Stephanie Kwolek
One Who Aspired, Advanced, and Achieved

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FEATURES

20 What We Really Did after the War
Esther Conwell, Barbara Johnson, and Mary Ross were among the women who gained a foothold in science and engineering during World War II and went on to pursue stunning careers. All three made significant contributions, but because a large portion of their work was classified, they experienced a delay in professional recognition.

28 Stephanie Kwolek: One Who Aspired, Advanced, and Achieved
While her best-known contribution, Kevlar®, has been a household word for decades, less has been known about the inventor, Stephanie Kwolek. A trailblazer whose determination and accomplishments can inspire women of all ages, Kwolek, now in her 90s, is set to receive another accolade.

Cover image: Kevlar fibers woven into material. An aramid compound, Kevlar can be spun into threads five times stronger than steel. Credit: Sinclair Stammers / Photo Researchers Inc.

32 Second-Generation Bias: A Subtle but Powerful Presence
The first generation of bias toward women in the workplace was expressed blatantly and consciously. Conversely, second-generation gender bias is often difficult to identify and manifests in subtle — and sometimes unintentional — ways that undermine women’s confidence and progress.

38 Literature Review
While examining more than 100 publications to compile SWE’s annual review of literature on women in engineering and other STEM fields, the authors uncovered interesting new findings that offer fresh insight on familiar research questions, or pose new questions. Among the studies were a number devoted to the examination of “pipeline” issues, women engineers in the workplace, and essays and research articles that presented a feminist critique of engineering.
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As part of a global Caterpillar team, I’ve had the opportunity to work on numerous exciting projects, from designing a waste water treatment facility in China to managing a team that is developing cleaner emission engines. I have not only felt appreciated for my contributions, but also that I’ve been able to make a difference in the world.
“Writing women back into history” has been the underlying theme of both Women’s History Month and the National Women’s History Project since its inception more than 30 years ago. While this sentiment addresses the overall status of women in history books and in contemporary society, for women in science and engineering, issues of visibility and invisibility have been even more acute. To varying degrees of success, remedies have been and continue to be implemented to address this lack of visibility. Despite these efforts and regardless of their effectiveness, however, there is one category of women whose contributions will remain unseen for years—decades, even—in spite of their significance. These women work in areas deemed classified.

Meredith Holmes’ article, “What We Really Did after the War,” examines both the Cold War era and the work of three SWE members from that time whose contributions were classified and, therefore, professional recognition came later in their careers. The Cold War years are typically thought of as a period when women in the United States did not work outside the home and were content with narrowly defined gender roles, hence, their invisibility.

Inspiration for Holmes’ story came in part from a discussion several years ago with some of the “old guard,” the most senior members of the Society. At a gathering in the “Over the Hill” suite at the annual conference, it was casually mentioned that Mary Ross, an early SWE member, was unable to be nominated for the SWE Achievement Award because her work could not be made public. It certainly seemed that there must be a fascinating story behind this, if it could be unearthed. How instructive, then, to discover in the course of our research, that much of the work she did more than six decades ago remains classified to this day. While we can’t provide the full picture of Ross’ significant contributions, we can provide a window into some of it. Turn to page 20 for an insightful look both at the Cold War era and the contributions of Ross, Esther Conwell, and Bobbie Johnson.

In a similar vein, our cover story recognizes Stephanie Kwolek, inventor of Kevlar®. Her invention is pretty much a household name, but as the figure behind the fiber that makes bulletproof vests and fire-resistant fabric, Kwolek remained relatively unknown and unrecognized until fairly recent years. Please see Charlotte Thomas’ article, “Stephanie Kwolek: One Who Aspired, Advanced, and Achieved,” on page 28.

Blatant discrimination is usually identifiable and therefore can be addressed. In Sandra Guy’s article, “Second Generation Bias: A Subtle but Powerful Presence,” scholars examine the biases that are not explicit, necessarily conscious, or deliberate, yet remain powerful forces in the workplace. These cultural and organizational biases can be debilitating to a woman’s career and self-esteem, but as the article maintains, they can be challenged through education and the accumulation of small “wins” in the workplace. Turn to page 32 to learn more.

Certainly, much has changed over the decades since SWE was founded in 1950, and the status of women in engineering and the STEM professions has improved. When compared with other professions that historically were male-dominated, however, engineering lags behind law and medicine. The reasons for this are not entirely clear, and have been the subject of much research. This year’s annual review and analysis of the social science literature on women in STEM sheds light on the situation, and begins on page 38.

Here’s to Women’s History Month, and writing women back into history.

Director of Editorial & Publications
anne.perusek@swe.org
Status Update: SWE Social Media Notes and News

The Society of Women Engineers is a multifaceted community offering resources for women in engineering from college to retirement and beyond. As such, our online community comprises a dynamic group of engineers, employers, and organizations offering perspectives on thriving in the workplace while maintaining balance with your leisure-time pursuits and personal responsibilities.

From the Winter issue of SWE Magazine, the article “Finding Alyce Hall: Top Secret Rosie” generated numerous “likes.” This compelling story of the only known African-American woman to participate in ballistics calculations program during World War II remained unknown. The follow-up to “The Top Secret Rosies of World War II: America’s Secret Weapon” (SWE, Conference 2013) issue is as much a story of discovery as it is a celebration of accomplishment. With the help of a faintly penciled name on the back of a photo, the contributions of not one, but two, extraordinary women - sisters — have come to light.

Engineers Week year-round. The chat received more than 1 million impacts on Twitter. In March, the #AskSWE tweet-chat will celebrate Women’s History Month, and the theme of April’s session is your favorite outreach resource. The tweetchats take place the third Friday of every month at noon Central Time.

In February, Facebook crossed the momentous milestone of 20,000 “likes” and continues to grow daily. The most popular item to ever appear on Facebook was posted in January: A graphic representation of a quote President Stacey Erickson’s documentary featured twin sisters, Doris and Shirley Blumberg, who had a common interest in mathematics and were recruited as “Top Secret Rosies.” But they weren’t the only pair of mathematically talented sisters involved in Philadelphia’s war effort. Alyce Hall had a sister, too.

DelVecchio gave a newspaper reporter more than 60,000 views.

Facebook is a natural extension of the power of SWE’s networking benefits, which is evident when members ask for advice or guidance. For example, Laura H. had a question about a postsecondary program for an undergraduate engineering student who wants to be a software engineer. More than 50 users chimed in with thoughts on programs and schools that leveraged the student’s interests in liberal arts. Likewise, when Cassandra M. needed help finding a mechanical engineering program in English in Europe, more than 30 Facebook users suggested programs for her to investigate.

The new SWE Magazine blog also is catching on via social media. Visit www.SWE.org/magazine to read the story behind the story. Get an inside look at your favorite articles and learn what inspired and challenged our editorial staff.

Traditionally, the Readers Forum has provided an opportunity to respond to articles or comment on topical issues. Communications are printed on a space available basis; we reserve the right to edit for clarity or to meet space requirements. All opinions are those of the writer and in no way the responsibility of the Society of Women Engineers or SWE Magazine.

Send comments, opinions, or observations to swemag@swe.org or by regular mail to: Letters, SWE Magazine, Society of Women Engineers, 203 N. La Salle St., Suite 1675, Chicago, IL 60601.

Yet another way to engage with the material in SWE is through the Society’s social media — Facebook, Twitter, LinkedIn, and Tumblr. Social media is a space that allows like-minded individuals a way to discuss issues and contribute to the conversations started in SWE Magazine.
As part of our team, you’ll help solve some of engineering’s biggest challenges. Like how to operate safely at 30,000 feet down. How to unlock natural gas from dense shale. And how to extract heavy oil. You’ll join a team with the technology to take on big challenges, the integrity to do it responsibly, and the drive to keep the world moving forward.

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The Legacy of the First ICWES

This year marks the 50th anniversary of the first International Conference of Women Engineers and Scientists. Sponsored by SWE and held in New York City in 1964, the conference will return to the United States this fall, in conjunction with WE14 in Los Angeles.

By Anne M. Perusek, SWE Director of Editorial and Publications

The first meeting of its kind to be attempted on a global scale, the International Conference of Women Engineers and Scientists I was an ambitious and forward-looking undertaking. This first meeting became the genesis for many more international gatherings, spaced approximately three years apart, and hosted by women engineers and scientists in countries across the globe. By 2002, when ICWES XII was held in Ottawa, Ontario, it had become clear that a more formal structure was needed, and the International Network of Women Engineers and Scientists (INWES) was formed.

“Great oaks from little acorns grow”

In telling the story of ICWES I, the Society’s first executive secretary, Winifred (Winnie) White, pointed to a pivotal moment in August 1958. White’s role was the forerunner of today’s executive director and CEO, and so it was from that vantage point that she recalled the following:

“Great oaks from little acorns grow” was never more apropos than it is to express the First International Conference of Women Engineers and Scientists. Our little acorn emerged from obscurity on Saturday, August 9, 1958. The board of directors was in session with Catherine Eiden presiding as president and several New York Section members listening in. From someone’s hand a scrap of paper was passed to the other hands and the question of a SWE annual convention to be held in New York was raised. This was to include an international conference, and be held at the time of the World’s Fair. The following day, the board voted yes.

From that day, momentum was established. Various committees were formed, a grant was received from the National Science Foundation, and contributions from industry helped to fund the volunteer effort. In that pre-Internet era, logistics and communications posed challenges that were met with determination and dedication.

Aileen Cavanagh was president of the then-14-year-old Society of Women Engineers when ICWES took place. Putting the event into context, she later wrote:

“June 15, 1964. Will anyone who was there ever forget that day? Five-hundred twenty-nine people from 39 nations found their way to the opening of a technical program called Focus for the Future at the United Engineering Center in New York City. ... But this was no ordinary meeting. As best (we) know, it was the first international meeting of technically trained women and as such was unusual in 1964.”

Indeed, the atmosphere was one of optimism. With the 1964 World’s Fair as a backdrop, a White House administration that supported scientific and technological advancement, and an attendance of more than 500, for the women gathered that day, the future for women in science and engineering looked promising.

Cavanagh’s reflections on the significance of the time and of the gathering also included this important moment in the history of civil rights:

“Younger readers may not appreciate the setting: 1964 was the year of the passage of the law that prohibited discrimination in employment on account of gender in the United States. In those days, ... corporations divided their personnel organizations into male and female departments.”

Capping the event

Traditions familiar to SWE annual conference participants were a key part of ICWES I. Conference sessions covered technical topics such as transportation, energy, pollution, and the environment, as well as communications. The keynote speaker was Lillian Moller Gilbreth, Ph.D., the “first lady of engineering.”

Receiving the Achievement Award was Rear Admiral Grace Murray Hopper, author of the first computer compiler and of the computer language COBOL.

The resounding success of this first conference paved the way to many subsequent ICWES meetings. The second one, ICWES II, was hosted in the United Kingdom at Cambridge University in 1967. And so it has continued, sustained over nearly five decades by the energy and enthusiasm of women around the world, and always supported by a delegation of SWE members. The most recent ICWES (ICWES 15) took place in Adelaide, Australia, in 2011. Marking 50 years of significant growth for women in STEM, this year ICWES returns to the United States, meeting in Los Angeles in conjunction with WE14. Together, ICWES 16 and WE14 will help create positive change for women in science and engineering.
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The International Gender Summit aims to make gender equity and diversity key aspects of research, innovation, and policymakers worldwide. The Society of Women Engineers (SWE) helped to bring the Gender Summit to North America for the first time.

Hosted by the U.S. National Science Foundation, the summit took place Nov. 13-15 at the Washington Hilton Hotel in Washington, D.C., so that engineers, scientists, academics, policymakers, funders, and members of nongovernmental organizations could establish a plan to realize their goals. The first two summits focused on the European Union and were held in Brussels. Following the North American Summit, the next one will be held again in Brussels this summer.

Wanda E. Ward, Ph.D., head of the National Science Foundation's Office of International and Integrative Activities, said the summit's theme, “Diversity Fueling Excellence in Research and Innovation,” pinpointed the need to ensure the highest and best in research and innovation by “fully including women and a diversity of people.” Alluding to the present state of gender diversity, Dr. Ward said that “though tremendous progress has been made in women’s advancement in STEM (science, technology, engineering, and mathematics), we have a very, very long way to go.”

Betty Shanahan, CAE, F.SWE, past executive director and CEO and SWE’s member of the planning committee, said the summit was especially valuable because of the 650 attendees’ expertise. “The participants will be instrumental in developing positive and lasting change toward greater diversity in the STEM workforce and STEM leadership, and toward greater inclusion of a gender dimension in research content and process,” she said. In addition to bringing expertise, participants hailed from 35 countries, offering diverse global perspectives and contributing to the depth and breadth of the discussion. The goal is to ensure the full participation of both genders and to eliminate gender bias throughout processes driving the STEM research and innovation continuum.

Biomedical research, to ensuring inclusion in peer reviews and merit reviews, to addressing the needs and means of progressing women of color.

SWE President Stacey M. DelVecchio, engineering talent pipeline manager for machines and engine maker Caterpillar Inc., based in Peoria, Ill., participated in a panel discussion about recruiting, hiring, and developing women engineers in the workforce. “Our research shows it’s more important to make sure you are an attractive employer” by giving employees constant challenges that are suited to their skills, DelVecchio said. Caterpillar, for example, rejects a cookie-cutter approach by offering a suite of programs for new hires to enter, based on their skills, interests, and ambitions.

“The key is to show diversity — that there are people who look like them in the workforce — and that they will get to work on innovative projects and products and have a say in the work they do,” DelVecchio said. The efforts must start at the top, she said, noting that eight of Caterpillar’s 30 vice presidents are women. Such diversity isn’t simply the right thing to do; companies can be shown that they benefit from more inclusive and impactful research, industry practices, and conceptual work as a result, she said.

The summit, which featured leaders from Canada, Mexico, the United States, and throughout the world, included multinational perspectives on important topics such as:

- A focus on opportunities and challenges for women of color in STEM
- Early career development
- Career/life balance
- Creating and sustaining networks
- Fostering interdisciplinary careers
- Recognizing women in critical
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The summit’s sponsors, in addition to NSF, were the Natural Sciences and Engineering Research Council of Canada (NSERC); the National Council for Science and Technology of Mexico (CONACYT); the U.S. National Institutes of Health; the Canadian Institutes of Health Research (CIHR); and Portia Ltd., U.K.

In addition to addressing shortcomings, the summit also celebrated successes.

“I cannot emphasize enough the very high level of enthusiasm and engagement at the summit,” Dr. Ward said. “We were very pleased with the high caliber of science research and training from all of the participants, including researchers, policymakers, and postdoctoral fellows and graduate students.”

Those included undergraduate and graduate STEM majors, as well as NSF American Association for the Advancement of Science (AAAS) fellows and postdoctoral fellows representing NSERC.

Among the keynote speakers were Valerie Jarrett, senior advisor to President Obama and chair of the White House Council on Women and Girls; Julie Payette, chief operating officer of the Montreal Science Centre and vice president of Canada Lands Co. and a former NASA/CSA astronaut; and Isabelle Blain, vice president, research grants and scholarships for the National Sciences and Engineering Research Council of Canada.

Dr. Ward described the key messages of the summit:
- Gender issues in science have a rightful place at the top of intellectual and policy concern
- Among researchers of both genders, there is sufficient talent, understanding, financial and intellectual capacity; and a community of support to ensure evidence-based policies and actions
- Standard “good” research practice should ensure women’s advancement in STEM and an equal place or leadership role in science knowledge-making, including policymaking and industry and higher education leadership
- The roadmap from the summit will be rolled out at the next meeting in Brussels in June. The roadmap will recommend:
  - A need to ensure the elimination of gender discrimination in STEM employment practices, including attention to career/life balance issues with support at the policy level
  - Inclusion of a gender dimension in the process and content of research. This includes raising awareness of concerns as they relate to agency practices, such as merit review and decision making.
  - The need to establish and promote programs and policies to encourage and sustain women’s participation in STEM education and employment
  - A multinational collaboration with the European Commission’s Horizon 2020 initiatives and others to address gender imbalances across an array of technical areas, ranging from transportation to food security to biomedical research to climate-change research.

Nancy Cantor, Ph.D., chancellor at Rutgers University in New Brunswick, N.J., and a member of the steering committee, said, “People are increasingly understanding that diversity contributes; we can’t afford to leave behind a huge proportion of our talented workforce. So there’s a push in STEM fields to diversify.

“We need to get everyone on board that diversity is key to excellence of research and the ability to compete globally,” Dr. Ward explained. “It’s partly the old-fashioned consciousness raising and partly a function of trying to create very diverse problem-solving pools and education and commitment — making sure the professoriate is diverse, that we collaborate with community and industry, and that we start young in grades K-12 to encourage girls and women to go on in STEM fields.”

Elizabeth Pollitzer, Ph.D., director of Portia Ltd., said the three-day conference left participants wanting more. “It shows how much there is to say” about the issues, she said. “The summit is truly filling a gap.

“This will be a model for other regions that will host summits in the future,” Dr. Pollitzer said, noting that the attendees helped shape the roadmap, and were critically important in bringing the latest research before scholars, scientists, engineers, and policymakers.

Two regional summits are planned in 2015: One will be held in South Korea in the spring of 2015, in collaboration with WISET, the Centre for Women in Science, Engineering and Technology. The second summit will take place in Cape Town, South Africa, in collaboration with the Human Sciences Research Council, South Africa.

Every other year, the summit will return to Brussels. The Asia-Pacific rim is eager to do a subsequent summit, and Canada has committed to bringing it back to North America in 2017, Dr. Ward explained.

“Gender equity needs to be front and center in 21st century STEM,” Dr. Ward said. “We must empower women in science, then leverage the diversity of thought for greater discovery and innovation.

“Expanding the gender summit is an effective means to share sustainable strategies worldwide.”
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A Call for Inclusion
Supporting the diversity of the profession and broadening participation in engineering are dual goals that will help transform STEM disciplines.

By Seabright McCabe, SWE Contributor

“It’s funny, those of us who are in the field don’t think about the fact that five out of 10 people don’t know what the word STEM (science, technology, engineering, and math) means. So it was a huge thing when the president called it out in his speech,” Bevlee Watford, Ph.D., P.E., said.

“Unfortunately, the problem exists from K-12 through postsecondary education. And, at the end of the day, we are still looking at significantly low numbers of women in most engineering fields. In many cases, we’ve eliminated the overt actions that cause women to move away from engineering, but there are still issues in both the educational and the professional systems. The climate is slow to change — and I mean real change, not surface change.”

Dr. Watford is the program director for Broadening Participation in Engineering (BPE) in the Engineering Education and Centers Division of the National Science Foundation (NSF), but spoke from her experience as director of Virginia Tech’s Center for the Enhancement of Engineering Diversity. “We have a pipeline problem,” she said. “There are issues with students who are ill equipped to pursue engineering disciplines. Their educational background does not provide the content they need to succeed as undergraduates, or even to be admitted to a program. There are real barriers for all students, but I think women are impacted because we’re still trying to ‘climb out of a hole,’ while the guys were never in the hole to begin with.

“Two additional barriers that we’re dealing with now are the financial burden of earning a postsecondary education and the preparation for engineering,” she continued. “We’ve really got to reach back and solve that. On the positive side, we’re starting to see more attention to science content in the K-12 arena, which we hope will improve student preparation and excite them about engineering.”

In keeping with the administration’s push toward a better-prepared workforce, the NSF (and BPE specifically) is charged with implementing significant efforts in transforming the educational system for engineers, not just in building better content, but also in extracurricular activities that promote student participation, shaping “the whole engineer.”

Dr. Watford’s main focus is on the faculty end of the pipeline, but K-12 and postsecondary initiatives are also on the table. “We deliberately made this call very open to ideas that will increase the participation of any underrepresented group.

“The BPE program has had a number of workshops that focus on graduate students and faculty development,” she continued. “I’m looking to see some broader, more innovative proposals coming from the engineering community. I really want to encourage organizations
such as SWE that are in STEM but focused on diversity to participate in our programs and submit proposals for projects. I’m very hopeful for that.

“In a wider sense, BPE will work to influence the research-to-practice actions,” Dr. Watford added. “NSF has funded excellent research that addresses underrepresentation and poor retention. The next big step is to actualize that research in classrooms and institutions. We’ve done a lot with how we teach students, developing more inclusive pedagogies. These ideas have been tested and assessed, and now we need to get them going on a larger scale than what we currently see.”

The BPE program consists of two tracks: the Opportunity Track, which will develop mentoring, networking, and career development activities for individuals who are pursuing or intend to pursue career faculty positions; and the Strategy Track, which will develop and implement research-based strategies that promote a more diverse engineering workforce.

“Strategy tends to be a much broader and larger-scale activity,” Dr. Watford said. “We’re looking at partnerships among institutions and organizations, and not on a one-and-done basis. We want projects that will adapt from an R1 institution to an undergrad institution to historically black colleges and universities, to all kinds of institutions. The implementation and success of a project at one institution must be duplicated with respect to the culture of other locations.”

“I’m looking to see some broader, more innovative proposals coming from the engineering community. I really want to encourage organizations such as SWE that are in STEM but focused on diversity to participate in our programs and submit proposals for projects. I’m very hopeful for that.”

— Bevlee Watford, Ph.D., P.E., program director for Broadening Participation in Engineering (BPE) in the Engineering Education and Centers Division of the National Science Foundation

Dr. Watford stressed that funding is available for projects under the Opportunity and Strategy tracks of BPE, and that the SWE community is encouraged and welcome to apply with proposals or projects that will support diversity and broaden participation in engineering. For complete guidance and information on how to apply, please visit http://www.nsf.gov/funding/pgm_summ.jsp?pims_id=504870.
Over the course of March 5-6, the Society of Women Engineers conducted its fifth annual Capitol Hill Day event, with 37 science, technology, engineering, and mathematics (STEM) and diversity organizations serving as co-sponsors. A cross section of formal and informal leaders from SWE and the co-sponsoring organizations spent the first portion of the event receiving training as they prepared for visits with their congressional representatives the following day.

Preparation and context

A key point from the training and the overall experience of Capitol Hill Day is that congressional visits are the beginning of ongoing dialogues. Expectations of major policy change or initiatives on the basis of one or two visits are, therefore, unrealistic. The purpose of the visit is to establish a point of engagement to build upon.

Preparation for the visits was highly interactive and covered a range of topics, beginning with SWE President Stacey DeVecchio’s welcome, which set the productive tone, followed by Kelly Janowski, SWE’s manager of public relations and social media, providing tips for social media usage. Paula Stenzler, the SWE government relations and public policy (GRPP) chair, and Melissa Carl, SWE’s Washington representative, provided an overview of current public policy issues related to women and STEM, including information on the federal budget and the FY15 federal budget request.

Providing additional insight was Erin Prangley, associate director of government relations for the American Association of University Women. Prangley shared her perspective as a former congressional deputy chief of staff, providing pointers on communicating with Congress.

