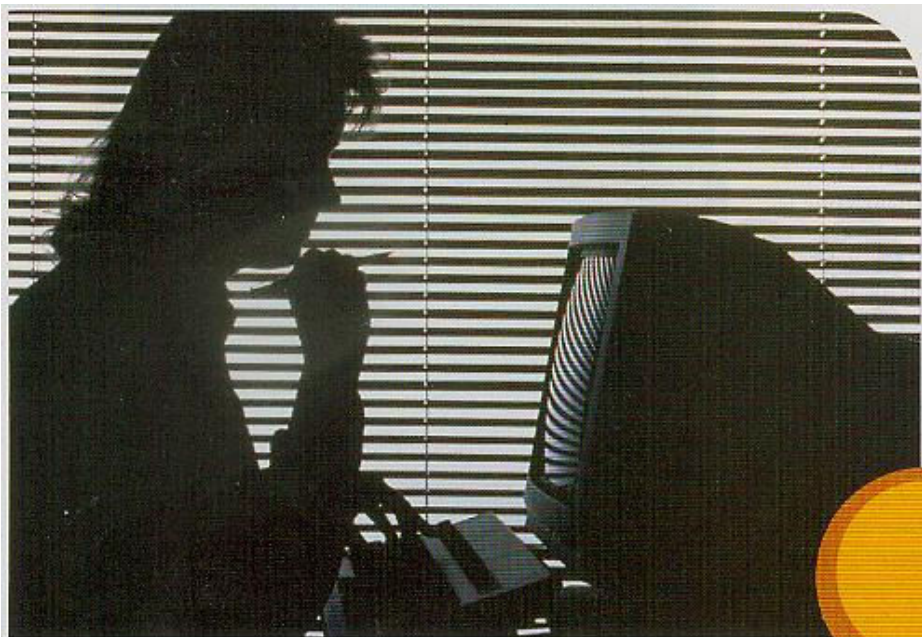
WEPAN's projects include Faculty for the Future, which it runs in cooperation with the Pennsylvania State University. The program, funded by General Electric, is an online career center for female and minority engineering faculty. WEPAN also launched MentorNet, an online service that links engineering students with professional mentors. The service is open to any student, but emphasis is placed on mentoring women and minorities underrepresented in engineering. So far, the organization says, it has matched 14,000 pairs. Most of the students in those pairs—some 87 percent—are women, as are 68 percent of the mentors.

wanting to make a difference

Rebecca Cohl is a Lockheed Martin engineer who works with her company's outreach programs to encourage girls to consider engineering. She wishes that more girls would be exposed to taking things apart to see how they work. Cohl works with the company's Discover an Engineer program, where volunteers go to classes in grammar and high schools to mentor students and answer their questions.

According to Cohl, women want to work in a field where they feel they are making a difference. That, she says, is difficult to see in working for a defense contractor, for instance, when much of what engineers design is with the hope that it never gets used.

"A teacher or doctor is much more obvious that they are helping," she said. "Engineers also help, but there is



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opportunities for women, so the feedback from parents in this way is very valuable," she said. "I see a correlation between their daughters and the choices they made for higher education in engineering."

having an impact

Knobloch feels that girls need to know their work has value beyond simply having a career and a well-paying job. They don't mind getting their hands dirty, but need to know they have an impact on society in a career that is comfortable for them. Consideration about their life work is vastly different from boys. When girls are

shown that math and science can

give them an opportunity to make a difference to people, they choose engineering readily.

Stephanie Blaisdell, a psychologist who consults in science, technology, engineering, and math projects, said girls do not opt for default careers. In the past decade, they've shown that they are just as academically prepared as boys, their selection of high school courses is similar, they earn similar grades, and they perform as well or better on most tests. She estimates, however, that only 10 percent of graduating high school girls get the opportunity to consider engineering as a choice for college.

Graduate mechanical engineer Pat Sanders teaches math at San Luis Obispo High School. A relatively recent college graduate, Sanders noticed that his engineering classes had few females. In one quarter there was a total of four in all of his major classes.

When he was close to graduation, he looked at ways to put his degree to work and found a serious shortage of math teachers in secondary schools. He applied to teach as a way of encouraging more students to become engineers.

"In my classes today, the female students do as well, if not better than their male counterparts," Sanders said.

There is some indication that major outreach by the Girl Scouts makes a difference. A coed program for ages 14 to 20 has 142 Explorer Posts in the country and mentors 4,000 members at summer camps with working engineers.

The shrinking pool of U.S. engineering graduates puts them into a special employment category. Some are flown to sites to get a special tour to encourage them to sign up before graduation. Helene Finger said that some of Cal Poly's students are signed well before they finish their work for a degree. In her estimation, the most active recruiters are Raytheon, Lockheed Martin, and Northrop Grumman.

somewhat of a mystery about what we do."

Practicing women engineers do not have a common set of circumstances that moved them to enter the field. At consulting firm Cannon Engineering of San Luis Obispo, Calif., Rebekah Oulton took easily to the education. Both her parents are scientists and her own gender never was an issue. She does support the idea that women engineers like to work with something that makes a difference in the world.