Betty Irish, SWE’s chair-elect of the government relations and public policy committee, presented talking points for the congressional meetings, conveying the importance of supporting the Education and Human Resources and the Engineering directorates of the National Science Foundation, particularly gender-focused programs such as ADVANCE and Broadening Participation in Engineering. These are programs that the Society, as well as many of the event’s co-sponsors, strongly back.
Communicating perspectives from Congress and the administration were Eric Hammond and Bevlee Watford, Ph.D., P.E. Hammond is the senior legislative assistant for House Science, Space, and Technology Committee ranking member, Eddie Bernice Johnson (D-Texas), while Dr. Watford is the manager of the National Science Foundation's Broadening Participation in Engineering initiative. (Note: See Dr. Watford's interview on pages 16-17.) The day's training representatives Kerry Bentivolio (R-Mich.), Richard Hanna (R-N.Y.), and Aaron Schock (R-III).

**Opening a dialogue**

Breakfast the following morning provided an opportunity for reinforcement of the previous day's material. Speakers included Bess Evans, senior public engagement advisor in the White House Office of Science and Technology Policy, who noted that with the large volume of constituents who visit Washington, it is important that one's message be clear and stand out. Jason Day, Ph.D., senior policy advisor for Rep. Daniel Lipinski (D-Ill.), described a typical workday in a congressional office and shared examples of what being a policy advisor to a member of Congress involves. Paula Stenzler, SWE GRPP chair, gave a final review of talking points. Participants then gathered in small groups to prepare for scheduled, individual visits with their congressional representa-

It's worth noting that because most members of Congress do not have backgrounds in STEM, few are aware that a lack of diversity in these professions is even a problem, let alone one with far-reaching implications.

concluded with role-playing exercises, facilitated by Elizabeth Berman, SWE president elect.

An evening reception was held at the Rayburn House Office Building, providing an opportunity to meet congressional representatives and staffers, and to network with event co-sponsors. Several congressional champions of STEM and diversity-related issues offered remarks, including Rep. Eddie Bernice Johnson, recipient of SWE's 2008 President's Award, as well as representatives. SWE leaders made 42 visits, capping the event.

It's worth noting that because most members of Congress do not have backgrounds in STEM, few are aware that a lack of diversity in these professions is even a problem, let alone one with far-reaching implications. SWE and its partners are well positioned to educate congressional members and staffers on the importance of a diverse and inclusive STEM workforce. Pointing out the advantages of diversity, and its role in increasing innovation and strengthening competitiveness, is one of the core messages conveyed in the visits.

Participants' use of social media increased dramatically from past Capitol Hill Days. It was encouraged during the training as a means of engagement, and evidence of the results are abundant on SWE’s Twitter feed and Facebook page, as well as on Storify. See http://storify.com/SWEtalk/capitol-hill-day-2014 for photos, tweets, and links.
High School Students Recognized for Tech Talent

The NCWIT Award for Aspirations in Computing honors young women for outstanding aptitude and encourages a new generation of technologists.

By Lynda Grindstaff, SWE Editorial Board

The National Center for Women & Information Technology (NCWIT) and Bank of America have named 35 female high school students recipients of the NCWIT Award for Aspirations in Computing, an annual award that recognizes young women for their outstanding aptitude in computing and technology.

The 35 students were selected from among more than 2,300 applicants, representing all 50 states, Puerto Rico, the U.S. Virgin Islands, and overseas military bases. Each recipient is awarded $500 cash, a laptop computer, and engraved plaques — one to keep and one for her school. In mid-March, the young women will be honored at a Bank of America Technology Stars of the Future Showcase and Awards Ceremony in Charlotte, N.C. Additionally, 350 applicants were selected as local affiliate runners-up and are eligible to compete again next year.

In addition to earning cool prizes and recognition, the Aspirations recipients at both the local and national levels have access to scholarships, internships, and a community of like-minded, technical young women. Because the competition recognizes aspirations as well as accomplishments, girls at all levels are encouraged to apply.

Award highlights

The winning entries indicated a sophisticated level of inquiry and understanding. For example, Safia Abdalla, from Chicago’s Northside College Preparatory High School, organized and taught a programming class for high school girls in her hometown of Arbagi, Sudan. She hopes to begin hosting the classes in Ethiopia and Pakistan and expand to other countries. She will also look into the development of an easy-to-use programming language in Arabic (her native tongue) and other languages in order to expand computer science education around the world. Abdalla hopes to pursue a degree in computer science with a specialization in artificial intelligence during college.

Molly Cinnamon of Sherman Oaks, Calif., attends Harvard-Westlake School. She has conducted computational research at the Harvard School of Engineering and Applied Sciences to create an algorithm, which led to a higher success rate of reconstructive surgery, at the UCLA Laboratory of Neuro Imaging. She used data analysis/image processing at the laboratory to help build a 3-D atlas of the mouse brain; and at the UCLA Center for Embedded Networked Sensing to program a smartphone application to encourage recycling. Cinnamon is also an accomplished filmmaker and created a film called “This is Laura” for the NCWIT Aspirations in Computing video competition that addressed the stereotypes of women in technology.

Putting the awards in perspective, Lucy Sanders, CEO and co-founder of NCWIT, said, “With the Department of Labor predicting 1.4 million computing jobs in the U.S. work force by 2020, it’s critical that we capitalize on this untapped talent pool and set these young women on the path to taking a seat at the technical design table.”

In terms of encouraging the next generation, since 2007 the Award for Aspirations in Computing has recognized more than 2,200 young women; more than 71 percent of the recipients currently in college report majoring or minoring in a traditionally male-dominated STEM field. In addition, many recipients “pay it forward” by hosting successful summer camps for middle-school girls through the NCWIT AspireIT program. If you know a talented United States high school woman (grades 9-12) who should apply for this award, stay tuned to www.aspirations.org for details.

“With the Department of Labor predicting 1.4 million computing jobs in the U.S. work force by 2020, it’s critical that we capitalize on this untapped talent pool and set these young women on the path to taking a seat at the technical design table.”

— Lucy Sanders, CEO and co-founder of the National Center for Women & Information Technology

Lynda Grindstaff is an innovation segment manager for Intel Corporation where she leads a team that creates new user experiences and software experiences for stationary computing devices. She is also a member of the SWE Magazine editorial board, a SWE life member, and a recipient of SWE’s Emerging Leader Award.
Congratulations to the recipients of the 2014 NCWIT Award for Aspirations in Computing

- Safia Abdalla, Chicago, Northside College Preparatory High School
- Gabriela Avila, Mission, Texas, Jimmy Carter High School
- Sampurna Basu, Issaquah, Wash., Skyline High School
- Blaire Bosley, Stone Mountain, Ga., Northeast Independent Preparatory Academy
- Samantha Botros, Wichita, Kan., The Doctors’ Schoolhouse
- Logan Brown, Eudora, Kan., Lawrence Free State High School
- Laurel Button, Ballwin, Mo., Mary Institute and Saint Louis Country Day School
- Karina Carvajal, Los Angeles, James A. Foshay Learning Center
- Pooja Chandrashekar, Potomac Falls, Va., Thomas Jefferson High School for Science and Technology
- Molly Cinnamon, Sherman Oaks, Calif., Harvard-Westlake School
- Ananya Cleetus, Pittsburgh, Upper St. Clair High School
- Janay Clytus, Cape Coral, Fla., Mariner High School
- Virginia Cook, New York, N.Y., Trinity School
- Selena Feng, Crozet, Va., Albemarle High School
- Marsha Ghose, New York, N.Y., The Bronx High School of Science
- Anvita Gupta, Scottsdale, Ariz., BASIS Scottsdale
- Patricia Hanus, Fremont, Neb., Hanus Academy
- Hadiya Harrigan, Lebanon, Ohio, The Seven Hills School
- Lauren Hastings, St. Petersburg, Fla., Lakewood High School
- Melissa Ivie, West Jordan, Utah, Copper Hills High School
- Ama Koranteng, New Albany, Ohio, New Albany High School
- Shrinithi Narayanan, Pleasanton, Calif., Amador Valley High School
- Vicki Niu, Portland, Ore., Lincoln High School
- Alisha Saxena, Bellevue, Wash., Interlake High School
- Caroline Schiavo, Berkeley Heights, N.J., Kent Place School
- Genevieve Sertic, Portage, Mich., Kalamazoo Area Math and Science Center
- Sandra Soueid, Port Reading, N.J., Middlesex County Academy High School
- Samantha Speer, Simpsonville, S.C., Southside High School
- Gala Taylor, Durham, N.C., Durham Academy
- Courtney Thurston, Mechanicsburg, Pa., Commonwealth Connections Academy
- Hannah Tipperman, Devon, Pa., The Baldwin School
- Taylor Torres, Los Lunas, N.M., School of Dreams Academy
- Jessica Wang, Austin, Texas, Liberal Arts and Science Academy
- Carolina Zarate, Germantown, Md., Pooleville High School

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Profiles of the 2014 NCWIT Award Recipients

The 35 young women profiled below, all recipients of the NCWIT Award for Aspirations in Computing, have demonstrated talent, determination, and critical thinking skills. Their accomplishments and plans are a hopeful sign toward a more diverse technological work force in the near future, and of emerging technical solutions to a broad array of issues.

Safia Abdalla
Chicago, Northside College Preparatory High School
Abdalla organized and taught a programming class for high-school girls in her hometown of Arbagi, Sudan. She hopes to begin hosting the classes in Ethiopia and Pakistan and expand to other countries. She will also look into the development of an easy-to-use programming language in Arabic (her native tongue) and other languages in order to expand computer science education around the world.

Gabriela Avila
Mission, Texas, Jimmy Carter High School
Avila has accumulated 55 college hours through her school’s partnership with South Texas College. In May, she will receive her high school diploma as well as her interdisciplinary associate. She plans to attend the University of Texas-Pan American for her bachelor’s degree before going on to The University of Texas at Austin to pursue her master’s in computer science/engineering.

Sampurna Basu
Issaquah, Wash., Skyline High School
After participating in the FIRST® Robotics program for some years, Basu wanted to delve into the more theoretical fields of engineering that involved research and innovation. She was able to work at the University of Washington’s Materials Engineering Camp in the same laboratories that were developing synthetic tooth enamel and preservative coatings.

Blaire Bosley
Stone Mountain, Ga., Northeast Independent Preparatory Academy
Prior to national recognition, Bosley received the Georgia regional Aspirations in Computing Award — an accomplishment that gave her the confidence to enroll in advanced placement computer science as a junior. She is now focused on pursuing a double major in chemistry and computer science, after graduating from high school.

Samantha Botros
Wichita, Kan., The Doctors’ Schoolhouse
Botros’ interest in computer technology began in the fourth grade, when she participated in her local LEGO® MINDSTORMS® Robotics Competition. Since then, she has taken crash courses in HTML and C++ from a professor at Wichita State University. She has also participated in the Johns Hopkins Center for Talented Youth fundamentals of computer science course and is active on her robotics team.

Logan Brown
Eudora, Kan., Lawrence Free State High School
As Brown’s interest in computer science grew, she quickly exhausted the computing courses at her school. Determined to expand her knowledge, she taught herself Java from online courses and attended a community college 500 miles away to take additional courses.

Laurel Button
Ballwin, Mo., Mary Institute and Saint Louis Country Day School
Button has been involved in both FIRST LEGO League and FIRST Tech Challenge and worked with several other students to start a computing club for middle-school girls. Last summer she attended an engineering camp at the Missouri University of Science and Technology, where she designed an award-winning robot.

Karina Carvajal
Los Angeles, Calif., James A. Foshay Learning Center
Through Technovation — a global technology entrepreneurship program for young women ages 10 to 25 by the nonprofit Iridescent — Carvajal has developed a mobile application to help with environmental issues. She has also created multiple websites, and because of her work she received a paid internship with website-designer Edlio to work more extensively on website development.

Pooja Chandrashekar
Potomac Falls, Va., Thomas Jefferson High School for Science and Technology
In her first year of high school, Chandrashekar took advanced-placement computer science, and her interest
in computing grew from there. She founded and serves as the director of ProjectCSGIRLS, a national initiative to encourage more girls to actively immerse themselves in technology and computer science. Last summer, she worked as a research intern at The MITRE Corporation in the Nanosystems Group.

**Molly Cinnamon**  
*Sherman Oaks, Calif., Harvard-Westlake School*  
Cinnamon has conducted computational research at the Harvard School of Engineering and Applied Sciences to create an algorithm, which led to a higher success rate of reconstructive surgery, at the UCLA Laboratory of Neuro Imaging. She used data analysis/image processing at the laboratory to help build a 3-D atlas of the mouse brain; and at the UCLA Center for Embedded Networked Sensing to program a smartphone application to encourage recycling.

**Ananya Cleetus**  
*Pittsburgh, Upper St. Clair High School*  
Cleetus has participated in competitive robotics with FIRST LEGO League, FIRST Robotics Competition, and MIT-NASA Zero Robotics. She’s been a part of the FIRST Robotics team both at Carnegie Mellon as part of its “Girls of Steel,” and for the Sarah Heinz House team, sponsored by the Boys and Girls Club. Cleetus has also been working to develop a prosthetic leg for disabled, low-income people in India.

**Janay Clytus**  
*Cape Coral, Fla., Mariner High School*  
Clytus is involved in CyberPatriot, a high school cyber defense competition created by the Air Force Association, at her school, where they “reverse-engineered” a computer. She attended the USC Principles of Engineering Design competition and is very involved in her school’s FIRST Robotics team, of which she is the captain. Clytus plans to pursue engineering in college.

**Virginia Cook**  
*New York, N.Y., Trinity School*  
Cook has participated in the Johns Hopkins Center for Talented Youth online program, where she learned Java. That course set her up for a successful intro to a computer science course and, subsequently, she has been asked to speak at a Python conference in New York; interned at a ground-zero start-up called Clickslide; participated in two college hackathons; and started her own hacking club at her school.

**Selena Feng**  
*Crozet, Va., Albemarle High School*  
Feng joined the University of Virginia’s FIRST Robotics Competition team, and Albemarle High School’s FIRST Tech Challenge team, where she is currently the head programmer. She competed in the CyberFoundations competition last year and placed first in the Computer Science Division at the Virginia Piedmont Regional Science Fair, in addition to receiving the Intel Award for Excellence in Computer Science for her project, “A Novel Solution to the Traveling Salesman Problem.”

**Marsha Ghose**  
*New York, N.Y., The Bronx High School of Science*  
Last summer, Ghose attended a Girls Who Code event and developed games, mobile apps, and websites. She is also involved in the all-girls FIRST Robotics team at her school, serving as team captain. Ghose and her teammates have presented at the World Science Festival and the Maker Faire to inspire more young women to become interested in technology.

**Kira Gobes**  
*Holliston, Mass., Advanced Math and Science Academy Charter School*  
Gobes has taken advantage of the technology courses offered at her school. Through one such class, along with a partner she created her own Android™ phone application. She and her partner were invited to the MIT App Inventor Summit to present their app. Gobes has also participated in the Technovation Challenge and is a founding member of a student-run program called GEMS (Girls Excelling in Math and Science).

**Anvita Gupta**  
*Scottsdale, Ariz., BASIS Scottsdale*  
Gupta has been involved in FIRST Robotics and placed second in Arizona State University’s robotics summer camp. She took a graduate-level online course offered by Stanford on robotics in order to learn the latest technologies. Gupta has interned in the IT and marketing department at Phoenix Computer Academy and has received awards from the U.S. Army; Sigma Xi, the Scientific Research Society; the Arizona Science and Engineering Fair; the Intel International Science and Engineering Fair; the Siemens Competition; and the Arizona Governor’s Future Innovator of the Year for her work in bioinformatics on pancreatic cancer.
**Patricia Hanus**  
*Fremont, Neb., Hanus Academy*

At HackMIT 2013, Hanus and her team worked on a project that added local server-side encryption to their Dropbox accounts. With projects ranging from using robotics to improve surgical resident training to examining the genetics of ground ivy, using technology has helped Hanus to make real scientific contributions. Eventually, she hopes to work as a software engineer or an electrical engineer.

**Hadiya Harrigan**  
*Lebanon, Ohio, The Seven Hills School*

Harrigan participated in the E3 Summer Institute at the University of Cincinnati, Black Data Processing Associates, an internship at Withrow University High School, and programming I and II. In both middle school and high school, she received the Frederick Hauck Scholarship for commitment and achievement in the fields of mathematics and/or science.

**Lauren Hastings**  
*St. Petersburg, Fla., Lakewood High School*

Hastings’ interest in technology began in middle school when she took a Web design class. She is passionate about programming languages and has learned Java and C# in school and independently studied JavaScript, C, C++, Ruby, Python, and Haskell. She is captain of her high school’s programming team, president of Mu Alpha Theta, and captain of her school’s debate team.

**Melissa Ivie**  
*West Jordan, Utah, Copper Hills High School*

Ivie programs microchips and shield systems to work with electronic devices, as well as website interfaces to support these projects. Her efforts have paid off in awards from several Intel International Science and Engineering Fairs, as well as scholarships and awards from Elphel Inc., the Society of Professional Engineers, XMission, the U.S. Air Force, the CI-Water Project, and other organizations. She has received two different scholarships to attend programming camps at the University of Utah.

**Ama Koranteng**  
*New Albany, Ohio, New Albany High School*

As part of her school’s Robot Theater group, Koranteng helped program a Bioloid® robot to act alongside humans in a series of comedic plays for middle- and high-school students. As part of her chemical engineering research under Ohio State University graduate students, Koranteng developed synthetic hemoglobin-based oxygen carriers to further studies in transfusion medicine.

**Shrinithi Narayanan**  
*Pleasanton, Calif., Amador Valley High School*

Narayanan is a member of her high school’s robotics team, which placed sixth in the Association for Unmanned Vehicles Systems International competition and was the top high school team against a variety of colleges. That same year, she also participated in the Technovation Challenge by Iridescent. Narayanan is interning with the California Scholarship Federation to make new registration forms and databases and to create mobile apps for club members.

**Vicki Niu**  
*Portland, Ore., Lincoln High School*

Since her first year of high school, Niu has competed in the FIRST Tech Challenge robotics program. Her robotics team has focused on how to combat unreliable sensor technology. She experimented with Monte Carlo localization, using Kalman and particle filters. This research culminated in a paper presented at the 2012 Pacific Northwest Software Quality Conference, on which she was first author. The summer before her junior year, Niu was able to utilize technology and computing in a summer internship researching atmospheric methane concentrations in Portland.

**Alisha Saxena**  
*Bellevue, Wash., Interlake High School*

To understand hardware-software interactions, Saxena attended a robotics class at the University of Washington and an undergraduate-level microprocessor programming class at Stanford University, receiving top grades and accolades in both. Her strong background in computer science and technology helped her land a summer internship at NASA’s Ames Research Center the summer of 2012. Working at NASA’s IT Security Division, her research article on WiFi security was published on the front page of NASA’s quarterly newsletter.

**Caroline Schiavo**  
*Bellevue Heights, N.J., Kent Place School*

Schiavo participated in iD Tech Camps, a summer program, where she took courses in programming in C++ and programming — iPhone® and iPad® Apps in Xcode. Toward the end of the course, she created a multiple-choice Latin quiz app. Schiavo also had a summer technology internship in the tech department at her school, where she reimagined computers, updated software, configured computers through a generated image, took inventory of new computers, and retired the old ones.

**Genevieve Sertic**  
*Portage, Mich., Kalamazoo Area Math And Science Center*

Last summer, Sertic developed a PC game aimed toward younger children to teach them about positive environmental practices in an interactive setting, and started her own
business. She is a recipient of the American Computer Science League Outstanding Achievement Award, a four-time state finalist in Science Olympiad, member of the Technology Student Association TEAMS state champion team (Division 2), and a 2013 Siemens Competition semifinalist.

**Sandra Soueid**  
*Port Reading, N.J., Middlesex County Academy High School*  
Soueid gained a lot of experience in software engineering through her FIRST Tech Challenge robotics team. She enlisted in the NYU Polytechnic School of Engineering’s Cyber Security Awareness Week challenge — a “hacking” competition using a Linux® platform (CERT Fedora) and Linux commands. The most important technological project she is working on is the building of an automatic wheelchair brake called SwiftStop. The current design schematic consists of an Arduino Uno microcontroller board connected to reed switch sensors, an accelerometer, and the motors to power the brake made of TETRIX® pieces and custom metal.

**Samantha Speer**  
*Simpsonville, S.C., Southside High School*  
Speer collaborated on a project to build robots, including a robot named SAM Sr. Speer helped to develop a control system for SAM Sr. on an Android™ phone. She helped design another app that controlled a smaller robot, as well as a flashcard app, and a calculus quiz app. She has taken AP computer science and is the co-president of the Southside Automated Machines Team (SAM Team).

**Gala Taylor**  
*Durham, N.C., Durham Academy*  
Taylor has competed on five FIRST and Google XPRIZE robotics teams; participated in the Program in Theoretical Computer Science with the Center for Computational Intractability at Princeton University; and taught computer programming to middle- and high-school students in her community as part of her Shodor Education Foundation computer science apprenticeship and internship. She has contributed open-source code during the Google Code-in competition, and researched and designed a water-from-air harvesting device for ExploraVision. She had a booth on “3D Printing for the Maker in You!” at the 2013 Maker Faire North Carolina.

**Courtney Thurston**  
*Mechanicsburg, Pa., Commonwealth Connections Academy*  
Thurston is currently an intern for Miyagi, a math software startup that teaches kids how to solve linear multistep equations through dance. She also works as the release manager for OpenHatch, a nonprofit dedicated to matching prospective free software contributors with communities, tools, and education. Thurston has participated in the FIRST Robotics programs for several years as team lead, public relations lead, and programming lead, and has participated in the Real World Design Challenge.

**Hannah Tipperman**  
*Devon, Pa., The Baldwin School*  
Tipperman is co-founder and co-captain of her school’s VEX Robotics team, and has joined both FIRST Robotics and FIRST Tech Challenge teams. Tipperman has started a nonprofit organization called Robot Springboard, which helps children, who may otherwise not have the chance, to become involved in STEM. In June 2013, Robot Springboard ran a robotics camp in Homer, Alaska, and in August held a technology camp at Drexel University, funded in large part by an NCWIT AspireIT grant.

**Taylor Torres**  
*Los Lunas, N.M., School of Dreams Academy*  
Torres is currently taking a college course in computer science at the University of New Mexico. For the past three years, she has been involved in the robotics program at her school, competing in several competitions, including BEST Robotics and FIRST Robotics Competition Botball®. She has also been in charge of programming for the iRobot® Create®. This year, she is involved in the following competitions: Supercomputing Challenge, the Intel International Science and Engineering Fair, and Lemelson-MIT InvenT-teams, and has participated in the Science Olympiad.