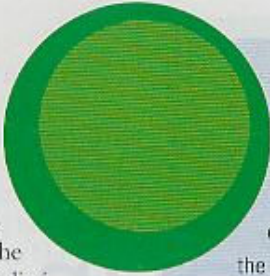
Her work included a massive remediation project for Unocal Corp. consisting of an underground spill of diluent under the Guadalupe Dunes, a pool larger than the Exxon Valdez accident in Alaska. She oversaw the permitting process for the oil company to meet the demands of the site's geology, hydrology, and protected species.

Oulton believes that engineering is still seen as a "geek" profession by the public. She said males may fall into the field because of the pay, but females make a conscious decision to overcome the stigma if they become engineers.

"Ignoring gender is not the answer," she said. "In some of my classes I was the only girl, and without thinking I wore skirts to those classes. I have no idea where that came from, but it did. I taught an environmental class at the college level and was surprised to find only four girls in a class of 34."

There are no easy answers to the complex question of where to concentrate efforts to recruit more women engineers. Cheryl Knobloch, associate director of Women in Engineering at Penn State, believes that parents are the critical link to increasing interest. After five years of concentrated research and outreach on the problem, she sees positive results of some programs, including Penn State's one-week summer engineering camp for high school girls. That improvement came when the school included parents in the experience. During the week the girls are at the camp, parents are invited to a special workshop to educate them about the opportunities for their daughters.

"Most of them are completely unaware of engineering



Patricia Daniels, associate dean of the Department of Electrical and Computer Engineering at Seattle University, has concerns that engineers themselves are not working in the right ways to meet the challenge of finding engineering students, both male and female. "That's an issue for mechanical and electrical, my field, that the message is not getting out about the fact that the discipline does indeed involve significant ways of accomplishing the social, environmental, and health problems."

Daniels said it is critical that students come from the broadest possible spectrum of experience—men and women of all ethnic, social, and racial backgrounds—in order to find the relevant solutions posed for society at large.

better marketing needed

Daniels feels that sometimes engineers themselves don't always make the best spokesmen for their profession. According to Daniels, for many engineers, once they have solved a problem, they have a tendency to think the results speak for themselves.

"That's especially true of MEs," Daniels said. "The kinds of ways an ME affects current problems like fuel cells or sustainable energy are critical and relevant. I think the discipline does not market those important aspects of the profession. Engineers love their work so much they can't imagine others not wanting to do the same."

She believes that the return of young engineers to the classroom as mentors and teachers is vital since students can make a better connection to one who is not many years older than themselves. The school intends to find ways to impart the excitement generated by engineering and endow the next generation with it.

At Seattle University, Daniels is part of an emphasis to meet the challenge by hiring more women faculty as role models. Almost 40 percent of the university's engineering faculty consists of women.

In its annual report on engineering education, the American Society of Engineering Education illustrates the coming years of continuing decline for women engineers in the country. Michael Gibbons, director of data research for ASEE, said the numbers of women students at the graduate level are up 19.7 percent. At the same time, undergraduate numbers are down 17.5 percent.

His research shows that women are entering the newer disciplines, such as biomedicine, agriculture, and environment, in greater numbers. Also, more women are opting for graduate degrees, which will lead to increased representation as faculty mentors.

Gibbons finds that many people are concerned about how the image of engineers is projected to young people and their parents. "We don't talk enough about the benefits of what engineers accomplish," he said. With women expressing interest in how they can benefit society, he feels image is vital to attracting them to engineering. Potential students need to recognize that iPods, bicycles, school buses, backpacks, or even Hershey's Kisses would not be available without the work of an engineer. ■

a national academic initiative

The U.S. National Academy of Engineering has embarked on a five-year project aimed at helping the engineering profession improve its image among young women. According to Catherine Didion, the NAE's senior program officer for diversity, the target audience consists of female students in sixth grade through the end of sophomore year in college, when most students have chosen academic majors.

The project, the Engineering Equity Extension Service, has received funding of \$2.5 million over five years from the National Science Foundation. It is administered by Norman L. Fortenberry, director of the NAE's Center for the Advancement of Scholarship on Engineering Education, with collaborating organizations including ASME, IEEE, Project Lead the Way, and the National Alliance for Partnerships in Equity.

Project Lead the Way is an organization that is devoted to creating partnerships among public schools, engineering schools, and the private sector to promote and advance the field of engineering.

The National Alliance for Partnerships in Equity is composed of state and local agencies, corporations, and national organizations working to establish equitable and diverse classrooms and workplaces.

ASME and IEEE were chosen as partners because their respective arts of mechanical and electrical engineering are two of the largest engineering disciplines in terms of numbers of college graduates while they have two of the lowest percentages of female graduates. Thus, through these organizations, the project has the opportunity to make a significant impact on the recruitment and retention of students in these fields.

The partners already conduct programs for students, teachers, and faculty, and influence the way their disciplines are taught in colleges and universities.

"They are already involved in engineering education," Didion said. "Rather than create a whole new structure, we plan to work with organizations to address gender equity." Representatives of the program, for instance, will offer to study the organizations' materials for gender bias of signals that may misrepresent the field to women.

Didion's group has begun to identify what she calls "a cadre of experts" in various gender-related areas, such as retaining baccalaureate students. Their expertise will be made available through various channels—webinars, training meetings, conference calls, and the like.

For more information on the project, contact Amy Bentow at bentowa@asme.org or Catherine Didion at cdidion@nae.edu. The project has a Web site at <http://eees.nae.edu>.