**Jessica Wang**  
*Austin, Texas, Liberal Arts and Science Academy*  
Wang is captain of the Science Olympiad team and president of the Math Club at her school and helped start a girls computer science club called CiSters. She plans to pursue a career in STEM and is intrigued by the interdisciplinary fields, such as bioinformatics, that seamlessly meld computer science, math, and science. Wang has been recognized as a 2011-2012 Siemens Competition regional semifinalist and a 2013 Intel International Science and Engineering Fair finalist.

**Carolina Zarate**  
*Germantown, Md., Poolesville High School*  
Zarate is a senior in her school’s science, math, and computer science magnet program. Within the past several years, she has developed an interest in cyber security and digital forensics topics, subsequently becoming involved in several national- and international-level competitions in these areas. Last summer, she conducted research in digital forensics in the Digital Evaluation and Exploitation Laboratory for the Naval Postgraduate School and the Department of Defense.

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What We Really Did After the War

History is complicated. It’s a mix of contradictory influences and thousands of untold stories. Now that we have some distance from the Cold War era, historians are beginning to examine the many social forces at work in those tense and uncertain times.

By Meredith Holmes, SWE Contributor
Following the end of the Berlin blockade, a banner in the Communist sector proclaims: "The sector of liberty greets all those who fight for law and freedom in the Western sector." In the foreground is a sign indicating the exit of American territory.
Historian Laura Micheletti Puaca, Ph.D., has posed these same questions. She is assistant professor of history at Christopher Newport University and co-director of the program in Women’s and Gender Studies. Dr. Puaca earned her doctorate in U.S. women’s history from the University of North Carolina at Chapel Hill. When she was an undergraduate at Douglass College, Rutgers University, pursuing a double major in women’s studies and history/political science, Dr. Puaca’s senior honors thesis was on the war’s impact on women who attended Douglass College. “In the course of doing that research,” she said, “I was amazed at the number of stories detailing the recruitment of women into scientific and technical fields during the Second World War.”

In graduate school, Dr. Puaca investigated how this recruitment happened and who was involved in it. She found that, while government planners and policymakers were instrumental, so were some well-known and highly respected women’s education advocates, such as Virginia Gildersleeve, Ph.D., dean of Barnard College, and Lillian Moller Gilbreth, pioneering industrial engineer and SWE’s first honorary member. Dr. Puaca said, “During WWII, these female reformers and professionals made the argument that the war effort demanded full-scale mobilization of women, and that they should be recruited into the masculine fields of science and technology as a defense measure.”

This strategy, or what Dr. Puaca calls “technocratic feminism,” was also used in the postwar years by women scientists and engineers. As she pointed out, many of the technocratic feminists of this era, including a large number of SWE’s founders and early members, were trained during WWII or “got their first big break” in the engineering profession under the government-sanctioned war effort to recruit women. They did not want to give up the gains...
WHAT WE REALLY DID AFTER THE WAR

they had made, and they learned how to take advantage of official language claiming that engineering talent has no gender. Their postwar activism drew heavily on these wartime lessons, while also seeking to respond to shifting national security needs.

“The national defense rhetoric during WWII focused on immediate wartime needs that were expected to disappear or subside when the conflict was over,” said Dr. Puaca. “Educating and employing women in scientific fields were also largely seen as solutions to short-term problems. The Atomic Age, and the Cold War, however, changed the very meaning of what it means to be secure. The precarious peace that characterized the Cold War demanded ongoing preparedness with no immediate end in sight.”

Dr. Puaca contends that, when SWE was founded in 1950, just as the conflict in Korea was heating up and as the implications of a never-ending, worldwide rivalry with the Soviet Union and

at Western Electric. After a few weeks, she was told by management that the company had no female job category called “assistant engineer,” so she would have to be recategorized as an “engineer’s assistant.” Dr. Conwell knew she had no legal recourse, and that the demotion would mean a pay cut. This “underutilization,” and the low pay that went with it, was common in the 1940s and 1950s.

In 1945, when the war ended, Dr. Conwell’s thesis research was published in Physical Review, bringing her widespread recognition as a scientist. While pursuing her Ph.D. at the University of Chicago, Dr. Conwell worked with the astrophysicist Subrahmanyan Chandrasekhar, Ph.D., on atomic physics and took classes with Enrico Fermi, Ph.D., a leading physicist on the Manhattan Project. She earned her Ph.D. in physics in 1948.

Over her long career, Dr. Conwell distinguished herself in both academia and industry. She taught at Brooklyn College, the University of Chicago, University of Rochester, Stanford, and the Massachusetts Institute of Technology. She worked at Bell Labs and at Sylvania Research Laboratories, and was a research fellow at Xerox. She is one of the few scientists to be elected to both the National Academy of Engineering and the National Academy of Sciences.

Dr. Conwell was the 1960 recipient of the SWE Achievement Award. A SWE Newsletter article about the award includes her citation: “In recognition of her significant contributions as a research physicist in the field of solid state research.” Correspondence between SWE founding member Evelyn Jetter, P.E., and Sylvania Electric Products reveals that Dr. Conwell was first nominated in 1954. A letter, dated Jan. 22, 1954, from Sylvania’s Physics Laboratories is evidence of the esteem in which the Achievement Award — then only 2 years old — was already held. It reads, “We are very pleased to have Dr. Conwell as a member of our staff and appreciate the distinction which reflects upon us as a result of the high compliment which your evaluation implies.”

An April 1991 announcement, released jointly by the American Physical Society, the American Institute of Physics, and Xerox Corporation when Dr. Conwell received the Xerox President’s Award, reads, “The world’s understanding of the interactions between matter and energy would not be the same without Esther Conwell.”

In 1997, Dr. Conwell received the Edison Medal conferred by the Institute of Electrical and Electronics Engineers (IEEE), the first woman to do so. An IEEE newsletter clipping about this honor quotes Dr. Conwell’s reflection that “… more important than those fine and truthful words, were the acts of Marie Curie, who taught me that women could do what before only men were allowed.”
Communist China were becoming clear, the future actually looked promising for women engineers and for SWE as an organization.

**SWE and the history of feminism**

In the postwar era, advocacy groups had to take great pains not to be labeled subversive. Technocratic feminism, therefore, was an effective and politically savvy way to advance women's education and employment. The atmosphere of anxiety and uncertainty caused by the Cold War arms race and the proliferation of nuclear weapons made U.S. security concerns urgent and ongoing. So when policymakers said they needed scientists and engineers—both men and women—to defend the U.S. against the Soviets, organizations like SWE took them up on it.

Dr. Puaca’s new book, *Searching for Scientific Womanpower: Technocratic Feminism and the Politics of National Security*, focuses largely on how this

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**Barbara Crawford Johnson**

Barbara “Bobbie” Johnson was the first woman engineering graduate of the University of Illinois College of Engineering. Immediately after earning her B.S. in general engineering in 1946, she joined North American Aviation, which became part of Rockwell. She spent her entire career there and worked on the United States’ most important and advanced missile and space programs.

A highly regarded expert in reentry trajectory and performance analysis, Johnson designed the reentry guidance instrument for the Apollo spacecraft and was responsible for mission analysis and integration management for the shuttle system. Prior to 1961, Johnson directed the performance and much of the aerodynamics for the second phase of the Navaho project, a long-range, supersonic, ramjet guided missile. The Navaho program began in 1946 and was canceled in 1958,

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Dr. Puaca spent three weeks conducting research at the SWE archives, located in Wayne State University’s Walter P. Reuther Library. It was there that she came upon the image that graces the cover of her new book, which will be published in June.

“I knew right away that it would make the perfect cover,” she said.
strategy was employed. It was a gambit used by a variety of advocacy groups, but as Dr. Puaca pointed out, “… in no area was this strategy more effective than in science and technology, due to the growth of big science and the threat of nuclear war.”

Dr. Puaca did a great deal of her research for the book in the SWE archives at Wayne State University’s Walter P. Reuther Library in Detroit. While working with these records, Dr. Puaca noticed the Society’s recurring use of Cold War “womanpower” rhetoric, which became a key theme in the book.

“I was struck by the wealth of material,” said Dr. Puaca. “I used a wide variety of materials, including committee reports, correspondence, newsletters, images, and oral histories that revealed much, not only about the Society’s history, but also how SWE relates to the broader history of feminism.”

Among the images in the SWE archives, Dr. Puaca found one that grabbed her attention. It was an advertisement from a 1957 issue of Life magazine titled “The girl, the men, and the atom.” It featured 18-year-old Joyce Myron, a student at the Drexel Institute of Technology and a winning contestant on the television game show “The $64,000 Question.” Myron was photographed near a nuclear power plant at the General Electric Vallecitos Atomic Laboratory, surrounded by a group of male engineers.

“The image immediately captured in my mind both the problems and possibilities of using national security concerns to justify women’s education and employment in scientific fields. It highlighted women’s inclusion in national security science, and also their marginalization.”

**On the ground in the 1950s and ’60s**

Just after being elected SWE president at the organization’s historic founding at Camp Green in 1950, Beatrice Hicks proclaimed, “I am convinced we are going to grow into a large and powerful organization.”

There were many signs that Hicks might be right, and that the timing of SWE’s formation was fortuitous. President Truman and others in his administration were deeply concerned about an engineering manpower shortage caused by mobilizing troops for the Korean conflict. In 1951, Frances Perkins, U.S. Civil Service commissioner, pointed out, in a letter to SWE founding member Hilda Edgecomb, P.E., “… opportunities for women are now more attractive than ever … inasmuch (as) many of the limited number of young men with specialized engineering training are needed for military service.”

Newspapers and magazines ran stories with headlines such as “Market for Science Majors Up; Demand Outstrips Supply” and “Women Engineers Urged.”

In addition, prominent public figures,
In 1952, Lockheed selected Ross and 39 other engineers to be part of a pioneering, top-secret, advanced space-engineering unit. Ross was the only woman in what became the legendary Skunk Works.

increased “scientific womanpower” to meet urgent defense needs.

The federal government took little meaningful action on behalf of women scientists and engineers, however, and for the most part, industry remained resistant to increasing the percentage of women among its engineers. SWE, on the other hand, did grow in membership and influence. Its leaders and members continued to promote the engineering profession for women, and they continued to remind business, academe, and the government that women engineers were a valuable resource for national defense. That resource, however, remained largely untapped, and the expansion of opportunities for women engineers that Hicks anticipated as a result of Cold War defense needs did not materialize in the postwar era, at least not for most women, and not on the scale of WWII recruitment of women.

For numerous and detailed examples of the disconnect between rhetoric and reality in the “Defense Decade,” as the 1950s was sometimes called, look no further than Margaret Rossiter’s Before Affirmative Action, 1940-1972, volume two of her three-volume opus, Women Scientists in America. In the chapter titled “Scientific Womanpower — Ambivalent Encouragement,” Dr. Rossiter describes a 1962 government-sponsored conference intended to encourage women to enter engineering, at which the manager of industrial relations for

Mary Golda Ross, P.E.

Mary Golda Ross was born in Park Hill, Okla., in 1908. She was the great-great-granddaughter of John Ross, chief of the Cherokee Nation during the 1838 Trail of Tears forced march from Georgia to Indian Territory in Oklahoma. She earned her B.A. in mathematics from Northeastern State College (founded by John Ross) in Tahlequah, Okla., in 1928 and her M.A. in math from Colorado State College in 1938.

After doing statistical work at the Bureau of Indian Affairs in Washington, D.C., and teaching in New Mexico for several years, Ross felt underutilized and applied for a job at Lockheed Aircraft Corp. In an interview published in the Oct. 30, 1994, San Jose Mercury News, Ross said, “There wasn’t much use for my technical training at the school, but the war was on, and my friends told me what Lockheed was doing with people with my technical education.” She was hired in 1942 as a mathematician, eventually becoming the first woman engineer to work for the company. She received her California P.E. in 1949 by taking extension classes in aeronautical engineering at UCLA.

Several of the newspaper clippings in the file marvel that the descendent of an influential Cherokee chief, the aeronautical engineer, and the woman, are one and the same. Ross, the interviewee, is offhand about her accomplishments and her multiple minority status in what many view as the rarefied profession of aeronautical engineering. She says that education for both boys and girls is an important Cherokee value, and that curiosity is encouraged. Her high school math teacher was Native American, and she always thought math was “more fun than anything.”

In 1952, Lockheed selected Ross and 39 other engineers to be part of a pioneering, top-secret, advanced space-engineering unit. Ross was the only woman in what became the legendary Skunk Works®. In the Mercury interview, Ross said, “With such a small group, you had to do everything. Aerodynamics. Structures … I was in on the ground floor at Lockheed Missiles and Space, and I couldn’t think of any more ideal situation.” Almost all of the reports and studies done in the Skunk Works, including
U.S. Steel in Pittsburgh announced that the company planned to hire 600 engineers that year, and that none of them would be women. Dr. Rossiter documents the struggles of women scientists and engineers to secure education, jobs, and recognition, while Dr. Puaca focuses on women’s pragmatic strategies for advancement. Documents in the SWE archives open another window on postwar history. It’s a compelling, close-up view of the professional lives of remarkable individuals. While relatively few women were able to leap the hurdles placed in their paths, some did. These women succeeded spectacularly, working and innovating in emerging scientific disciplines, such as aerospace, computer science, and nuclear physics. In the era before affirmative action, the example set by these “exceptions” was crucial to their peers and to the next generation of women engineers.

Sketches of three of these women are interspersed on these pages. They may have been ahead of their time, but each understood how to make the most of their time, forging outstanding engineering careers and making contributions to both science and society. All three — Esther Conwell, Barbara Johnson, and Mary Ross — gained a foothold in the profession during WWII, and persisted through the postwar era and into the 1970s and 1980s. In addition, all three did classified defense work and experienced, to varying degrees, an obscuring of their accomplishments and a delay in professional recognition because they could not reveal the nature of their work. They circumvented this barrier, as they had so many others, pursuing work they cared about and earning recognition on their own terms.

In 2004, at age 96, Ross got out of her electric wheelchair and walked in the opening procession at the Smithsonian National Museum of the American Indian in Washington, D.C.

Clearly, Ross was highly regarded at Lockheed. However, despite the fact that, according to an official Lockheed bio, she determined launch characteristics and duration of fly-by missions to Mars and Venus for the Early Manned Planetary-Interplanetary Round Trip Expedition (EMPIRE), helped prepare the NASA Planetary Flight Handbook, and analyzed trajectory data for Mars fly-by missions, all between 1961 and 1973, recognition for Ross as a pioneering aeronautics engineer was internal and local.

Ross did not seek recognition; she was fully absorbed in the technical challenges before her and glad to be engaged in work she found necessary and important. She did receive awards and honors over the course of her career. She received the Matrix Table Award for Space Age Communication of Ideas in 1961 from Theta Sigma Phi and the Woman of Achievement Award, 1961, from California State Federation of Business and Professional Women’s Clubs. In 1961, she was the San Francisco Examiner Distinguished Woman.

Stephanie Kwolek
One Who Aspired, Advanced, and Achieved
INVENTOR OF KEVLAR FIBER
SWE’s mission and tagline are visible not only on its website — they are also written in the lives of the women engineers and scientists who have appeared in SWE Magazine articles over the years. These women are trailblazers in their careers and in their achievements.

By Charlotte Thomas, SWE Contributor

Stephanie Kwolek is one of the trailblazers. “Stephanie embodies the SWE tagline of Aspire, Advance, Achieve,” wrote Ronna Robertson, F.SWE, fiscal year 2006 SWE president, in the fall 2006 issue of the magazine. Discussing Kwolek’s remarkable discovery of Kevlar® in a 1995 issue, Barbara Rosenstroch, SWE editorial board member, described the importance of this heat-resistant synthetic fiber that is five times the strength of steel and is best known for its use in bulletproof vests and fire-resistant clothing. Rosenstroch wrote, “Her work has stimulated research in industry and universities throughout the world.”

As with many women in engineering and science both past and present, Kwolek’s career exemplifies tenacity and persistence. “Her life story has so many messages for women engineers,” said Robertson, noting that Kwolek’s initial dream to be a doctor in the 1940s, when few women aspired to such goals, demonstrates her strong determination.
Robertson and Kwolek are both women with careers in STEM, but they are from very different generations. In 1965, when Kwolek made her breakthrough discoveries in the lab, Robertson had not been born. Their paths crossed for two reasons: Robertson worked for Kwolek’s career-long employer, DuPont, from 1998 to 2009; and secondly, in her SWE leadership roles. Robertson reached out to Kwolek, inviting her to meet local members of the DelMar Peninsula Section at various activities. Knowing of Kwolek’s accomplishments, she believed the interaction would be beneficial.

Currently with Packaging Dynamics as director of engineering and reliability, Robertson reflected on Kwolek’s story, noting that when reality didn’t follow her original intentions, Kwolek persisted and succeeded. Without the funds to attend medical school after graduating in 1946 with a degree in chemistry from the Margaret Morrison Carnegie College (now Carnegie Mellon University), Kwolek accepted a job with DuPont. The fact that DuPont hired her right out of college points to Kwolek’s talent. “She took that job with the intent to save funds and go back to school to become a doctor. If you look at that time period, that says a lot about her resolve. She didn’t give up,” said Robertson.

**Impacting the world through science**

Kwolek stayed at DuPont for 40 years until her retirement in 1986. Of this extraordinarily long career with a single employer, Robertson said, “She found she loved chemistry.” Instead of going to medical school, she refocused her plans and remained at DuPont, acquiring 29 patents and numerous awards (see sidebar on next page). Her commitment and enthusiasm were prime factors in her discovery of Kevlar.

Describing how that discovery happened, Robertson relayed that, “Originally, her project had to do with developing longer-lasting tires in anticipation of an impending gas shortage.” Kwolek was discarding a mix of chemicals down a drain — a common practice at the time — and noticed that the strands were not dissolving. She knew this was a compound different from anything else. When she described to her manager what had happened, he told her to give it up.

“However, Stephanie had a sense this was something unique and worth pursuing,” Robertson elaborated. “She worked on her own. That’s why to me, when you look at her career, the word ‘determination’ instantly comes to mind.”

Kwolek, now in her 90s, still tracks how others have taken her inventions and expanded them. She remains engaged, intrigued by and excited about science and technological advancement.

**Across generations**

Having been a source of inspiration for women behind her, Kwolek was a distinguished guest when Robertson was inducted as the SWE president. “We thought it was a way to recognize and embrace the past, present, and future. Stephanie was at the end of her career and retired, but was still getting rewards and recognition. I was in the middle of my career and beginning my position as SWE president with new ideas and programs,” Robertson said.

The occasion provided an opportunity to honor Kwolek in a special way by presenting her with the medallion from her induction into the National Women’s Hall of Fame several years earlier. Because Kwolek was unable to attend the 2003 ceremony, the SWE president at the time, Alma Martinez Fallon, stepped in on Kwolek’s behalf. It was serendipitous then, to use this venue to put Kwolek on center stage, where she received the medallion and engaged with an enthusiastic audience of women engineers of all ages.

Robertson noted that Kwolek’s dream to go into medicine was based on the desire to help people. It was a desire that stayed with her and is seen in her tenacity in developing Kevlar. Her aim, to help people, is also paralleled in SWE’s mission to attract young women into engineering.

“At SWE we have conversations about how to attract more young women to engineering. Part of the answer is that young girls will choose fields that help people. Unfortunately, many don’t see..."
engineeering as a career based on helping people. Yet here is someone in her 90s, telling her story, and we can hear the passion in her voice. Getting messages like Stephanie’s out, that is what will help young women see they can make life better and safer by being engineers and scientists. Here is a woman who wanted to help people and did so. Kevlar has saved countless lives.”

**Why awards matter**

“The significance of awards for women such as Stephanie Kwolek goes beyond honoring the recipient. She is a role model,” said Jill Tietjen, P.E., F.SWE, SWE past president (1991-1992) and currently president and CEO of Technically Speaking Inc. In addition, Tietjen is the 2014-2015 president of the board of the National Women’s Hall of Fame.

Tietjen nominated Kwolek to the Hall of Fame of Delaware Women — where she will be honored in late March — as well as the National Women’s Hall of Fame years earlier. Tietjen has made it her personal mission to nominate women for various awards and halls of fame. “I want to make sure women get the recognition they are due,” she noted. Tietjen talks about the example Kwolek provides young women by exemplifying that they, too, can make a difference in the world. “That’s why I nominated Stephanie for the Hall of Fame of Delaware Women,” said Tietjen. “She’s an ordinary woman who made an extraordinary discovery.”

The Delaware Hall of Fame awards women because their “courage, vision, and resiliency have profoundly impacted their neighborhoods; community; the state and or the nation.” Kwolek, whose numerous contributions took place in the labs of Delaware-based DuPont, certainly meets those standards.

“Stephanie made a lasting impact when she spearheaded the discovery processing development of Kevlar, which has saved lives across the globe,” said Nina DeVoe, community relations officer at the Department of State Delaware Commission for Women. Commenting on other ways Kwolek’s career can be viewed and how it is more than an award, DeVoe said, “There have been many profound speakers who say that when you empower women, the nation is empowered. Our hall of fame contributes to empowerment.”

She explained that the purpose of the Hall of Fame is educational and attracts students from local schools and Girl Scout troops. “Young women see the achievements of women from Delaware in the hall and get a program with the details about their careers in Delaware. They say, ‘Gee, she looks like me. She lives in my neighborhood.’”

In the latter years of her retirement, Kwolek is still actively reaching out to young women to inspire them. Kwolek appears in a short video, “1999 Lemelson-MIT Lifetime Achievement Award Winner Stephanie L. Kwolek,” which is part of the article “Stephanie Kwolek and Kevlar®, The Wonder Fiber” on the website INNOVATIVElives (http://invention.smithsonian.org/centerpieces/lives/lecture05.html) by Caitlyn Howell. Here, Kwolek discusses how she is devoting herself to encouraging young people to consider careers in science.

Speaking about her ongoing mission in the video, Kwolek said, “I find their reaction to my work very satisfying. And I also feel that I’m doing some good, because when I grew up, I was not exposed to science and I’m always amazed that I became a chemist and scientist. I tell young people to reach for the stars, and I can’t think of a greater high that you could possibly get than by inventing something.”

**Reference**

SECOND-GEN
Deeply embedded and frequently unconscious cultural and organizational biases can be challenged both through small “wins” and by establishing policies that take a whole-organization rather than a women-only approach.

By Sandra Guy, SWE Contributor

Second-generation gender bias is making its way into the lexicon of women’s workplace issues as a subtle, covert, and at times unintentional, phenomenon that thwarts women’s power and potential.

This form of bias is complex because, unlike the first generation of overt, explicit, and conscious bias against women in the workplace, second-generation bias can occur in hard-to-pin-down incidents such as the way a job description is worded or never being asked whether one is interested in being promoted or taking an overseas assignment.

“Second-generation bias is unconscious, and most of it results not from intent, but from a system that is inadvertently unfair and results in a disparity of outcomes and numbers,” said Herminia Ibarra, Ph.D., the Cora Chaired Professor of Leadership and Learning and professor of organisational behaviour at INSEAD, a graduate business school with campuses in France, Singapore, and Abu Dhabi. Dr. Ibarra works at the campus in Fontainebleau, France.
Daily-life instances

Second-generation gender bias functions in ways that leave women out of top positions and out of the loop of decision-making. That’s because most top executives are men, and they — as do people in general — develop relationships on the basis of what they have in common with others — and they have more in common with other men than they do with women, said Dr. Ibarra, who studies informal networks. “You’ll have more in common, superficially, with someone of the same gender,” she said.

“In most organizations, which are male-dominated at the top, men will have their most important work relationships with people like them, and women with people not like them. So it’s harder for women to create a clique outside of the workplace, and if you don’t have that, you get less gossip, less trust, less coaching, and less of the ‘inside scoop.’ All of that common ground based on informality is harder to build (for women).”

Because men so often occupy the top positions at companies, the implicit model of what a great leader looks like is a man, Dr. Ibarra said. “If a woman has a different style, it might look not assertive enough, or not enough this or that, because the subconscious model is from one group — men — and not from a diverse group.”

Dr. Ibarra co-wrote an article about second-generation gender bias with Deborah M. Kolb, Ph.D., the Deloitte Ellen Gabriel Professor for Women and Leadership (Emerita) at Simmons College School of Management and head of Negotiating Women Inc.; and with Robin Ely, Ph.D., the Diane Doerge Wilson Professor of Business Administration and senior associate dean for culture and community at Harvard Business School.

The article, which appeared in the Harvard Business Review’s blog network, focused on the need to educate everyone about second-generation gender bias and noted that “small wins” can turn the tide.

Dr. Kolb said one example is how leaders and organizations that insisted women didn’t have leadership skills were shown how policies that require a worker to be on call 24/7 or to be “aggressive” made it virtually impossible for women to get those jobs. Another executive complained that women didn’t apply for open jobs, even though the job descriptions called for people willing to relocate, able to report to duty at odd hours, and take a tough stance on workers who proved to have disciplinary problems. Further, research shows that men will offer themselves up for promotions or bigger jobs even if they don’t have the attributes of the job description, while women will shy away, Dr. Kolb said.

“We started to write realistic job postings, rather than aspirational ones, and we got equal numbers of men and women applying,” she said, noting, for example, that some positions may require that the candidate have a diversity of experiences but may not truly require the person to move to a corporate headquarters.

Pointing to another instance, engineers at one company were expected to be able to work 24/7, so that flexible work arrangements seemingly had no place in the way work got done. In such cases, Dr. Kolb explained, “It is not about individuals; it’s about organizational and cultural assumptions and practices.”

Dr. Kolb believes one of the ways to fight the second-generation cultural bias is for women to negotiate in a smart way about issues that would otherwise set them back. She cited a female chief financial officer of a large manufacturing company who relocated in order to obtain her dream job. Yet after two years in the job, the CFO’s family issued an ultimatum: They would move back to their previous location, with or without her.

“She negotiated with her boss to create a dual office — spending part of the time in the field and parts in the other places,” Dr. Kolb said. “By doing so, she paved the way so that no one else in the company had to feel that a requirement of taking a senior leadership job entailed relocating to corporate headquarters.

“We think changing it (second-generation gender bias) will be with such ‘small wins,’” Dr. Kolb said. “It’s about trying to look at how you could change work so you could make it possible for people to work and have a life.” Taking such proactive positions confronts what Dr. Kolb described as a “fix the women”
assumption at many companies and institutions.

Another example is performance reviews, where women often get into a double-bind situation, she said. “When a woman’s name came up, the word ‘nice’ was used, but never with a man,” Dr. Kolb explained. Her research showed that men and women are evaluated more on their performance if they are rated together rather than each one separately, so that could be one solution. Such a change can then produce positive results for both men and women, she said.

As for women in STEM positions, including engineers, being dissuaded, Dr. Kolb said a cultural belief in many companies that they must “wear a badge of a tough guy when they have bad management” can be challenged. One example is the common assumption that engineers can be managed only by someone who is an engineer, even if that person is a bad boss. “I say, you have to learn how to manage,” Dr. Kolb noted, so if a fellow engineer is a bad boss, he or she needs to be retrained or replaced, even if it’s with someone who is not an engineer.

One female manager who holds conference calls with 3,000 people who report to her works through these kinds of gender-based issues during every meeting she holds, Dr. Kolb said. Such discussions work better than top-down, legislative measures in getting people to see what’s happening, she said. “These little seeds will take,” she said. “It’s like letting 1,000 flowers bloom.”

Dr. Kolb concedes that the fight is against a deeply embedded cultural belief, even now, that women don’t belong in senior leadership positions. “Many people believe, deep down, that the world works better when men are in the workplace and women are at home,” she said.

The role of personal beliefs

Kathleen Buse, Ph.D., adjunct professor, Case Western Reserve University’s Weatherhead School of Management, earned her Ph.D. in management following a struggle to find a fulfilling career in engineering once she left Eastman Kodak Co., primarily because of family obligations.

Dr. Buse noticed that certain corporations in her new, more conservative Midwestern location had trouble keeping women engineers. She found in her studies on the topic that a key factor was women’s self-esteem and their own personal beliefs that they could succeed — so, unlike Dr. Kolb, who believes men and women will always be competitive with one another, Dr. Buse sees part of the conundrum as one involving deeply personal matters. She believes in teaching young women about the need to be financially independent and to focus on achieving on their own merits, rather than continuing to uphold the traditional, and frequently unexamined, ways that women are taught to “fight” one another and vie for men to “take care” of them.

“Women with higher levels of a belief in themselves to succeed had higher levels of commitment to their careers in engineering,” Dr. Buse found in her studies. She suggests four ways for women to build self-esteem:

- Take active steps to do something that provides confidence in order to build up one’s ability to succeed based on past successes.
- Surround oneself with people who provide positive feedback. “We need to hear we’re good,” Dr. Buse noted. “I was on a panel about STEM careers, and one woman said every time she wasn’t believing in herself, she remembered words from someone who propelled her to move to the next step.”
- Seek out role models.
- Deal with the physical aspect of lacking confidence or having anxiety by doing activities that make one feel more confident. In many cases, that may mean doing yoga, meditation, cardio, or other exercise.

Having a bad boss at the start of one’s career is another key factor in female engineers leaving the profession. Dr. Buse found this to be the case both in her research and in her own personal experiences. At one of her previous jobs, Dr. Buse had more awards and accomplishments than her male colleague, but their boss promoted the man without discussing the promotion with her.

“I went to my boss. He said, ‘Oh, I didn’t know you’d want it.’ He didn’t know I would want to be promoted,” Dr. Buse said. “The second-generation gender bias is in my boss’ head. He didn’t consider that I wanted to be promoted. But I never thought I had to tell him.

“The rules are different for women, but no one tells us that,” Dr. Buse said. And it can take a long time to figure this out on one’s own. She advocates special training for women, especially in STEM careers, so they can recognize such subtle biases. Case Western Reserve’s Weatherhead School of Management, for example, has set up an executive education program for women in STEM in part to provide them the skills to navigate male-dominated environments.

The Leadership Lab for Women in STEM offers professional and leadership developing for women in technology-driven, traditionally male-dominated professions. “Part of it is (women) understanding themselves, what they want to achieve — and really articulating it,” Dr. Buse said. “We need to tell women they need to voice what they want.

“Universities teach skills to solve problems of a technical nature,” Dr. Buse said. “When someone graduates in engineering or with a STEM degree, we’re not giving them the skills they need to be successful in an organization. This Leadership Lab bridges the gap.”
She noted that though more than 20 percent of undergraduate engineering degrees are now conferred to women, women represent only 10.5 percent of employed engineers nationally, a share that has remained stagnant since the mid-1990s.

Deeper understanding: a prelude to change

Dr. Ibarra offers her own list of ways to overcome second-generation gender bias:

- Educate women that it’s not their fault; don’t point an accusing finger. “A lot of times, because it’s subtle, women think it’s them and their own individual choices,” Dr. Ibarra said. “It is helping people understand what this is about as a prelude to working together to change it.”

- Create psychological safety in programs such as mentoring opportunities or women’s development seminars. “It’s not easy for people to talk about these things,” Dr. Ibarra said. “They feel they’ll be told, ‘You’re prejudiced or you’re just being a victim.’ We’ve found that it’s really important for women to share their experiences with others who’ve had similar experiences so they know they’re not crazy, and they can get ideas on how to handle (tough) situations.”

- Never lose track of the goal of helping women become better leaders.

Elaborating on this last point, Dr. Ibarra explained: “The so-called ‘Fix the Women’ programs are aimed at how do you have more gravitas, how do you look, come across, have executive presence? It’s the means to an end — not the be all and end all.” Further, Dr. Ibarra said, “I’ve seen women exposed to well-intended things and be disgusted. Their response is, ‘I need to be myself; be authentic; I don’t want a total personality makeover. It’s about getting something important done and not the walk and talk.’

“We started to write realistic job postings, rather than aspirational ones, and we got equal numbers of men and women applying.”

— Deborah M. Kolb, Ph.D., the Deloitte Ellen Gabriel Professor for Women and Leadership (Emerita), Simmons College School of Management, and head of Negotiating Women Inc.

“The general idea is not to check a box — like, OK, we put in a mentoring program, check, but to think specifically about how the pieces come together and what’s really getting in the way (of women’s progress).”

Dr. Ibarra sees hope for progress in today’s leaders such as Hillary Clinton, who is widely believed to be planning a run for the presidency in 2016; Yahoo CEO Marissa Mayer; Facebook COO Sheryl Sandberg, author of Lean In; Anne-Marie Slaughter, D.Phil., president and CEO of the New America Foundation and author of a widely discussed article in The Atlantic magazine titled, “Why Women Still Can’t Have It All”; and Christine Lagarde, managing director of the International Monetary Fund. “People are seeing a diversity of role models,” Dr. Ibarra said. “I look to see the number continue to inch up.”

A multilayered approach is critical

Brian Rubineau, Ph.D., assistant professor of organizational behavior at McGill University’s Desautels Faculty of Management in Montreal, says changing the internal workings of an organization is extremely difficult because solutions must be multilayered. “Trying to focus on one (issue) at a time results in very little progress,” said Dr. Rubineau, who has studied workplace inequality for 13 years. “Many mechanisms combine to create inequality in the workplace.”

Indeed, efforts to create processes that are more gender equitable often backfire, Dr. Rubineau said. He cites recent research by Emilio Castilla, Ph.D., of MIT and Stephen Benard, Ph.D., of Indiana University showing that a formal, less-subjective process for rewarding employees with pay raises can still give rise to gender pay inequality where high-performing women get smaller raises than similarly high-performing men.

“When a company uses a subjective process (to give pay raises), people may recognize it as such and check their decisions to make sure they are being fair,” Dr. Rubineau said. “But when they
were told that the new procedure was meritoric, they didn’t check themselves. New biases emerged.” The result was continued gender inequity, with the reasons going unexpressed. “There are common cultural biases that result in seeing women as being less competent,” he said.

Companies also struggle with explaining ongoing gender inequity. A company is more inclined to identify and try to act on a single likely explanation than a comprehensive solution, Dr. Rubineau said. One explanation, for example, may suggest addressing a shortage of women eligible to fill higher-level job openings, while another suggests dealing with women’s need to balance work and family. These lone efforts at greater gender equity are usually well-intentioned, and many even have buy-in from corporate leaders, but the benefits from single-explanation solutions often end up being short-lived or much more modest than anticipated, Dr. Rubineau explained.

One reason may be that gender is such a sensitive issue, it can engender backlash, he added. “Gender is one of the first ways we learn about status differences,” Dr. Rubineau said. “If you want to change the gender dynamics of an organization, you have to change the organization fundamentally.”

Successful efforts to make the workplace more equitable take a whole-organization rather than a women-only approach. Successful efforts focus instead on such things as safety, civility, respect, and “general” values for which there is broad support, he said.

For example, it is often easier for junior men than for junior women to find informal mentors among senior staff. However, a women-only mentoring program may create resentment and would not last. Instead, formalizing the mentoring of both junior men and junior women is a less contentious way to level the field for men and women, Dr. Rubineau said.

One example of a successful organizational change occurred on an oil rig where nearly all of the workers were men. They felt forced to display the most masculine behavior in order to gain respect, even if that meant ignoring safety rules and getting into fistfights to earn a job. The culture improved when the workers on the oil rig were encouraged to obey safety rules and treat one another with respect.

“A number of men reflected on how the experience of working on the (oil rig) platforms had changed them,” according to the results of the organizational behavior research. “For some, the impact was personal, such as learning to be more attentive to ‘personal and interpersonal relationships,’ to comport oneself differently when exercising power (e.g., not to use profanity), to give others a chance to demonstrate knowledge, and to see others’ pain when they made a mistake. Others commented on how the work force as a whole had changed, with the men becoming ‘kinder, gentler people,’ able ‘to get in touch with the more tender side of each other.’”

“The idea is that it’s not about women,” Dr. Rubineau said. Yet, he was also quick to point out that fair processes are not enough. “It is the fundamental change around equity that is important,” he said. “Fair processes — such as parental leave available to both men and women — in the absence of fundamental change can exacerbate inequality.”

An example: A woman who takes parental leave may find herself on a “mommy track” with other disproportionately female workers whose commitment to the organization is suspect and who are seen as less ambitious and, as a result, are less likely to advance. But in companies where parental leave is common, men may take the leave even though they often have fewer care-giving demands at home. As a result, men may have more flexibility to take the leave to enhance their skills or do something else that’s beneficial to them, while women have less flexibility to do so.

“The policy is fair and applies to all equally, but in both cases, men disproportionately benefit,” Dr. Rubineau said. “You must create fundamental organizational change for true equity for everyone, and women will benefit.”

Positive indicators

Signs that the women’s optimism may be justified pop up each week, including the news on Feb. 10 that Mary Barra will earn 60 percent more than her male predecessor in her first year running General Motors. The first woman to run a major automaker will receive a pay package worth $14.4 million, with most coming from a long-term stock bonus plan, compared with her predecessor, Dan Akerson’s pay and bonus totaling $9 million for 2013, according to CNNMoney.

On the same day, Feb. 10, stock-photography company Getty Images announced a partnership with LeanIn.org, Sandberg’s organization, to create a library of 2,500 images that feature new, more empowering portraits of women.

Separately, nonprofit research group Catalyst reported on Feb. 4 that women represent from 36 percent of the directors of big-company boards in Norway to 26.8 percent in Finland due to mandates or public-reporting requirements, and that the numbers are growing. Though women in the United States represented 16.9 percent of the board seats at Fortune 500 companies in 2013 — a figure stagnant for eight years — greater efforts are being made to boost that percentage.

As Dr. Kolb concluded, integrating women into senior levels is a real challenge. Yet once a dialogue gets going, possibilities for change open up, she said.

No one says it will be easy.
Women in Engineering: A Review of the 2013 Literature

SWE’s assessment of the best research found in the past year’s social science literature on women engineers and women in STEM disciplines.

By Peter Meiksins, Ph.D., Cleveland State University
Peggy Layne, P.E., F.SWE, Virginia Tech
Elsa Camargo, Virginia Tech
Katie Snead, Virginia Tech

2013 saw the publication of a large quantity of scholarly work relevant to the situation of women in engineering. Our review of the literature covered well over 100 publications, including books, major reports, and journal articles in publications representing a half dozen or more disciplines, including sociology, psychology, education, and business, to name a few. We searched for articles by examining major research databases and more than 70 journals that publish articles on gender and engineering. As always, the studies varied tremendously in quality and rigor; they also varied in their methodological approach, from complex statistical analyses of large data sets to interpretive studies of qualitative data.

We will not be able to discuss every study we read for this review. As we pointed out in last year’s review, there is an element of déjà vu in reviewing the literature on women in engineering and STEM each year. Researchers continue to produce studies that duplicate work done previously and continue to disagree with one another about the implications of their research findings regarding the question of why women remain significantly underrepresented in engineering.

A significant portion of the published work we review each year consists of small-scale case studies focused on a single institution and/or involving very small samples, which raises a number of issues. Some of this research can be quite valuable, often pointing to important questions that need to be asked, helping to explain the results of larger-scale quantitative research, or suggesting possible directions in which research might move. At the same time, however, exploratory research of this type is just that — exploratory. It is not designed actually to resolve, finally, the questions it raises. As a result, while we discuss some of the more interesting pieces of small-scale research we reviewed, we have tried to focus on the most rigorous pieces of research, on peer-reviewed articles, and on work that offers fresh insight and new approaches. We have also pointed to any methodological limitations, and to innovative methodological approaches, in the research we discuss. We have tried, as well, to take seriously the call we found in the literature (Beddoes 2013) for more varied methodological approaches to exploring engineering and engineering education by incorporating discussion of both quantitative and qualitative research.

Some of the material we reviewed covered familiar ground; but some researchers were able to report on interesting new findings that shed fresh light on established research questions. Thus, we review a number of studies devoted to the examination of “pipeline” issues. Researchers continue to ask whether it is the case that fewer women are attracted to STEM disciplines and careers and, if so, why. They ask, as well, whether and why women who enter STEM fields leave at higher rates than their male counterparts. There is ongoing debate about which of these is of greater importance in explaining the underrepresentation of women in engineering, although it is safe to say that both factors play a significant role.

Continuing a development we noted in last year’s literature, there were a number of essays and research articles exploring a feminist critique of engineering. Is the problem not just a matter of increasing the numbers of women in engineering but of transforming engineering itself, and making it less “gendered?” And, if that is the case, how would engineering be changed and in what sense would the profession benefit from that change? Parts of this literature explored what is now relatively familiar ground. There were, however, several interesting contributions that raised new questions about whether orienting engineering more toward issues and approaches that appeal to women would actually succeed in attracting more women to the profession and in improving their position within it.

We also noted a number of relatively new emphases in the research we reviewed this year. None of this was entirely novel, but there was more attention devoted to themes that had been less than central to previous years’ research. Most notably, we were pleasantly surprised to find a significant number of research articles focused on the experiences of working women engineers...
outside the academy. We have lamented, for several consecutive years, the notable absence of this type of research, as well as the corresponding preoccupation with academic engineering. The publication of several substantial studies of working women engineers represents significant movement in the direction of correcting this imbalance in the research literature.

There was increased discussion of the situation of minority women engineers this year. An important book by Camacho and Lord (2013a) takes a detailed look at the situation of Latinas in engineering. And, the Institute for Women's Policy Research published a major report on women faculty of color in STEM (Hess, Gault, and Yi 2013). As another contributor (Beddoes 2013) noted, researchers influenced by feminist ideas and methods have become increasingly sensitive to the issue of intersectionality — i.e., to the idea that women, like the population as a whole, are a diverse group and that gender has different meanings and consequences linked to race, ethnicity, sexual orientation, etc. It is refreshing to see evidence that this idea has taken root in scholarship on women in engineering as well.

Also of note, Computer magazine, the flagship publication of the IEEE Computer Society, focused its March 2013 issue on gender diversity in computing, with 13 articles presenting both institutional and individual perspectives on computing education and careers from academics and practitioners. While not presenting peer-reviewed descriptions of specific research projects, this special issue includes overviews of the status of women in computing from experts at the National Center for Women and Information Technology (NCWIT), the Anita Borg Institute, MentorNet, and the Computer Science Teachers Association, and case studies of recruitment and retention programs at the University of Washington, the University of Virginia, and Harvey Mudd College. Individual faculty members and practitioners reflect on their career paths in computing, the importance of mentors, and the value of diversity.

**Drawing women in, pushing women out**

As in previous years, much research attention was devoted to the question of why women are not attracted to STEM majors or to careers in STEM fields, with engineering being a particularly acute case. There was also continued interest in the question of why women leave. While the “leaky pipeline” metaphor is not as widely endorsed as it once was as an explanation of women’s underrepresentation in engineering, researchers continue to find evidence that, in fact, the field does not attract equal numbers of young men and women and that women who enter engineering are more likely to leave at various points along the way.

Various familiar explanations were offered for the continued tendency for boys to show more interest in engineering and STEM than girls. One group of studies identified knowledge about the profession, as well as stereotypical beliefs about its being more appropriate for boys, as a primary cause. Sandrin and Borror (2013) reported on their study of a large (more than 6,000 cases) sample of college and high school students in the upper Midwest. They found that male students were significantly more likely than female students to be interested in engineering careers and that female students were more likely to respond “I don’t know what it is” to questions
about their interest in engineering. Male students were more likely to report having been encouraged to consider STEM careers, perhaps reflecting prevailing attitudes toward its gender appropriateness. Significantly, interest in engineering and computer fields for both groups peaked at about sixth grade, suggesting that early interventions are needed if the goal is to encourage increased female interest in those fields. It would be important to learn whether studies of other geographical regions would yield similar results.

Archer et al. (2013) reported on a study of 9,000 primary school children in England that included follow-up interviews with a small group of participating children and parents. They found that cultural constructions of femininity tended to push against the development of girls’ interest in science careers. While some did aspire to pursue science careers, there was a tendency for both children and parents to associate science with “cleverness” and for girls who didn’t develop science aspirations to see themselves as not “clever” enough. Girls tended to see femininity as involving nurturing and caring for others, and were most likely to aspire to careers that were associated with these characteristics (teaching, child care) or that were glamorous and “girly” (acting, singing). Parents lacked knowledge of the range of careers available to those who had science interests, so were not in a position to offer their children concrete advice about the various directions in which an interest in science could lead.

The importance of family support and encouragement to girls’ pursuing STEM careers was underlined by several other studies, including those by Hobson et al. (2013) and by Skaggs (2013).

Colvin et al. (2013) report on a set of workshops designed to increase participants’ knowledge of civil engineers. Forty-five elementary school students were asked to draw an engineer prior to the program; they generally drew a man wearing overalls and fixing cars with basic tools. During the workshop, the participants discussed the role of civil engineers in pursuing goals such as safety, environmental issues, and improving the quality of life. At the end of the program, students’ drawings of engineers reflected a more varied perception of what civil engineers do. The number of female engineers drawn rose from two to 10 for grade 5 students and from four to eight for grade 6 students. Participants also showed evidence that they had increased their understanding of the field, perhaps opening them to becoming interested in exploring it.

Finally, Smith et al. (2013) identified a different kind of stereotype that may discourage women from entering various STEM programs. They studied several groups of students at two western universities and found that women in male-dominated programs felt that they had to work harder than their peers and, as a result, experienced a decreased sense of academic belonging. In addition, experimental data indicated that when students were presented with descriptions of fields identified as male dominated, they expected those fields to require more effort than when the same field was described as gender equal.

The implication is that male-dominated fields may seem less welcoming to female students, who perceive them as involving unusually high levels of effort and as fields in which they don’t feel they belong.

Other researchers focused on girls’ preparation for engineering careers, particularly in key subjects such as math and physics. Given the degree to which strong preparation in these courses predicts entry into and success in engineering programs, the question arises whether girls are equally likely to get strong math and physics backgrounds, and, if not, why not.

Riegle-Crumb and Moore (2013) conducted an interesting study of the gender gap in high school physics using a large data set drawn from the National Longitudinal Study of Adolescent Health and the National Center for Education Statistics. They found that while the gender gap in physics persists, with boys remaining more likely to take high school physics, interestingly, there are many school districts in which this is not the case. In exploring the differences between the various schools, the researchers found that girls’ participation in high school physics correlated with the percentages of women in the community who were employed in STEM occupations. While they are unable to specify the precise mechanism by which the community’s characteristics influenced girls’ choices, one can hypothesize that factors such as parental support, the availability of role models, and girls’ perceptions of career opportunities in STEM may all be relevant.

Finally, Wang, Eccles, and Kenny (2013) conducted a large, national, longitudinal data study of a sample of college-bound students in the United States. High school seniors were surveyed in 1992, then again by telephone 15 years later. They found that students

![Image](https://example.com/2013LITERATUREREVIEW.png)

Source: Yoder, Engineering by the Numbers, American Society for Engineering Education, 2013
who had high math and high verbal scores in 12th grade were less likely to have chosen STEM careers by age 33 than those in the high math/moderate verbal category. The former contained more female respondents. There were no gender differences in the high math/high verbal group in the likelihood to select STEM careers, however. Females were less likely to have chosen STEM careers, but this difference diminished if one controlled for ability (high math ability), pointing to the conclusion that high math ability accounts, partially, for gender differences in selection of an occupation. Unfortunately, the study is unable to explain the gender differences found in math ability in the sample. It would be interesting to know if a sample of students in 2014 would be similar, since girls’ achievement in math has increased in the years since 1992.

Researchers also examined the question of whether and why women persisted in engineering programs once they entered them. One line of inquiry considered the question of whether female engineering students are as confident and secure in their ability as their male counterparts. Fowler and Meadows (2013) followed a group of male and female engineering students who entered a Midwestern engineering program in 2011 and found that female students began the program with lower expectations of succeeding and a weaker sense of belonging than their male counterparts. These differences tended to decrease, however, as the first year progressed, with women’s expectations of success increasing, while men reported a decrease in their belief that a degree in engineering was worth the cost. Jagacinski (2013) conducted a study of another group of engineering students at a Midwestern university and found that women in first-year engineering courses reported lower competence perceptions than men, although there were no significant gender differences in grades. Pinelli et al. (2013) noted that female STEM interns in a summer program at NASA Langley Research Center tended to rate their abilities lower than their male counterparts in areas such as analytical thinking, computational skills, computer skills, and technical skills. Evidence such as this, of female students’ lack of confidence that they belong, points to the possibility that they may conclude that engineering is not the right choice for them.

A number of studies pointed to factors that worked in the opposite direction, encouraging women to persist in engineering and STEM programs once they entered them. Watkins and Mazur (2013) report on research on a first-year physics course at Harvard that points to the value of active learning experiences as a tool for attracting and retaining students to STEM majors. They compare students who enrolled in a version of the course that involved “peer instruction,” built around using class time to have student-led discussions of short, conceptual, multiple-choice questions, rather than conventional lecture-based versions of the course. They found that students who enrolled in the active learning version of the course were twice as likely to continue in STEM majors than those who took the conventional one. While this study does not look specifically at the issue of whether this pedagogical approach favors the retention of female students, it is consistent with earlier research showing that female students are more likely to be drawn to and retained in STEM majors if they are given opportunities for hands-on learning.

Samuelson and Litzler (2013) report on research done as part of a larger, 2013 LITERATURE REVIEW

PACE: Project to Assess Climate in Engineering

By Peter Meiksins

PACE is a major study of undergraduate engineering programs that promises to shed light on the factors affecting the retention of undergraduate engineering students, particularly women and minority students. Its goal is to collect and analyze data on the climate of undergraduate engineering programs, with a focus on persistence and retention. The aim is to help undergraduate engineering programs improve climate and create a more inclusive environment.

A long-term, multisite research program involving 22 participating institutions, PACE is funded by the Alfred P. Sloan Foundation. It is currently headquartered at the Center for Workforce Development at the University of Washington. The program began in 2006 and was refunded in 2011. The project is led by Suzanne Brainard, Ph.D., principal investigator, and Elizabeth Litzler, Ph.D., co-principal investigator. Susan Staffin Metz was co-PI from 2006 to 2011.

PACE employs a careful, mixed-methods approach designed to ensure that its results are meaningful and valid. To ensure consistency, the research focuses on institutions that are “one-tier” — i.e., that either admit students directly as first years or provide an engineering advisor to first-year students interested in engineering. Across institutions, the sampling strategy deliberately oversamples minority students and women to ensure adequate numbers of underrepresented groups participate.

To date, the PACE research team has either completed or is in the process of completing a number of research projects:

- The PACE survey on “climate” was conducted at all institutions in 2008, and at 16 in 2012 (allowing an assessment of change)
- 179 interviews with students at 18 institutions in 2008, and at 16 in 2012 (allowing an assessment of change)
- 179 interviews with students at 18 institutions in 2008-09 (about one-third with students who left) to learn more about climate, the reasons students leave/stay, the treatment of women/minority students, etc.
- Focus groups with undergraduates on a range of issues, including climate, retention, career goals, etc. Several focus groups were completed in 2012-13 and more are contemplated.

The PACE research team has already published several papers and presented others at conferences. The papers and more information about the project can be accessed at the PACE web page: http://depts.washington.edu/paceteam/method.html
Alfred P. Sloan Foundation-funded program, entitled Project to Assess Climate in Engineering (PACE), at the University of Washington. They interviewed a group of 27 women engineering students who had participated in an internship or co-op. All of the respondents spoke positively of these experiences, reporting that they contributed to their understanding of the engineering profession, provided valuable networking opportunities, and contributed to their motivation to stay in their engineering programs. Even those who had decided to leave engineering said that participation in an internship or co-op had delayed their decision to leave.

Mentoring and female role models also were identified as factors promoting the retention of female students in STEM and engineering. Poor and Brown (2013) describe a mentoring program at Washington State University that increased the retention rate among female students by helping them feel more connected and confident in their field of study — succeeding, apparently, in countering some of the negative feelings identified in the research discussed above, about why female students leave engineering. Young et al. (2013) examined the influence of female role models on women’s implicit science cognitions. They surveyed 320 college science majors, two-thirds of whom were women, and found that men had more favorable implicit attitudes toward science and identified more with it than did women. Women did have higher science aspirations than men, however, and having a female science professor as a role model increased their implicit science identity and decreased gender stereotyping.

Ackerman, Kanfer, and Beier (2013) studied a group of almost 600 first-year students at the Georgia Institute of Technology to examine factors that predict STEM persistence. They found that persistence was affected by a combination of considerations, some of which reflected ability and achievement, as in test scores and/or high school GPA, and others of which were personal characteristics. These included math/science self-concept; mastery/organization; openness and verbal self-concept; anxiety in achievement contexts; and extroversion. All of these factors were significantly correlated with students’ GPAs in their four years in college. Gender differences appeared as well, as men scored higher on math/science self-concept, while women scored higher on mastery/organization, openness and verbal self-concept, and extroversion. The authors concluded that differences among students, including gender differences, should be taken into consideration in designing curricula aimed at maximizing student retention.

**Intersectionality: minority women in engineering**

Those who study the underrepresentation of women in engineering increasingly recognize that minority women represent a particularly significant untapped pool of potential female engineers. While the numbers of women in engineering remain relatively small, the numbers of women of color are even smaller. This points to the reality that much can be learned about diversity in engineering in general through an examination of Latinas’ experiences.

Two important full-length studies, and a small number of research articles, this year drew attention to the small numbers of minority women engineers. First, Camacho and Lord’s *The Borderlands of Education: Latinas In Engineering* (2013a) reports on their own and others’ research on Latinas in engineering, a group to whom little attention has been devoted previously. They note that Latinas constitute only 2 percent of all engineering degree recipients in the United States. Despite their small numbers, however, Camacho and Lord posit that much can be learned about diversity in engineering in general through an examination of Latinas’ experiences.

The authors argue that Latinas are allocated to a “borderland” within engineering education and practice, where they are marginalized and defined as the “other.” They encounter a culture that is not at all welcoming and experience a range of “microaggressions” that remind them of their difference and lack of acceptance. Surprisingly, Camacho and Lord report that those Latinas who make it into engineering programs are retained at unusually high rates. They attribute this to Latinas’ ability to develop strategies to deal with an unwelcoming culture: They form their own support groups; avoid male groups that devalue them; seek help from faculty; not
other students, etc. Martin, Simmons, and Yu (2013) make a similar point in noting that Latina students lack the “social capital” that family members could provide if they had more experience in engineering or university education. Despite a delay in realizing that resources were available to them, however, they compensated by relying on peer groups and institutional support systems in negotiating undergraduate engineering programs at the University of Houston, where the study took place.

Other research published this year provided insight on the issue of retention of minority students in engineering. Litzler and Samuelson (2013) analyzed data on 119 engineering students at 13 U.S. universities; they were particularly interested in the 41 students who had decided to stay after seriously considering leaving. The study found that there were both gender and racial differences in students’ reasons for persisting. Women were more likely than men to cite the rewards of the degree as a primary reason for staying. Women also were more likely to give, as a second reason, an aversion to quitting and a desire to show they could do it. There were ethnic/racial differences among the women as well; black and Hispanic women were more likely than their male counterparts to say that “they had come this far and it was too late to turn back,” while the same was not true for white and Asian women.

A study by Hernandez et al. (2013) of more than 1,000 high-achieving minority undergraduates, the majority of whom were female, in STEM disciplines found that the one factor that predicted attrition was having “performance-avoidance” goals, i.e., being motivated primarily by a desire to prove that one is not incompetent, no worse than others. These findings, along with Camacho and Lord’s, suggest that the retention of minority women presents a different set of challenges than the retention of white women in engineering.

Camacho and Lord’s (2013a, b) analysis points to the conclusion that the most important step that can be taken to increase the numbers of Latinas in engineering involves recruitment: More young Latinas need to be attracted to engineering programs. They note that professional groups are eager to do precisely this, but that their efforts are negated by a broader negative social definition of Latinas (and Latinos). Young people from this background are linked with low academic performance (thus lowering expectations), are associated with the issue of illegal immigration, and are allocated to schools that are under-resourced and frequently engage in what has been called “subtractive schooling,” which divests students of their language and culture.

Camacho and Lord (2013a, b) advocate a range of educational innovations to attract more Latinas to engineering. These included making the math curriculum more culturally relevant to Latinas; various forms of outreach to increase awareness of career opportunities in engineering and to mobilize the prestige of engineering careers; and efforts to bridge the classroom and community for Latino and Latina students, e.g., encouraging them to think of engineering as a way to help improve their communities. They also stress the need to be aware of and to mobilize the important support provided to Latina students by family, peers, and communities. And, they note that programs seeking to increase the number of Latina students in engineering should target two-year programs, an important “pipeline” of Latina and Latino students who can potentially go on to more advanced education.

Other research published this year echoed aspects of Camacho and Lord’s arguments about recruiting Latinas to engineering programs and extended them to African-American women as well. You (2013) analyzed data on 10,599 participants in the Education Longitudinal Study of 2002 to understand gender and ethnic differences in advanced math-course taking and their effects on choosing STEM majors in college. The results indicated that African-American and Hispanic students were less likely to take advanced math courses in high school than white or Asian-American students; racial differences were actually greater than gender differences in this study. Else-Quest, Mineo, and Higgins’ (2013) study of more than 300 participants in the Philadelphia Adolescent Life Study confirmed that Latino and African-American adolescents were the lowest-achieving students in math and science; however, they found that, within these groups, males were lower achieving than females. You (2013) added that, across all ethnic/racial groups, men were more likely to choose STEM majors than female students, although the gender differences were greater for whites. Data such as these point to the particular difficulty of recruiting minority women to engineering, since both race and gender are relevant to whether students

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**Engineering Bachelor’s Degrees by Gender within Race/Ethnicity, 2012**

<table>
<thead>
<tr>
<th>Race/Ethnicity</th>
<th>Male</th>
<th>Female</th>
<th>Total</th>
<th>% Female</th>
</tr>
</thead>
<tbody>
<tr>
<td>African-American</td>
<td>2489</td>
<td>896</td>
<td>3385</td>
<td>26.5%</td>
</tr>
<tr>
<td>Hispanic</td>
<td>5734</td>
<td>1614</td>
<td>7348</td>
<td>22.0%</td>
</tr>
<tr>
<td>Asian-American</td>
<td>7681</td>
<td>2269</td>
<td>9950</td>
<td>22.8%</td>
</tr>
<tr>
<td>Native American</td>
<td>276</td>
<td>76</td>
<td>352</td>
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</tr>
<tr>
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<td>1343</td>
<td>56286</td>
<td>23.9%</td>
</tr>
<tr>
<td>Foreign National</td>
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<td>1403</td>
<td>6640</td>
<td>21.1%</td>
</tr>
<tr>
<td>Other/unknown/multi</td>
<td>5214</td>
<td>1343</td>
<td>6557</td>
<td>20.5%</td>
</tr>
<tr>
<td>Total</td>
<td>71484</td>
<td>16692</td>
<td>88176</td>
<td>18.9%</td>
</tr>
</tbody>
</table>

*Source: Yoder, Engineering by the Numbers, American Society for Engineering Education, 2013*
take advanced math coursework in high school. On the other hand, since minority girls seem to outperform minority boys in some respects, and since gender differences in these groups are less significant, effective efforts to increase the numbers of minority women in engineering may not take the same form as those to increase the numbers of white women in the profession.

The underrepresentation of minority women is particularly apparent in the academy. In May 2013, the Institute for Women’s Policy Research organized a convening of almost 50 experts to discuss the underrepresentation of women faculty of color in STEM and issued a full-scale report later in the year (Hess, Gault, and Yi 2013). The report notes that women faculty of color represent only 5.7 percent of STEM doctorates in faculty positions at four-year colleges, universities, and affiliated centers and institutes, although they represent 15 percent of the overall working-age labor force. To make matters worse, those few women of color who obtain faculty positions are less likely to advance through the ranks. Participants in the convening discussed various characteristics of women of color that help to explain these problems: Women of color are less likely to be married and have access to second incomes, although they are responsible for raising children; wealth gaps that limit personal resources to support research; and the burden of health conditions particularly likely to affect women of color. They also noted that women faculty of color encounter high community service demands that draw them away from research, insufficient social support, and ongoing discrimination. The report outlines a set of recommendations for increasing the numbers of women faculty of color in STEM. These include developing a national standard for valuing the volunteer and service work these women perform; creating funding and other programs to help overcome the resource disadvantages women faculty of color encounter; and various measures to create greater awareness of the value of diversity and the reality of barriers and inequities among faculty, search committees, and academic administrators.

Women working as engineers
Many researchers previously have noted that the percentages of engineering degrees earned by women exceed the percentages of employed engineers who are women. The underrepresentation of women in engineering, then, is not simply a matter of women’s initial lack of interest in the profession or their choices to leave engineering education before they finish their degrees. Clearly, some women earn engineering degrees and enter the labor market, but drop out of the engineering labor force at some point later in their lives. Skaggs’ (2013) study of a small group of undergraduate engineering students at a land-grant university confirms this by finding that some of the women who persisted in an engineering program did so not because they planned to be engineers, but because they believed they could do anything with an engineering degree.

Given the obvious importance of understanding what happens to female engineering graduates after they complete their degrees, it has been surprising that in recent years, researchers have devoted relatively little attention to employed engineers and to engineering labor markets. This year, however, there was renewed interest in this aspect of the question, and a number of significant pieces of research were published that shed light on what may be happening. Several pieces of research we reviewed examined why some women persist in engineering and why others leave. All noted that women had to contend with an engineering environment in which, to some degree, they did not obviously “fit.” Their ability to develop a sense that they did, in fact, belong, and were competent engineers was among the factors identified as predicting persistence in engineering. Ayre, Mills, and Gill (2013) continued their ongoing research on women in engineering in Australia with a study of 56 women who graduated from a civil engineering program between 1974 and 2008. Their interest is in why these women stayed in the profes-
Founders Award
Sheila Edwards Lange, Ph.D., University of Washington

The National Academy of Engineering

New Female Members
Donna G. Blackmond, Ph.D., The Scripps Research Institute
Dawn A. Bonnell, Ph.D., University of Pennsylvania
Ursula M. Burns, Xerox Corporation
Helen Greiner, CyPhy Works Inc.
Sharon L. Wood, Ph.D., University of Texas Society of Women Engineers (SWE) Awards

Achievement Award
Eve Sprunt, Ph.D., Chevron Corporation
Suzanne Jenniches Upward Mobility
Cindy R. Kent, 3M

Resnik Challenger Medal
Christine E. Geosling, Ph.D., Northrop Grumman Corporation

Entrepreneur Award
Pamela Dingman, P.E., Engineering Design Consultants LLC

Distinguished Engineering Educator
Beth Todd, Ph.D., F.SWE, The University of Alabama

Work Life Integration Award
Kathleen Cullinan Bove, GE Global Research

Emerging Leaders
Linh Dang, Northrop Grumman Aerospace Systems
Lisa E. DePew, Intel Corporation
Sonja Domazet, Northrop Grumman Corporation
Elizabeth Garype, Sikorsky Aircraft
Jessica Gullbrand, Ph.D., Intel Corporation
Ya Guo, Ph.D., Medtronic Inc.
Diane C. LaFortune, Northrop Grumman
Pushpa Manukonda, John Deere
Susan Rea Peterson, Ph.D., Medtronic Vascular
Danielle Simonelli, Ph.D., Intel Corporation

SWE Distinguished New Engineer
Holly Ann Friedt, Rolls-Royce North America
Maureen E. Masiulis, General Dynamics Advanced Information Systems
Jessica R. Mattis, General Motors
Karen E. Roth, Air Force Research Laboratory
Natalie Vanderspiegel, Solar Turbines Incorporated

Eileen Vélez-Vega, P.E., Kimley-Horn and Associates Inc.
Charlene Willenbring, UTC Aerospace Systems

Fellow Grade
Elizabeth A. (Libby) Allman, Hallmark Cards
Naomi Brill, Consultant
Virginia Counts, P.E., Medtronic Inc.
Semahat S. Demir, Ph.D., Istanbul Kütürk University
Mary E. Kinsella, Ph.D., Air Force Research Laboratory, Wright-Patterson Air Force Base
Marilyn Mikulski Reeder, Westinghouse Electric Company
Linda M.S. Thomas, The Boeing Company

Distinguished Service Award
Anita E. Gale, F.SWE, The Boeing Company
Felicta Saiez, F.SWE, Ohlone College

Outstanding SWE Counselor
Helene Finger, P.E., California Polytechnic State University, San Luis Obispo

Outstanding Faculty Advisor
Elizabeth A. Thompson, Ph.D., Indiana University-Purdue University Fort Wayne

Outstanding Collegiate Member
Katherine Alfredo, Ph.D., The University of Texas at Austin
Christella J. Chavez, The University of Oklahoma-Tulsa
Rachel Hughes, The University of Alabama
Sofie Leon, University of Illinois at Urbana-Champaign
Nicole Navinsky, Southern Methodist University

The Anita Borg Institute for Women and Technology Awards

Women of Vision Innovation Award
Genevieve Bell, Ph.D., Intel Labs

Women of Vision Social Impact Award
Vicki Hanson, Ph.D., University of Dundee and IBM Research

Women of Vision Leadership Award
Maja Mataric, Ph.D., University of Southern California

Intel Science Talent Search Awards
Sara Volz, first place, Colorado
Hannah Larson, fourth place, Oregon
Brittany Wenger, eighth place, Florida
Sahane Vasudevan, 10th place, California

National Society of Black Engineers (NSBE) Awards

Golden Torch Legacy Award
Pat Walker Locke, Life Plan Services LLC and Seeds of Humanity Foundation Inc.

Graduate Student of the Year
Chinyere Mbachu, Tennessee Technological University

Pioneer of the Year
Toni K. Brown, The Boeing Company

Pre-College Initiative Director of the Year
Sybil Y. Brown, Ph.D., Northland High School

Pre-College Initiative Program of the Year
Helen Howell, Martinsville and Henry County NSBE Jr. Chapter

Pre-College Initiative Student of the Year (Female)
Joi Stevens, San Antonio City Wide NSBE Jr. Chapter

Outstanding Woman in Technology
Jamesha Parks, Northrop Grumman Aerospace Systems

Mike Shinn Distinguished Member of the Year (Female)
Sarah Brown, Northeastern University

Alumni Extension Member of the Year
Sheila Alves, Virginia Information Technologies Agency

Society of Hispanic Professional Engineers (SHPE) Awards

Community Service Award
Deborah Berebichez, Ph.D., Morgan Stanley Capital International

Jaime Oaxaca Award
Diana Gomez, California High-Speed Rail Authority

Junipero Serra Award
Lynnette Madsen, National Science Foundation

SHPE Star of Today Award
Teresa Hamid, IBM Corporation

SHPE Star of Tomorrow Award
Nicole Theberge, NAVAIR

Student Role Model, Graduate
Eva Gabriela Baylon, Stanford University
Women Engineering Deans

By Peggy Layne, P.E., F.SWE

Cammy R. Abernathy, Ph.D. .................................... University of Florida
Linda Abriola, Ph.D. ........................................... Tufts University
Emily L. Allen, Ph.D. .......................................... California State University, Los Angeles
Cristina H. Amon, Ph.D. ...................................... University of Toronto
Nada Marie Anid, Ph.D. ...................................... New York Institute of Technology
Nadine N. Aubry, Ph.D. ...................................... Northeastern University
M. Katherine Banks, Ph.D. .................................. Texas A&M University
Gilda A. Barabino, Ph.D. ..................................... City College of the City University of New York
Julia Biedermann, Ph.D., P.Eng. ......................... Conestoga College
Stacy G. Birmingham, Ph.D. ............................. Grove City College
Barbara D. Boyan, Ph.D. ..................................... Virginia Commonwealth University
Mary C. Boyce, Ph.D. .......................................... Columbia University
Candis S. Claiborn, Ph.D. .................................. Washington State University
Robin Coger, Ph.D. ........................................... North Carolina A&T State University
Teresa Dahlberg, Ph.D. ...................................... Cooper Union
Natacha DePaola, Ph.D. ..................................... Illinois Institute of Technology

Doreen Edwards, Ph.D. ...................................... New York State College of Ceramics at Alfred
Julie R. Ellis, Ph.D., P.E. ...................................... Western Kentucky University
Jacqueline A. El-Sayed, Ph.D. ......................... Kettering University
Elizabeth A. Eschenbach, Ph.D. .................... Humboldt State University
Lorraine N. Fleming, Ph.D., P.E. ...................... Howard University
Liesl Folks, Ph.D. ............................................ University at Buffalo, The State University of New York
Jane S. Halonen, Ph.D. ...................................... University of West Florida
Deborah Huntley, Ph.D. ..................................... Saginaw Valley State University
Leah H. Jamieson, Ph.D. .................................... Purdue University
Sharon A. Jones, Ph.D., P.E. .............................. University of Portland
Zella Kahn-Jetter, Ph.D. .................................... Saint Martin’s University
Maria V. Kalevitch, Ph.D. ................................. Robert Morris University
Anette M. Karlsson, Ph.D. ................................. Cleveland State University
Debra Larson, Ph.D., P.E. ................................. California Polytechnic State University
Charla Miertschin, Ph.D. ................................... Winona State University
Amy J. Moll, Ph.D. ........................................... Boise State University
Lynne A. Molter, Sc.D. ...................................... Swarthmore College
Mitzi Montoya, Ph.D. ....................................... Arizona State University, Polytechnic campus
Cherry Murray, Ph.D. ....................................... Harvard University
Sarah A. Rajala, Ph.D. ....................................... Iowa State University
Anca L. Sala, Ph.D. ......................................... Baker College
Elaine P. Scott, Ph.D. ........................................ University of Washington, Bothell
Laura J. Steinberg, Ph.D., P.E. ......................... Syracuse University
Pearl Sullivan, Ph.D., P.Eng. ............................. University of Waterloo
T. Kyle Vanderlick, Ph.D. ................................. Yale University
Susan E. Voss, Ph.D. ....................................... Smith College
Sharon L. Wood, Ph.D., P.E. ............................. The University of Texas at Austin
Kimberly A. Woodhouse, Ph.D., P.Eng. ........... Queen’s University
Sandra Woods, Ph.D. ...................................... Oregon State University
J.K. Yates, Ph.D. ............................................ Ferris State University

Source: American Society for Engineering Education

2013 LITERATURE REVIEW

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profession. Important to the development of the probability of their leaving the engineering profession by women engineers is their job satisfaction, which in turn decreases as a result of lower work-life balance, gender stereotyping, and the need to define an engineering identity. Interestingly, according to Ayre, Mills, and Gill, women engineers who persisted and had fewer children, on average, than being pushed into it by others; they were also less likely to be married and had fewer children, on average. The authors conclude that female engineers who persisted exhibited higher levels of self-efficacy, a strong engineer identity, and strong engagement with their work.

Contextual factors also mattered, as persisters were more likely to report having chosen engineering as a career rather than being pushed into it by others; they were also less likely to be married and had fewer children, on average. The authors conclude that female engineers who persisted experienced engineering as a career rather than being pushed into it by others; they were also less likely to be married and had fewer children, on average. The authors conclude that female engineers who persisted exhibited higher levels of self-efficacy, a strong engineer identity, and strong engagement with their work. Contextual factors also mattered, as persisters were more likely to report having chosen engineering as a career rather than being pushed into it by others; they were also less likely to be married and had fewer children, on average. The authors conclude that female engineers who persisted exhibited higher levels of self-efficacy, a strong engineer identity, and strong engagement with their work. Contextual factors also mattered, as persisters were more likely to report having chosen engineering as a career rather than being pushed into it by others; they were also less likely to be married and had fewer children, on average. The authors conclude that female engineers who persisted exhibited higher levels of self-efficacy, a strong engineer identity, and strong engagement with their work. Contextual factors also mattered, as persisters were more likely to report having chosen engineering as a career rather than being pushed into it by others; they were also less likely to be married and had fewer children, on average. The authors conclude that female engineers who persisted exhibited higher levels of self-efficacy, a strong engineer identity, and strong engagement with their work.

Singh et al. (2013) agree, based on a survey of 2,042 women who had received bachelor’s degrees in engineering in the U.S. since the early 1980s. They found that a sense of self-efficacy in engineering enhanced women engineers’ job satisfaction, which in turn decreased the probability of their leaving the profession. Important to the develop-
A sense of self-efficacy were opportunities to obtain training and for personal development. They recommend that employers offer developmental opportunities so that women engineers would feel confident that they have the right skills and have the ability to employ them on the job.

Moore, Meiksins, and Root (2013) shed light on women who leave the STEM workforce. They studied a pooled sample from the Displaced Worker Surveys, seeking to determine whether STEM workers are exposed to job loss and how they respond to it. They found, first, that STEM workers are quite vulnerable to job loss, with women and men equally affected. Most find new work after job loss. Important gender differences emerged, however, particularly when family status was taken into consideration. The study found that married women with children were more likely than married men with children to leave the work force altogether after losing a STEM job. On the other hand, women who returned to employment were more likely to leave STEM fields, a finding that was true primarily of unmarried women. This finding suggests that many women experience discomfort in STEM fields, with job loss functioning as a catalyst for their eventual decision to leave, with the additional variable that family situation shapes their decision as to how to respond to that discomfort.

Finally, Glass et al. (2013) looked more broadly at the issue of women’s exit from STEM careers by analyzing 1,258 cases from the National Longitudinal Survey of Youth for the years 1979-2008. They identified two groups of college-degreed recipients, some of whom had had job spells in STEM, while others had had professional/managerial job spells. The study sought to answer the question of whether (and why) women are more likely to exit STEM careers than comparable jobs in professional/managerial fields. Glass et al. explicitly avoid comparisons with males in these fields, arguing that the male/female comparison would not shed light on the question of why women leave STEM fields at rates higher than observed in other fields where women are present.

This study produced striking and significant results. First, women in STEM were dramatically less likely to persist in their field — they were more than eight times more likely to leave than women in other professional jobs. When they leave, they do not leave the labor force altogether, shifting instead into other non-STEM professional jobs. The disparities were not the result of demographic differences between the two groups of women (e.g., there were no differences in rates of marriage and numbers of children). Glass et al. did find some evidence that family formation had a more negative effect on retention in STEM than in other fields. They also note that women with advanced degrees were particularly likely to leave STEM, suggesting that jobs in which cultural aspects of STEM are most pronounced (high-level jobs requiring substantial technical skill) intensify the lack of “fit” between women and STEM employment. They note, however, that most women leave STEM early on, before the most significant effects of marriage and family develop and before women rise to the most challenging technical positions. They speculate that there is something about the organization of STEM work, and/or about co-worker attitudes and expectations, that may be making women feel they do not belong. However, their data do not allow them to examine this hypothesis, which remains speculation.

### Engineering Bachelor’s Degrees by Gender within Race/Ethnicity, 2012

<table>
<thead>
<tr>
<th>Race/Ethnicity</th>
<th>Male</th>
<th>Female</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total</td>
<td>71484</td>
<td>16692</td>
</tr>
<tr>
<td>Other/unk/multi</td>
<td>5214</td>
<td>1343</td>
</tr>
<tr>
<td>Foreign National</td>
<td>5237</td>
<td>1403</td>
</tr>
<tr>
<td>Caucasian</td>
<td>44853</td>
<td>9091</td>
</tr>
<tr>
<td>Native American</td>
<td>276</td>
<td>76</td>
</tr>
<tr>
<td>Asian-American</td>
<td>7681</td>
<td>2269</td>
</tr>
<tr>
<td>Hispanic</td>
<td>5734</td>
<td>1614</td>
</tr>
<tr>
<td>African-American</td>
<td>2489</td>
<td>896</td>
</tr>
</tbody>
</table>

*Source: Yoder, Engineering by the Numbers, American Society for Engineering Education, 2013*
Glass et al. hypothesize that an important reason women feel they do not belong results from the tensions that arise when they have children and have to balance family and work responsibilities in ways that most men do not. Several other studies focused more squarely on the issue of work/family conflict and its effect on women’s persistence in engineering. Beddoes and Pawley (2013) examined a group of 19 STEM faculty members at a Midwestern university and found that their respondents perceived particularly intense conflict between work and family in the academy. They tended to see jobs in industry and government as preferable for women because work/family and parental leave policies are more common in those settings.

Herman, Lewis, and Humbert (2013) studied 24 scientists and engineers who were mothers working for three different companies in France, the Netherlands, and Italy. Their respondents reported that after having children, they were no longer seen as “one of the boys” and that maternity leave and reduced work hours placed them in a stigmatized position, raising questions about the optimism shown by Beddoes and Pawley’s respondents regarding the positive effects of family-friendly policies. The authors describe the various strategies the women adopted to overcome this reaction, most of which did not challenge the male culture of their work settings. Some tried to work the expected long hours and juggle their family roles; others chose to accept stalled careers and prioritize motherhood. Only a few were willing to adopt a trailblazer role and to try to break the mold. Overall, the study indicates that, in Europe at least, family roles continue to get in the way of women’s ability to “fit” in to science and engineering workplaces.

Beddoes and Pawley (2013) also raise an important question that pertains both to the work/family literature and to the research on women’s fit in engineering. They note that their respondents talked about work/family conflict by making use of a discourse of “choice.” They recognized that women and men were in different positions, but emphasized that women make choices that are good for them and are based on what they believe is important. Beddoes and Pawley note that this discourse tends to obscure the unequal realities faced by men and women — men do not have to choose between work and family as do many women — and reduces the pressure to change the context in which choices are being made. A similar point can be made about women’s “fitting in” to engineering. Several of the studies we reviewed identified strategies that women developed to deal with and counteract the less-than-welcoming context they found in engineering. But, the ability of some women to adapt to the prevailing norms of engineering workplaces may actually obscure the gendered circumstances that require women — and not men — to adapt in the first place. This is a theme taken up in a growing feminist literature on engineering culture, to be discussed momentarily.

A very different aspect of women’s experience in engineering workplaces and labor markets is the focus of Cech’s (2013) study of a sample of 9,936 engineers drawn from the National Survey of College Graduates. Cech finds that the average annual gender wage gap in engineering, controlling for a variety of factors, was $13,000. In seeking to explain this difference, she points to patterns of gender segregation within the profession. Women are segregated into technical and social subdisciplines and work activities that, on the average, are less well remunerated. Thus, women are less likely to work in electrical and mechanical engineering, fields that are better paid than fields such as chemical or industrial engineering, in which women are more common. Similarly, women are less likely to have technical primary work activities (research, development, computer applications) and more likely to have social primary work activities (management, administration, teaching), which again maps on to pay inequalities.

Hunt et al. (2013) argue that this form of gender segregation explains another aspect of the difference between male and female engineers — the underrepresentation of women among patentees. Although they found that women’s having lower percentages of doctoral degrees played a smaller role, the basic problem is that women are underrepresented in the fields and types of work in which patents are most common. As Reskin and Roos (1990) argued in their classic work on gender segregation, it is difficult to tell whether “female” portions of an occupation are devalued because they become associated with women, or whether men leave them to women because they are already devalued. This is an important issue that merits further exploration, particularly in view of the effort to attract more women to engineering by emphasizing elements of it that seem more consistent with women’s interests and preferences (see the next section for more on this issue).

Finally, a number of studies, including several that reported on programs funded by NSF-ADVANCE, contributed to the large and growing literature on the experiences of women working in academic science and engineering. Settles et al. (2013) report on data collected at the University of Michigan regarding the consequences of personal gender discrimination, the derogation of one’s own gender, and sexism toward women. They found that these negative experiences are linked to scholarly alienation and perceptions of a negative workplace climate, which in turn reduced job satisfaction. Interestingly, although it was women faculty who experienced the most negative experiences, men, too, were negatively affected by these experiences; they, too, linked them to perceptions of negative workplace culture and scholarly alienation. Whether these perceptions occurred because they feared that they, too, might one day be mistreated, or whether they simply sympathized with female colleagues was unclear. Settles et al. also found that men experienced derogation of their sex, but this did not result in negative feelings about the work environment, perhaps because men’s dominant position allowed them to pass these experiences off as inconsequential or a joke.
Long et al. (2013) describe interesting research at Purdue University on the mentoring networks of women faculty in engineering. The women faculty studied were not satisfied with the formal mentoring program at their institution, which they perceived as focused on progress toward promotion, having limited scope, and not meeting all of their needs. They developed a diverse set of network connections alongside formal institutional mentoring networks. These included both human and nonhuman resources, varied by whether the faculty member was tenured or untenured, with the latter tending to have more extensive networks that extended beyond the home institution; and by race/ethnicity, with minority women tending to have more extensive networks. This is a small, exploratory study, but it points to a need for additional research on the kinds of mentoring networks women faculty develop and on what works and what does not work within these networks.

Carpenter and O’Neal (2013) describe a successful ADVANCE program at Louisiana Tech University that resulted in increased job satisfaction and work self-efficacy, increased self-confidence, and decreased sense of isolation for women STEM faculty. The program involved a range of familiar elements: a formal mentoring program; professional development and training on climate issues; creating a male advocates and allies program; and creating publicity materials to increase the visibility of female faculty on campus. While not a groundbreaking program, LSU’s experience demonstrates that it is possible to take concerted action to improve the situation of women faculty in STEM programs.

Fox and Xiao (2013) examine a question that likely will become of increasing importance in the study of academic science and engineering: involvement in entrepreneurial activity. They focus on computer science, an area in which the production of marketable products has become an important part of what faculty do, as it has for other sectors of academic science and engineering. Fox and Xiao are interested in female faculty members’ attitudes toward such activity. They examine 170 female associate professors of computer science to determine whether they believe that time spent in entrepreneurial activity enhances their promotion chances and whether their attitudes are affected by their departments’ culture regarding entrepreneurial activity. They found that neither women’s involvement in such activity as measured by both time and quality, nor their departmental climate predicted their perceived chances of promotion to full professor. Instead, female faculty tended to view more conventional academic achievements, such as publications in well-regarded, refereed journals, as the key to promotion. Fox and Xiao lack a male comparison group, so they cannot say whether these attitudes are specific to one gender. But, they speculate that female faculty in computer science may feel less secure in their academic positions and be less willing to break the academic mold and take the risk of engaging in entrepre-
neurial activity. As universities become increasingly focused on patents and marketable products, this may work to the disadvantage of female faculty seeking promotion.

**The feminist critique: transforming engineering?**

One view of what needs to be done to increase the numbers of women in engineering emphasizes that focusing solely on women is not the answer. From this perspective, efforts to encourage gender equality in engineering by increasing the numbers of young women taking advanced math classes early in their academic careers; or by ensuring that potential women engineers see female role models; and/or receive the same kinds of economic and social support along the way as their male counterparts, are all inherently limited because they fail to confront the gendered character of engineering as a discipline and as a profession.

A number of articles reviewed this year renewed the call to incorporate feminist ideas into research on engineering. Riley (2013), for example, reviewed three “cases” of engagement between feminism and the teaching of engineering ethics: the work of Caroline Whitbeck, Ph.D.; the incorporation of notions of “care” and “justice” into engineering ethics; and an instructional film entitled “Henry’s Daughters.” In each case, these efforts exhibited reluctance explicitly to engage with feminist ideas and thus limited the transformative possibilities of each endeavor. She is particularly critical of “Henry’s Daughters” — which attempts to encourage engineering students to think about issues of gender in engineering — for everything from its title, which defines women in relation to a man, to its approach to sexual harassment, which rehashes traditional attitudes about female attractiveness. Her contention is that a truly transformative engagement with feminism would produce a more valuable shift in thinking about engineering ethics and a corresponding improvement in approaches to women within the profession.

Beddoes (2013) interviewed 15 faculty associated with feminist research in engineering education to explore how a feminist critique could benefit the field. She argues that her respondents identified a number of potential benefits, including an awareness that changing women without changing engineering was not likely to be a successful strategy; a shift in focus from the individual to structural concerns; and increased sensitivity to the issue of who benefits from research and who should be made aware of it. She notes, as well, that feminist ideas continue to struggle to find a welcome in engineering journals, which lack reviewers familiar with feminist approaches and methods, and which continue to be resistant to qualitative methods.

Implicit in this kind of work is the idea that engineering itself needs to be problematized. If women are not attracted to or comfortable in engineering, attention must be devoted to what it is about engineering that causes this, and, presumably, to how that might be changed. Consistent with this line of argument, several studies noted that women in engineering experienced various kinds of discomfort and had to take steps to “cope” with these gendered aspects of engineering in order to persist.

The study by Ayre, Mills, and Gill (2013) discussed above provides a good

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**Percent of Bachelor's Degrees Awarded to Women by Discipline, 2012**

![Bar chart showing the percentage of bachelor's degrees awarded to women by discipline in 2012. The highest percentage is for Environmental Engineering at 45.5%, followed by Biomedical Engineering at 30.2%.](chart.png)

*Source: Yoder, Engineering by the Numbers, American Society for Engineering Education, 2013*
example of women struggling with gendered engineering settings. Their respondents’ ability to develop a sense of belonging was shaped by the ability of the women in question to redefine engineering as something they, as women, were good at. So, while respondents took it as a given that engineers should possess technical skills, they put greater emphasis on the importance of people skills. Underlying this argument is the view that, as conventionally presented, engineering feels masculine to female engineers; to feel as if they belong, they have to redefine it as something more conventionally female. This study is limited by the lack of a male comparison group (who could, of course, similarly emphasize people skills). Nevertheless, Ayre, Mills, and Gill provide evidence that female engineers find it necessary to redefine engineering in ways that are arguably gendered in order to belong.

Hatmaker (2013) reports on a study of 52 women engineers in the United States that comes to similar conclusions. Her respondents indicate that they found their status as women marginalized their professional identity; that their expertise and competence as engineers were called into question simply because of gender. The prevailing definition of engineering competence as male forced women to engage in a range of strategies to establish their identity as engineers, rather than as women. Some of these involved coping strategies that allowed women to assert that they belonged despite their gender. Other strategies were more potentially transformative, as they involved not just saying that women could compete with men on male terms, but could actually add something new and different to the profession as women.

One of the more interesting conclusions emerging from Hatmaker’s research is the reality that some of the strategies women employ to cope with the masculine character of engineering tend to reinforce that masculinity, while others offer the possibility of gender transformation in engineering. This argument seems to link well with the contention, present in many studies of women in engineering, that the profession needs to make itself more welcoming to women, to emphasize those aspects of what engineers do that might appeal to women, such as helping people solve problems, improving the environment, etc.

Some of the research we reviewed this year provided ambiguous, perhaps even contradictory evidence about whether this approach actually appealed to aspiring women engineers or was likely to be effective. For example, Matusovich, Oakes, and Zoltowski (2013) report on a small-scale study of eight participants in the EPICS (Engineering Projects in Community Service) project at Purdue in 2006. EPICS is a program of design courses, involving multidisciplinary teams that partner with community organizations, agencies, or schools to solve problems that can be addressed with technology. The program has been shown to attract women at higher rates than is typical for engineering majors at Purdue. One possible reason for the program’s success in drawing women to engineering is that it involves a “hands-on” approach to learning, something that has been argued attracts women more than the traditionally abstract, lecture-based learning typical of undergraduate engineering curricula. And, indeed, the women who participated in the program cited this as a virtue of EPICS — they emphasized the fact that the contextualized learning enhanced their understanding of the material. On the other hand, Matusovich, Oakes, and Zoltowskis are not able to show that this is specific to women — in the absence of a male comparison group, they can only say that the women they spoke to enjoyed this aspect of the program (the men could have as well!). And, another aspect of the program that has been argued to be potentially appealing to women, its community orientation, was not cited by women participants as a significant motivator for joining, although they were aware that this was a feature of the program.

Perhaps even more revealing is research by Bystydzienski and Brown (2012) on a group of 138 10th-grade girls who participated in an NSF intervention and research project called Female Recruits Explore Engineering (FREE) in 2008. The program was designed to expose girls to engineering through an exploration of engineering websites, participation in hands-on engineering projects, and by encouraging communication among participants while they were taking part in program activities. The researchers participated in the program itself, observed participants as the program unfolded, and interviewed 24 of the participants as the program drew to an end.

What they found was that young women’s involvement with engineering was “gendered.” They were aware of, and skeptical of it, as being more for men. But, they also gravitated toward areas of engineering perceived as more female friendly, such as environmental engineering. The study’s respondents expressed skepticism about presentations that portrayed engineering as friendly to women — the presenters were not engineers, they complained, and they worried that female engineers might be marginalized if they defined themselves as different and interested in different things than men. At the same time, when they took part in engineering activities, their behavior tended to reinforce gendered binaries: They tended to adopt feminized roles pursuing altruistic projects and taking on nurturing, managerial positions.

Research such as this reveals the tightrope that feminist critiques of engineering must walk. On the one hand, the argument that there are problems with requiring women to accommodate themselves to male structures within engineering has considerable power. On the other hand, empirical studies such as those reported above point to the dangers of pursuing this argument unaware of these tensions. If women insist that they are different, and assimilate to engineering on different terms than do men, the danger exists, as participants in the FREE program were aware, that women will be ghettoized in areas of engineering that others define as not really engineering, thereby perpetuating
and even strengthening the gendered character of the profession. An interesting question for future research presents itself here: Are men also attracted to the aspects of engineering that allegedly are more appealing to women? If so, a redefinition of engineering along those lines would not only attract more women, but would reshape it in ways that redefined engineering competence as something of which both men and women are capable.

About the authors

Peter Meiksins is interim vice provost for academic programs and professor of sociology at Cleveland State University. He received his B.A. from Columbia University and Ph.D. from York University, Toronto. Major publications include Putting Work in Its Place: A Quiet Revolution, with Peter Whalley (2002), and Changing Contours of Work: Jobs and Opportunities in the New Economy, 2nd edition, with Stephen Sweet (2012). He is a member of the editorial advisory board of Engineering Studies.

Peggy Layne, P.E., F.SWE, joined Virginia Tech in 2003 as director of the AdvanceVT program and is currently assistant provost reporting to the vice provost for faculty affairs. She holds degrees in environmental and water resources engineering and science and technology studies. Layne is the editor of Women in Engineering: Pioneers and Trailblazers and Women in Engineering: Professional Life (ASCE Press 2009). A Fellow of the Society of Women Engineers, Layne served as SWE FY09 president.

Elsa Camargo is a doctoral student in the Educational Leadership and Policy Studies program at Virginia Tech. Prior to beginning her doctoral program, she worked for the Council on Teacher Education at the University of Illinois at Chicago (UIC), where she analyzed national and state statutes and policies that affected the certification of teacher candidates. She holds a master’s degree in Hispanic studies from UIC and a bachelor’s degree in English and Spanish. Her research interests include college access and success for minority students and advancement of underrepresented faculty in higher education.

Katie Snead is a graduate student in Industrial and Organizational Psychology at Virginia Tech. Her research interests are broadly based in the application of cognitive science to leadership and followership and studying the relationships between leaders and their followers. She is also interested in measurement development and the practical application of assessments in applied settings.

References

Note: The following list of references comprises all of the noteworthy articles and conference papers found in our search of the 2013 literature on women in engineering. We selected for discussion in our review the literature that seemed to be based on the most substantial research and/or that offered interesting, fresh insights into the situation of women in engineering. For the convenience of interested readers, we have included the complete list of materials we consulted.


Atwood S. and J. Frey (2013). Gender Differences in Motivation to Perform K12 Outreach. 120th ASEE Annual Conference and Exhibition, June 23–26, 2013, Atlanta, American Society for Engineering Education.


Bilen-Green, C., R. Green, C. McGeorge, C. Anicha, and A. Burnett (2013). Engaging Male Faculty in Institutional Transformation. 120th ASEE Annual Conference and Exhibition, June 23–26, 2013, Atlanta, American Society for Engineering Education.


login.aspx?direct=true&db=a9h&AN=8370162&scope=site.


Carpenter, J. and P. O’Neal (2013). Building a More Supportive Climate for Women in STEM: Discoveries Made, Lessons Learned. 120th ASEE Annual Conference and Exhibition, June 23–26, 2013, Atlanta, American Society for Engineering Education.


Dagley, M., N. Ramlakhan, C. Young, and M. Georgiopoulos (2013). Establishing a Women’s Mentorship Network in a STEM Learning Community. 120th ASEE Annual Conference and Exhibition, June 23–26, 2013, Atlanta, American Society for Engineering Education.


Fowler, R. and L. Meadows (2013). Assessing Gender Differences in First-Year Student Motivation. 120th ASEE Annual Conference and Exhibition, June 23–26, 2013, Atlanta, American Society for Engineering Education.


Fu, K. et al. (2013). Broadening Participation: A Report on a Series of Workshops Aimed at Building Community and Increasing the Number of Women and Minorities in Engineering Design. 120th ASEE Annual Conference and Exhibition, June 23–26, 2013, Atlanta, American Society for Engineering Education.


Maeda, Y. and S. Yoon (2013). “A Meta-Analysis on Gender Differences in Mental Rotation Ability Measured by
the Purdue Spatial Visualization Tests: Visualization of Rotations (PSVT: R).” 


Pinelli, T., C. Hall, K. Brush, and J. Perry (2013). *Are There Gender Differences in How Male and Female Interns and Their Mentors Rate Workforce Skills in STEM Fields?* 120th ASEE Annual Conference and Exhibition, June 23–26, 2013, Atlanta, American Society for Engineering Education.


Building Skills with Social Media, Webinars, and Blogs

Typically associated with personal and recreational activity, social media has a pivotal role to play in career development.

By Seabright McCabe, SWE Contributor

In a world where cellphone users check their phones an average of 150 times a day, it’s vital to make time spent online an investment, not a distraction. Toward that end, SWE offers a robust selection of ways to gain new skills and find or offer support, all with the convenience of today’s online technology.

Social media
Online interaction is ever present in modern life and, for many, it’s a career necessity. In her recent webinar, “Social Media: The Cliff Notes for Busy Businesswomen,” Kelly Janowski, SWE social media and public relations manager, notes, “95 percent of recruiters use social media as a screening tool, and 39 percent use it to judge personality and organizational fit.”

Does that mean you have to build an online presence? No, but you may be missing out on significant contacts and opportunities. “Social media has changed the way we speak, network, stay in touch,” Janowski said. “It’s only natural to make it part of career strategy. Whether you’re active online or reluctant to log on, potential employers and business associates will search for you online. Why not take control of how these vital groups view you by mastering your social media outlets?”

The big three platforms are Facebook, LinkedIn, and Twitter, and SWE is growing fast in all of them. Janowski reported that “SWE recently celebrated 20,000 ‘likes’ on Facebook, and growth across all social media sites is up 45 percent over last year.”

Webinars
SWE webinar content has increased by more than 50 percent since 2012, and online participation is growing with it. Webinars are part of the Society’s continuing mission to provide professional assistance and development opportunities to women at every stage of their careers.

“Webinars are one of the many exclusive membership benefits you receive,” Janowski continued. “You can log in from anywhere and connect with the most innovative leaders in our industry, as well as access previously recorded content. With SWE’s robust offerings, you have a multitude of professional development courses just waiting for you.”

(For upcoming webinars, please see the sidebar on page 58.)

Blogs
Blogs are an informal way to discuss new ideas, share tips, and solve problems. Post-webinar blogs are also a venue for continuing discussion after the presentation ends.

For those on a tight schedule, microblogging site Twitter offers a rapid-fire forum where text messages are limited to 140 characters. Janowski recently introduced SWE “tweetchats,” which take place at noon Central Time on the third Friday of every month. “It’s an hour-long virtual coffee date,” Janowski said. “Each time, we discuss a given topic, such as developing leadership skills, preparing for your first semester of college, or setting goals. These sessions allow users to connect online with SWE and your fellow members, share insights, and learn from women who have walked the same path you’re on now.”

“Social media has changed the way we speak, network, stay in touch. It’s only natural to make it part of career strategy. Whether you’re active online or reluctant to log on, potential employers and business associates will search for you online. Why not take control of how these vital groups view you by mastering your social media outlets?”

- Kelly Janowski, SWE social media and public relations manager

continued on page 58
Finding the bandwidth

With so many offerings available, it’s easy to lose track of time or decide you don’t have time at all. Janowski has a number of suggestions that have worked for her and are simple to implement.

“Set a timer,” she said. “Decide you’re going to spend only X amount of time online in a given evening and get it done. Otherwise, it’s too easy to see an interesting story link and go down a rabbit hole of distraction. Sometimes I’ll send myself an email with interesting content I’d like to share and address it in the time I’ve set aside.”

Whether a webinar, tweetchat, or blog best fits your schedule, the final result is enhanced networking. “It’s no surprise to me that our online community loves to give advice,” Janowski said. “It’s an extension of the insight our members get from their sections and our annual conference. Some of the most popular topics have been from other members asking for guidance on career or education-related choices in their engineering journeys.”

What’s New in Webinars

2014 is chock full of presentations you won’t want to miss. Mark your calendars now, and remember: You can always find the webinars in the archives if you miss the date.


The electric utility system in the United States, often referred to as “the grid,” is being transformed by market forces, technology developments, and global competition. Join an IEEE smart grid expert, who will review the key factors leading to the development of the grid as we know it today, describe why and how those factors have changed dramatically, and examine new circumstances that will require an entirely different kind of electric grid, generally referred to as the “smart grid.”

March 27: “Biologically Inspired Engineering,” with Jacquelyn K. Nagel, Ph.D., assistant professor of engineering at James Madison University

Biological organisms, phenomena, and strategies, referred to as biological systems, provide insight into sustainable and adaptable design, which can be used to inspire innovative engineering solutions to human problems. Background information on biomimicry, knowledge transfer processes across the domains, and several examples of how biological inspiration has influenced the field of engineering will be given. Gain an understanding of how we can learn from nature to solve engineering problems.

April 17: “What Your Male Mentor Won’t Tell You! The Secrets to Power and Status,” with Linda Talley, Ph.D., body language expert and founder of Linda Talley & Associates

Power and status is an important aspect of social and, particularly, business relationships. When discussing men and women, male behavior is more often associated with power. How can women change this perception?

“It’s an hour-long virtual coffee date. ... These sessions allow users to connect online with SWE and your fellow members, share insights, and learn from women who have walked the same path you’re on now.”

- Kelly Janowski, SWE social media and public relations manager

This program will demonstrate how to motivate yourself to be perceived as powerful; how to handle interruptions; what body positions indicate power and status; how to use the verbal message to be perceived as powerful; and what reduces your power in the eyes of men.

April 29: “Venture Capital: How to Obtain It and What to Expect,” with Sharon Dauk, co-founder, Dauk/Wagner Investments

Venture capitalists invest in companies in return for an equity ownership with and gaining a return on that ownership, usually through a sale of the company or an IPO. With venture capital investments come expectations for the entrepreneur. The presenter will discuss when it’s right to seek venture capital, how to create a successful pitch, and what pitfalls to avoid. The webinar will also explore the extra challenges facing women seeking venture capital in this very competitive marketplace.

May 7: “Seven Steps to a Stellar LinkedIn Profile,” with Kelly Janowski, social media and public relations manager, SWE

Whether you’re actively looking for a new job or want to learn how the best in the business use LinkedIn, this webinar is for you. Janowski will walk attendees through best practices that will transform your online presence. Learn how to highlight your strengths and leave this session with actionable tips to improve your online profile now.

May 15: “Managing Transitions: Making the Most of Change,” with Barbara Taylor, partner, JanBara & Associates

In today’s world, all of us must continually deal with changes in all aspects of our lives — work, home, internally, and in the world around us. Gone are the days of “one-size-fits-all” solutions for dealing with change. This webinar provides a framework for understanding the impact of change on you and others — and how to effectively move through the transitions of change.

This program will demonstrate how to motivate yourself to be perceived as powerful; how to handle interruptions; what body positions indicate power and status; how to use the verbal message to be perceived as powerful; and what reduces your power in the eyes of men.
Engineering and Quilting

What might seem to a casual observer as two gender-specific and distinct behaviors turns out instead to be two creative and fulfilling activities, both requiring a mathematical mind.

By Marcie Mathis, SWE Editorial Board

I started quilting when I was in high school, teaching myself mostly through books and magazines, along with a couple of classes. At the time, I learned the traditional ways: cutting templates from cardboard (cereal boxes), tracing them on fabric, and then sewing the pieces together by hand. Then, of course, the final product was quilted by hand. I still have my first quilt, which is also my first unfinished project. Unfinished projects (UFOs) are kind of a running joke with quilters.

Quilting and counted cross-stitch were among the things that faded away while I was busy with college.

After I graduated and was a brand new engineer, working in my first job, I felt I needed to eschew most things considered “typical” for a woman. I didn’t want any of my work to be considered as less because I behaved in ways that would be considered typically feminine. So I took up other things I enjoyed, such as amateur (ham) radio and sailing.

Fast-forward 25 years, and eventually my interest in quilting overcame the stigma I had imposed on it. I met some other women who were ham radio operators, sailboat sailors, and also quilted. I joined the local quilt guild my friends belonged to and was overwhelmed by the changes quilting had undergone. The quilting world now included rotary cutters, long-arm quilting machines, and stores specializing in quilting tools, fabric, and supplies. There were high-tech, computerized sewing machines that cost about the same as an economy car did when I first started quilting. Now, what used to take weeks to accomplish could be done in a day.

Engineering and quilting

Over the last year, the speakers at our local quilt guild have included an engineer and a mathematician — which definitely caught my attention. I started thinking about how engineering impacts both the designs I choose for my quilts and quilting in general. Quilting entails math. Quilters can find formulas, but by understanding the underlying math involved, it’s possible to get more creative, make adjustments, and finish the project with the quilt you envisioned. Considering the angles involved with quilt design, the need to accurately calculate yardage, and the development of easier and more-efficient piecing and cutting techniques, the connection between quilting and engineering makes sense. It’s not hard to see how an engineer could love quilting, and how being a quilting instructor or author could be both a satisfying hobby or an alternative or part-time career for someone with an engineering degree.

One way my engineering shows in my quilting is that I tend toward geometric quilt designs, my favorite being hexagons pieced using the English paper piecing technique. Several people told me my last quilt looked like something an engineer would design. I haven’t completely embraced all the new-fangled ways of doing things. I enjoy handwork, and because the main point of quilting is to do something pleasurable, I do most of my work by hand.

The way a quilt design usually starts for me is with hexagon graph paper and colored pencils. I have also been known to use Microsoft Word to do some of the designing. Even the old-fashioned paper piecing technique I use involves engineering at some point because I use pre-cut paper pieces manufactured by a company.

Even though at times I still find myself justifying being an engineer who quilts, I have been an engineer long enough to recognize that being a complete person — even with traditionally feminine hobbies — helps me convey diversity of thought to work to help solve problems, as well as bringing better balance into my life.

Marcie Mathis graduated from the University of Washington with a bachelor’s degree in electrical engineering. She has spent most of her engineering career as a civilian U.S. Navy employee and currently works at the Puget Sound Naval Shipyard and Intermediate Maintenance Facility in Bremerton, Wash. Mathis joined SWE in 1988 as a student and currently serves on the multicultural committee and as a member of the SWE Magazine editorial board.
SWE Members Receive The Manufacturing Institute Awards

The Manufacturing Institute awarded 160 recipients, including 13 SWE members, the Women in Manufacturing STEP (science, technology, engineering, and production) Award. The STEP Awards honor women who have demonstrated excellence and leadership in their careers and represent all levels of the manufacturing industry, from the factory floor to the “C-suite.”

“These 160 women are the faces of exciting careers in manufacturing,” said Jennifer McNelly, president, The Manufacturing Institute. “These women were selected because they each made significant achievements in manufacturing through positive impact on their company and the industry as a whole.”

The STEP Awards are part of the larger STEP Ahead initiative launched in 2012 to examine and promote the role of women in the manufacturing industry through recognition, research, and best practices for attracting, advancing, and retaining strong female talent.

A recent survey from Deloitte and The Manufacturing Institute found that nearly 82 percent of American manufacturing companies have a moderate to severe shortage of available, qualified workers. Contributing to this gap is the underrepresentation of women in the industry. While women make up approximately 50 percent of the labor force, that number is only about 24 percent in the manufacturing labor force.

The STEP Ahead initiative not only celebrates the accomplishments of outstanding current leadership in manufacturing but also aims to inspire the next generation of female leaders.

SWE members who received the STEP Award this year include:

Elizabeth Bierman, senior program manager, Honeywell Aerospace
Sandra Bouckley, P.E., vice president, operations, Electrical Systems and Services Group-Electrical Sector, Eaton Corp.

Cally Edgren, program manager, product environmental compliance, Rockwell Automation
Jonna Gerken, deputy CIPT leader, 30K Core, hot section engineering, Pratt & Whitney
Mary Beth Heydrick, business manufacturing technology leader, The Dow Chemical Company
Shari Kennett, responsible care leader, The Dow Chemical Company
Deborah MacKay, vice president, total customer experience systems, Lexmark International
Jessica Mattis, shift leader, paint production, General Motors
Helen Patricia, quality assurance manager, Kennametal
Jackie Pier, director, SEL University, Schweitzer Engineering Laboratories Inc.
Sue Shimoyama, vice president, global sales and marketing operations, Rockwell Automation
Alyse Stofe, engineering program manager, Medtronic
Melissa Tata, director, program management, global supply chain enablement, Dell

AAES National Engineering Award
Christine Shoemaker, Ph.D., Joseph P. Ripley Professor of Engineering in Civil and Environmental Engineering and of Operations Research and Information Engineering at Cornell University, received the American Association of Engineering Societies’ 2014 National Engineering Award. One person annually receives the award after each of the major engineering societies nominates one individual. Dr. Shoemaker was recognized for her inspirational leadership and tireless devotion to the improvement of engineering education and to the advancement of the engineering profession, as well as to the development of sound public policies.

Writing in the Cornell Chronicle about Dr. Shoemaker, Anne Ju states, “The award is for contributions to engineering education, research, and inspirational leadership, including becoming in 1985 one of the very first women engineering department chairs in a U.S. university, and founding and leading a 10-year international United Nations Environment Program/Scientific Committee on Problems of the Environment (UNEP/SCOPE) project on groundwater contamination in developing countries.” After the environmental problems highlighted by Love Canal, Dr. Shoemaker initiated the UNEP/SCOPE program in 1985 as environmentalists began to recognize the dangers of underground contamination by industrial chemicals.

Additionally, Dr. Shoemaker has planned workshops in developing countries and identified and worked with local organizers, and invited internationally leading scientists in the discipline to speak.

Tietjen Elected President of National Women’s Hall of Fame

Jill S. Tietjen, P.E., F.SWE, was elected as 2014-2015 president of the National Women’s Hall of Fame. Tietjen, president and CEO of Technically Speaking Inc., has spent her engineering career in the electric utility industry and is currently an independent director on two corporate boards.

A SWE past president, Tietjen began nominating technical women for prominent awards in the 1990s. She has successfully nominated more than 20 women into the National Women’s Hall of Fame and was herself elected to the Hall in 2008.

Tietjen was the first woman to chair the Cornell University Electrical and Computer Engineering Department and the first woman to chair its Board of Visitors. She has received numerous awards, including the 2010 Distinguished Achievement Award from the Engineering Council for Women. Tietjen has been inducted into the National Women’s Hall of Fame and is the first engineer to receive the American Association of Engineering Societies’ Women in Engineering Leadership Award. Tietjen has been recognized as a Women of the Year by Women in Engineering and Technology and Women at Cornell. She is a member of the National Academy of Engineering and the National Academy of Sciences and is past president of the New York Academy of Sciences. Tietjen has also received an honorary doctorate from Cornell University.

Jill Tietjen

Christine Shoemaker
Hall of Fame and has seen two of her nominees receive the National Medal of Technology and Innovation. She is co-author of the award-winning and best-selling book, *Her Story: A Timeline of the Women Who Changed America*. Tietjen was inducted into the Colorado Women’s Hall of Fame in 2010.

The National Women’s Hall of Fame is the United States’ oldest membership organization dedicated to recognizing and celebrating the achievements of great American women. It was established in 1969 in Seneca Falls, N.Y., birthplace of the American women’s rights movement.

**Pioneering Contributions in Polymers**

Sindee Simon, Ph.D., Texas Tech University, Whitacre Department Chair and Horn Professor of chemical engineering, received the Society of Plastics Engineers (SPE) 2014 Research/Engineering Technology Award for research and technology developments in polymers and polymer composites and for her pioneering contributions in thermal analysis of polymers. Dr. Simon’s research interests include the physics of the glass transition and structural recovery, melting, and the glass transition at the nanoscale, and cure and properties of thermosets.

The SPE recognizes excellence in the plastics industry annually by rewarding the efforts of individuals who have made outstanding contributions or lifetime achievements in plastics. The Research/Technology Award recognizes an individual who has made significant contributions in the fields of polymeric material development, processing, design, the innovative application of polymer engineering principles, and/or the fundamental understanding of the science of polymeric materials and their behavior (creation of new polymer structures, characterization, and understanding of polymer structures, properties, performance, and processing).

**Recognized for Innovative Contributions**

For her work on a committee dedicated to the development of standard test methods for use with testing pesticides, antimicrobials, and alternative control agents, Darla Goeres, Ph.D., assistant research professor of chemical and biological engineering in the Center for Biofilm Engineering at Montana State University, received an award from ASTM International.

The ASTM International committee, dubbed Committee E35, presented Dr. Goeres with the Chip Collins Memorial Award in recognition of her innovative contributions to the development of ASTM biofilm standards in the antimicrobial arena. She has been a member of ASTM International since 2000 and currently serves as a recording secretary on the E35 executive board.

“The award is something that validates the groundbreaking work that is done at the Center for Biofilm Engineering. At ASTM, I represent both the center and MSU,” said Dr. Goeres, who has taken a lead in the ASTM committee’s work on standardizing biofilm methods for use in testing the effectiveness of antimicrobial agents. “It’s an amazing example of technology transfer. We are taking technology that is being developed in an academic setting (the Center for Biofilm Engineering) and are getting it into the private sector so it can be put to use throughout the world.”

In January, Dr. Goeres was in Finland on a Fulbright Scholarship to pursue research and teach biofilm standards and methods as part of a continuing effort to make the technology she has helped develop at MSU available to industry around the globe.

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CNA is a not-for-profit organization that conducts objective, empirical research and analysis to help decision makers develop sound policies, make better-informed decisions, and manage programs more effectively.

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And through CNA’s Center for Naval Analyses, the federally funded research and development center (FFRDC) for the Navy and Marine Corps, we provide research and analysis services to the military to help improve the efficiency and effectiveness of our national defense efforts.

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Technology, Entertainment, and Design: Ideas Worth Spreading

We all look to find inspiration in our lives, and TED talks are popular for this very reason. They furnish a continually updated source of information, motivation, common-sense advice, and entertainment that is easy to share.

By Mary Verstraete, Ph.D., SWE Editorial Board

TED (technology, entertainment, and design) is listed as a “nonprofit devoted to Ideas Worth Spreading.” TED talks have been presented at TED conferences, which have occurred throughout the world since 1984, most recently in December 2013.

According to www.ted.com, “Each TED Conference features more than 50 of the world’s most innovative and influential speakers.” The speakers come from all walks of life and present on a wide variety of topics, including science, business, the arts, technology, and global issues. The conferences are also peppered with shorter, entertaining performances. Each talk is limited to 18 minutes, so speakers are expected to give “the talk of their lives.” The speakers may be well-known names in business or in entertainment, or they may be completely unknown.

The first TED talk I watched was by Sheryl Sandberg, COO of Facebook. Our collegiate section at The University of Akron chose this presentation to view at a member meeting, and it made quite an impact on the audience. In “Why We Have Too Few Women Leaders,” Sandberg provides compelling evidence, including personal stories, to show why women do not rise to leadership positions and offers three recommendations. The first is “sit at the table.” Sandberg discusses in a humorous way and through examples how women tend to underestimate their abilities, how they do not negotiate for higher salaries, and how they attribute their success to other external factors and people.

Her second piece of advice, “Make your partner a real partner,” is self-explanatory. Sandberg presents observations about successful marriages and the distribution of responsibilities in the family unit. Lastly, she suggests, “Don’t leave before you leave,” because thoughts concerning future plans such as pregnancy can prevent one from taking additional responsibilities or applying for promotions. Sandberg encourages women to keep moving upward on the career ladder every day, regardless of what they believe future plans may entail.

TED talks also include entertaining presenters who keep the audience amused and/or inspired, such as Maysoon Zayid: “I Got 99 Problems... Palsy Is Just One” (http://new.ted.com/talks/maysoon_zayid_i_got_99_problems_palsy_is_just_one).

Zayid is an Arab-American born with cerebral palsy. Encouraged by her parents, who convinced her that she could do anything, she has had an amazing journey on her way to becoming a comedian, actress, philanthropist, and an advocate for the disabled. Her performance is riddled with the shakes and tics associated with cerebral palsy, but the audience is only marginally aware of them. Instead, they revel in her comedic style, captivated, as she takes them on the journey of her life.

Elizabeth Gilbert, author of Eat, Pray, Love, gave a compelling talk, “Your Elusive Genius,” which proposes that we all have a bit of genius in us — genius moments in which whatever we are doing or thinking falls into place (http://www.ted.com/talks/elizabeth_gilbert_on_genius.html).

Her examples of these elusive times that cannot be “scheduled” made me recall days I’ve walked out of a classroom with a mental fist in the air, thinking “that was a fantastic lecture.” And she suggests that calling someone genius may be too heavy a burden; instead it should be recognized that we all have genius moments.

The website is fairly easy to navigate and viewers can narrow the talks to fit their interests, explore the “most-viewed” talks, or sort them by adjectives such as inspiring or funny. There are 144 different “playlists” where talks have been grouped according to a particular subject or a specific individual. However you choose to browse these more than 1,600 talks and presentations, you will most likely stumble upon one that inspires you, that makes you laugh or even cry, or makes you shake your head in disbelief.

Mary C. Verstraete, Ph.D., is associate professor and associate chair of the undergraduate program in biomedical engineering at The University of Akron. She earned her B.S., M.S., and Ph.D. in engineering mechanics/biomechanics from Michigan State University. A member of the SWE Magazine editorial board, Dr. Verstraete was named SWE’s Distinguished Engineering Educator in 2007 and received the Society’s Outstanding Faculty Advisor Award in 2011.
What Makes SWE Special?

Have you noticed how much attention SWE is getting these days? In the past several months, we’ve been quoted in *The Wall Street Journal* and the *Chicago Sun Times*, to name a couple of major sources. This coverage shows that the work we’re doing is important, and that people outside of SWE want to hear about it.

For many reasons, different individuals, groups, and employers find SWE is a great organization to be part of. In light of the external attention we’re receiving, it’s especially important to understand the reasons for our success and why there is interest. One way to ensure that our growth and this interest continue is to always portray our SWE brand as a professional organization.

When we say SWE is a professional organization, what exactly does this mean? Perhaps it’s best to start with what it does not mean. SWE is not just a social group. Yes, there is a social aspect to SWE. In fact, most of us probably came to our first SWE meeting because a friend invited us or because it just sounded like a way to meet like-minded people. That’s how I became involved. The social aspect of SWE is how we make connections and is a key component of what makes it such a great organization to belong to. But when you look at our mission — to stimulate women to achieve their full potential in careers as engineers and leaders, to expand the image of the engineering profession as a positive force in improving the quality of life and to demonstrate the value of diversity — the Society’s purpose certainly extends beyond social activities.

Then, what does it mean to be a professional organization? In content it means we treat one another in a respectful manner. It means our programs are conducted in a competent, businesslike fashion and with worthwhile and meaningful content. It means we manage our funds according to association standards. It also means that we might not always agree with our friends in SWE, but that we still work together for the common good.

Simple, right? Well, it should be, but we all know that working together toward a shared purpose can be challenging at times. In order to guide us toward a standard of professional behavior, we are fortunate to have our SWE values — inclusive environment, professional excellence, mutual support, integrity, and trust. We must put these values to use. When deciding what programs to have, for example, we want to be sure they are inclusive. Yes, SWE is a group largely composed of women engineers, but there is much diversity among us, and we need to be mindful of this.

We want to be inclusive of all. In fact, our diversity principles were designed to guide us on this path — from race/ethnicity, family status, age, physical abilities, sexual and affectional orientation, actual or perceived gender, gender identity and expression, socioeconomic status, and occupational focus. We need to show mutual support to this range of diversity, and to offer an inclusive environment. If it is pointed out that we are conducting ourselves in a manner that may seem offensive or noninclusive, we need to listen and trust this feedback, even though our opinions and perceptions may differ. Our programs and the environments we create within SWE need to have the utmost integrity. And, of course, we need to strive for excellence in all we do.

Maintaining excellence in a professional organization such as ours is tough work. We are 25,000+ members strong and growing every year. Others outside of SWE, such as potential employers, government agencies, adult influencers, and, yes, the media, are watching us. With so many eyes on us, being true to our values and standards is critical, now more than ever. Our mission includes to expand the image of the engineering profession as a positive force in improving the quality of life and to demonstrate the value of diversity; therefore, these external eyes will be impressed with us only if we exemplify these qualities. In fact, we have established our professional image because of our intentional efforts to do so.

I am proud to represent this great organization and all the work we do. Continue to make connections and make history, so that everyone can see that SWE is indeed a wonderful organization to be part of.

Stacey M. DeVecchio
FY14 President
Coffee Table Conversations

What happens when a SWE collegiate member sits down for a random chat with a practicing woman engineer? This periodic series set out to find the answer by pairing two women, previously unknown to each other, for a quick conversation about school, career, life, and whatever else struck their fancy.

A Collegian’s Experience
By Megan Hamilton

When I first met Lisa Depew at the 2013 SWE annual conference, I was struck by her energy and dynamic spirit. Lisa is a technical manager for the Business Client Platform Division within Intel’s PC Client Group. Within the span of her 16-year career with Intel, she has contributed greatly in various roles in technical marketing, served as an invaluable mentor, and made enriching connections with many individuals through SWE and Intel’s Women at Intel Network (WIN). In recognition of her achievements, SWE named Lisa a 2013 Emerging Leader. I was extremely grateful for the chance to meet Lisa and share a few words over coffee about engineering, female role models, and developing one’s personal and professional paths in life.

Growing up, Lisa was always highly interested in math and enjoyed the process of finding finite solutions. While in high school, her mother, a travel agent, kept a keen eye on her daughter’s interests and invited an engineer she had met through work to speak with Lisa about his job. While Lisa had never heard of engineering and was intrigued, initially she had doubts about the nature of engineering work. Nevertheless, she chose to pursue electrical engineering at the University of Dayton, receiving her bachelor’s degree in 1999.

It wasn’t until Lisa interned with Intel after her sophomore year that she realized engineers could be so much more than the “isolated cubicle, circuit designer” stereotype. She found that being a “people person” and being an excellent engineer didn’t have to be mutually exclusive and, in fact, could be a winning combination! This revelation inspired Lisa to intern with Intel for subsequent semesters.

I found it intriguing that Lisa’s background was so different from mine. While Lisa is the first engineer in her family, practically every other person in my family is an engineer of some sort, and since childhood, I’ve been inundated with the term “engineering” without truly understanding what it means to be an engineer. Although many people in my family have backgrounds in science and technology, something I do share with Lisa is that I am the first (and only) female engineer in my family. I found it inspiring that we were both drawn to this field because of our curiosity and passions for problem solving. I hope that many other women who are passionate about technology and related fields find the courage to pursue it — whether they are the first or the 17th female engineer in their family, passion is passion and should not be ignored.

Since earning her B.S., Lisa has made the Intel team at Folsom, Calif., her home base, while traveling all over the world to connect with customers and develop innovative client solutions. I was particularly impressed that Intel sent Lisa as part of a small team to familiarize children in a rural African village with personal computers, helping to connect them with vital technology with the potential to create change in their community.

Hearing Lisa speak so passionately about all the amazing opportunities she has had to grow, learn, and teach through Intel has made me tremendously excited to launch into my own career. During college, I’ve had the fortune of mentoring high-school students in a local ESOL (English for Speakers of Other Languages) program, and it has been incredibly rewarding to see how much they appreciate being listened to and understood. One day, I’d love to counsel young engineers and contribute my knowledge and advice in a similar manner. And, I know that as I progress in my career, I can look up to valuable mentor figures such as Lisa.

About 10 years into her career, Lisa reflected on her relationships at work and felt that something was missing. Through a friend, Lisa began attending WIN events and meetings. WIN provides opportunities available to all women in Intel to meet and communicate, share ideas, and build their careers. Lisa’s involvement in SWE came about several years later, through an internal announcement of a SWE leadership award recognizing one of Lisa’s mentors. After seeing her female mentor recognized for her technical leadership, Lisa was inspired to join SWE. Because of her involvement with WIN and SWE, Lisa has been able to build lasting connections, enrich her life through mentorship and friendship, and expand her network and influence to a size and scope beyond what she had ever imagined at the beginning of her career. Although Lisa wasn’t aware of SWE in college, she has been able to make a profound impact on the lives of others in the seven to eight years of her involvement thus far, including teaching regularly at annual conferences. I found this greatly reassuring; she didn’t need to be involved in something right from the inception of her career to make an impact, and sometimes opportunities for contribution and growth arrive at unexpected moments.

One piece of wisdom Lisa shared particularly resonated with me. Her father had always told her, “You can be anything you want to be!” While he
meant this to be wildly inspiring, Lisa said that she found it overwhelming at times; by having so many options at her fingertips, it was difficult to make decisions. She amends this advice for her own children by adding, “Be sure that you do something you love.” Although it sounds simple, I look forward to keeping this advice in mind. As someone who changed her major from art to math to engineering, I have found it difficult to pursue all my interests, while feeling pressure to reach my full potential.

Speaking with Lisa has helped me realize that the path to success and fulfillment isn’t always linear, and it’s immensely important to reach for new opportunities and challenge yourself at each stage of your career. I am so thankful for her insight. Speaking with her about her wealth of experiences has made me even more excited to embark on a new stage of life, after graduating with my B.S. this past December.

A Professional’s Perspective
By Lisa Depew

When I was approached about meeting and interviewing a collegian at the 2013 SWE annual conference, I did the first thing any midcareer professional would do: I tapped my network! I quickly went over to the Intel recruiting booth and said I needed to meet a fabulous, engaging, up-and-coming superstar ... and not two hours later, I received a text saying, simply, “We got one.” Let this be a lesson to all, on how to make your network work for you, because, boy, were those Intel recruiters right!

An hour or so later, I found myself having coffee with Megan Hamilton, a then-soon-to-be materials science and engineering graduate from the University of Florida. I saw a lot of my younger self in Megan — she was nervous, bright (but afraid to appear full of herself), and wanted to absorb anything and everything she could about how to continue to grow and be successful along her engineering career path.

Megan and I talked about our early years, and how we both found our paths to engineering. While I came from a very “non-techie” background and had no engineering role models, Megan had multiple family members who were engineers, so she knew a bit more about what a career in engineering might be like. What intrigued me was hearing that she initially started out as an art major! She then moved to math and quickly to materials science and engineering as she explored further and was fascinated by those topics. I could completely relate to the sense of having many passions and wanting to do them all, but ultimately having to pick one. Degree that is. (At least to start.)

What I wanted to make sure she took away — and that I would have loved a mentor to have told me early in my career — is that having multiple, diverse skills is a huge asset to your career and achieving your potential. And that even that interest can change over time — for example, evolving from a B.S. in one discipline to an M.S. in a second. Having talent at artistic design (and what I see pushing Megan toward user experience work as she pursues her master’s) is a tremendous strength and will differentiate Megan in a very positive way as she pursues full-time employment in the engineering profession.

A second trait that struck me during our conversation was Megan’s humility — that she seemed stunned people would spend such time and attention investing in her future. At the Intel career booth, she chatted with our company’s experts about a fellowship program and also possible internships. I think sometimes people think only electrical and computer engineers can find a fit at Intel. I thoroughly enjoyed my chat with her — as did our recruiters — and I’m thrilled to say Megan will be in Folsom for an Intel internship starting in March 2014!

She’ll be leveraging all that artistic and technological talent working on interaction design — what a perfect fit!

My advice to up-and-coming professionals: Embrace your talents and go be amazing! While humility is an admirable trait, do not ever doubt your capability. Technical females are bright, vibrant, smart, future leaders of the world. Feel empowered, go meet people, talk about what inspires you and what you’re passionate about, and let people help you get there!

Lastly, I’d like to say a word on opportunity. Call it coincidence, fate, or as my mother would say, “just good, clean living.” But keep your eyes and ears open for opportunity. I joined SWE somewhat by chance — back in 2007, I saw my mentor at the time receive the prestigious SWE Emerging Leader award, and I was in awe. “Wow, women in technology can do that?!” That’s amazing.” And I wanted to learn more. Megan joined SWE after meeting someone during a Dow Corning internship in Michigan who raved about SWE, her involvement, mentoring high school students, meeting professionals in the industry, etc. What’s ironic is that this same SWE advocate was actually an engineering student at Megan’s university in Florida. They realized this one day when both were wearing their Gators shirts. Never underestimate the value of a chance encounter or a random conversation — including a coffee talk at the annual SWE conference. Keep your eyes and ears open for ways to learn more and get involved. Pursue what you love, and be who you are, because you never know where it will lead.

Thanks to Megan for allowing me to be a part of her story. My best to her and all the professional women and future engineering professionals out there. Keep following opportunities, meeting others, and sharing your stories. As we learned throughout the WE13 conference: Make Connections. Make History.
From Gilbert, Ariz., to Washington, D.C.

A longtime SWE member finds a rewarding niche in the Society’s public policy efforts.

By Betty Irish, SWE

My journey into the world of public policy and SWE’s government relations and public policy (GRPP) committee began, officially, in July 2013. Unofficially, my journey began in my youth. Public policy issues were a topic of frequent conversations at the family dinner table in our household. In addition, I watched and listened to my father discuss policy matters with our local and state representatives in Indiana. In recent years, I’ve found myself thinking more about public service and I’ve become interested in my local downtown redevelopment commission. When I saw the opening for chair-elect for the GRPP, I knew immediately that I wanted to apply. I thought it would be a role I would truly enjoy, and it would fit nicely with my interest in public service. My application for chair-elect was accepted.

In addition, SWE is fortunate to have partnered with ASME’s Washington office, which has more than 40 years’ experience in public policy matters. Through this partnership, legislation pertinent to SWE’s goals is tracked by Melissa Carl, whose diligence keeps SWE’s public policy efforts focused and streamlined.

A memorable experience

During the 2013 SWE annual conference in Baltimore, I had the opportunity to support the Society’s mission in person on Capitol Hill. It was my first time in D.C. as something other than a tourist and it was a truly memorable event. For me, walking the halls of the Senate and House office buildings can only be described as “intoxicating.” I think had I walked those halls earlier in my life, my career would be very different today. Technical engineering input and expertise is needed by our legislators and I think I would have enjoyed serving in an advisory role.

Armed with information and fact sheets provided by Carl, I stepped into the office of Congressman Matt Salmon, who represents Arizona’s fifth district. To my surprise, I found his office full of memorabilia from Arizona State University, my alma mater. Even though I had been told that our congressional legislators are typically quite cordial, I was still surprised by the pleasant conversation I had with Salmon. I wasn’t able to personally meet with Arizona senators John McCain and Jeff Flake; however, I did meet with knowledgeable members of their staffs.

As I write this article, I’m preparing for the 2014 Capitol Hill Days, a large, prestigious event organized by SWE and attended by representatives from several dozen engineering and technical organizations. Armed again with fact sheets, I’ll get another opportunity to visit with Salmon, McCain, and Flake to ask for their support of critical STEM-related legislation and funding. As the FY15 GRPP chair, I’ll get a third opportunity.

The more I learn about public policy, the more I’m interested in it. I am coming to understand that meeting with one’s representatives is just the start of a dialogue, one that needs to be continued in order to be effective. I’ve visited the local offices of our congressional legislators and will continue to touch bases with them a few times a year to provide additional information on pertinent STEM-related legislation. I’ve also looked into public policy legislation related to my employment and other interests I have.

The training SWE provides is designed to empower us, the individual members, to engage in ongoing advocacy for the profession and ourselves. I am excited about the opportunities, and encourage readers to check the public policy page of the SWE website to find ways to become engaged, too.

Did I mention that Matt Salmon’s local office is located in the middle of the downtown area governed by the redevelopment commission I’m interested in getting a seat on?

Betty Irish works in the construction industry as a project manager for Comfort Systems USA Southwest, a large mechanical contractor in Arizona. In addition to being active in the SWE Phoenix Section, Irish is the current chair-elect of the government relations and public policy (GRPP) committee. Irish graduated from Arizona State University with a B.S. in mechanical engineering, and from Indiana University with a B.A. in history.
Donald P. Naismith, Ph.D.
SWE Fellow, Rodney D. Chipp Memorial Award recipient, longtime University of North Dakota department chair

Donald P. Naismith, Ph.D., professor emeritus of mechanical engineering at the University of North Dakota, died Jan. 16. A staunch advocate for women in engineering, Dr. Naismith was the faculty advisor to the university’s SWE collegiate section for many years, a role he continued following his 1995 retirement as chair of the mechanical engineering department.

Dr. Naismith was born April 22, 1931, in Lakota, N.D. He earned a B.S. in mechanical engineering from the University of North Dakota and was commissioned as second lieutenant in the U.S. Air Force. Returning to the university, he received a master’s in 1959, and in 1966 earned a Ph.D. in nuclear engineering from Iowa State University. He became chair of the mechanical engineering department at UND in 1969.

In 1973, Dr. Naismith joined the Society as a member of MASWE — the men’s auxiliary, which was disbanded in 1976 when men were able to become full-fledged members. In recognition of his outstanding support, he was awarded the Rodney D. Chipp Memorial Award in 1984. The citation read:

To Dr. Donald P. Naismith, our friend and advisor, whose inspiration taught us no goal was unattainable.

Contributions: Challenged, encouraged and supported women engineering students at UND to develop their fullest technical and personal abilities and to high levels of achievement and professionalism; supported the establishment of the UND SWE Student Section, serving as faculty member since chartering in 1974; instrumental in establishment of the position of Director of Women in Engineering at UND; supported and participated in the development of the UND Summer Institute for High School Girls for young women interested in considering engineering as a career field.

The SWE president at the time, Susan Whatley, recalled the circumstances of the award presentation, which was not at the SWE annual conference. Whatley traveled to Grand Forks, N.D., for the event.

“Don was one of my favorite SWE people,” Whatley said. “I was privileged to present him with his Rodney Chipp Award at the University of North Dakota. I worked with Joyce Medelan (longtime SWE counselor for the UND section) to keep it a surprise. He was sitting at the table in his shirtsleeves when he suddenly realized I was talking about him. He quickly donned his suit jacket.”

Dr. Naismith was highly regarded as an unselfish servant to his profession and the university. He not only supported the SWE section at the university, but he also was instrumental in the establishment of the American Society for Engineering Management and was the first faculty advisor to the university’s student section of ASEM. He was also active in ASME, receiving the ASME Centennial Medallion for distinguished service in 1980.

“His students thought the world of him, and he did everything in his power to help them succeed in their chosen field,” Whatley added. As evidence, in 1994 the SWE collegiate section endowed the Dr. Donald P. Naismith Scholarship at UND. For the university’s summer 2013 commencement ceremony, the speaker, Karen Nyberg, Ph.D., was a former student of Dr. Naismith. A NASA astronaut, she delivered her address from the international space station, and recognized Dr. Naismith by thanking him for his contribution to the “outstanding education and the excellent preparation” she received.

Dr. Naismith became a SWE Fellow in 1996, selected as the first male Fellow of the Society.

In addition to his wife, Shirley, whom he met in seventh grade and was married to for nearly 61 years, Dr. Naismith is survived by three daughters, nine grandchildren, and four great-grandchildren. Services were held Jan. 27 at Hope Covenant Church in Grand Forks. Memorial contributions may be given to the Dr. Donald P. Naismith Scholarship at UND. For the university's summer commencement ceremony, the speaker, Karen Nyberg, Ph.D., was a former student of Dr. Naismith.

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A NASA astronaut, she delivered her address from the international space station, and recognized Dr. Naismith by thanking him for his contribution to the “outstanding education and the excellent preparation” she received.

— Anne Perusek
Sources: SWE archives; www.grandforksherald.com
Stella Lawrence Daniels, F.SWE

SWE Fellow, founding and charter member, electrical engineer in academia and industry achieved a number of “firsts”

Daniels had a successful and varied career in industry and academia. A pioneer and trailblazer, Daniels earned a B.A. in math and physics, magna cum laude, from New York University in 1938, followed by a master’s in physics in 1941, also from NYU, prior to pursuing engineering.

Daniels’ work as a mathematician and a development engineer during World War II was the start of her engineering career. Following the war, she worked at Bell Telephone Laboratories, among the first women to work at the facility, and enrolled at Polytechnic Institute of Brooklyn. She became the first woman graduate from the school, earning a B.E.E., summa cum laude, in 1949, and an M.E.E. in 1952.

While at Bell Labs, Daniels began teaching evening courses on electrical circuits at Pratt Institute and physics at The City College of New York. After a few years of part-time teaching, she became an assistant professor of electrical engineering technology at Bronx Community College, retiring as a full professor in 1988. Her areas of expertise included fault tolerance of computers, solar energy applications, space industrialization, magnetohydrodynamics, and coding in communications systems.

Daniels kept her hand in industry through consulting work in the summers, most notably the years from 1975 to 1992, when she consulted for NASA, Wright-Patterson Air Force Base, and other employers.

As a founding and charter member of the Society, Daniels edited and published the New York Section newsletter and wrote for the Newsletter, Society of Women Engineers, predecessor to SWE Magazine. Daniels also wrote about women in engineering for various publications, most notably American Girl, which was the magazine of the Girl Scouts of the USA. Her article “Slide Rule Princess” was reprinted for many years and distributed to young women. She also wrote technical reports, served as an editor for Electronic Design magazine, and translated technical articles from Russian to English. Daniels became a SWE Fellow in 1985.

A fellow and the first woman member of the Brooklyn Engineers’ Club, Daniels was also a senior member of IEEE, serving on the executive committee and receiving the 1978 Professional Achievement Award. In 1970-72, she also served as the first woman president of the Technical Societies Council of New York. — Anne Perusek

Sources: SWE Archives, PalmMortuary.com

Margaret Haden Kipilo, P.E.

SWE pioneering member, founding member of the Pittsburgh Section

Margaret Haden Kipilo, P.E., a founding member of the Pittsburgh Section, died Aug. 25, 2013, in Naperville, Ill. Kipilo, who spent most of her life in the Pittsburgh area, was born Sept. 1, 1924, in Ebensburg, Pa.

Kipilo graduated from an accelerated program at The Pennsylvania State University in February 1945, earning a B.S. in electrical engineering. The only woman in a class of 120 electrical engineering students, she was also the first American woman to graduate from Penn State with a degree in electrical engineering.

A SWE pioneer and life member, she and 10 other women in the Pittsburgh area formed SWE’s Pittsburgh Section in 1952. Kipilo was among the first engineers to become a registered professional engineer in the state of Pennsylvania when the licensing program began, and for a time was the only woman in the state to hold a P.E. license.

Dedicated to the cause of women in engineering, Kipilo served the Pittsburgh Section as its first section representative, and as treasurer, as well as in other roles. On the Society level, she designed the first dues collection system, served on the scholarship committee, and attended many annual conferences. For each of the three times that the annual conference has been held in Pittsburgh, Kipilo served on the conference committee.

She was fond of recalling her meetings with many of the founding and early members of the Society that took place at the annual conferences — referred to as national conventions in SWE’s earlier days. Especially memorable was Lillian Moller Gilbreth, Ph.D., known as the “first lady of engineering,” the “mother of modern management,” and the mother in the book Cheaper by the Dozen.

Kipilo’s career included employment at various Westinghouse facilities, where she wrote technical manuals, among other projects, and was involved in developing people movers for the Bay Area Transit System. She also worked for Pennsylvania Electric in Johnstown, Pa., and Hamilton Standard in Hartford, Conn.

Her husband, Joseph, also an electrical engineer and P.E., preceded her in death. She is survived by five children, two of whom have engineering degrees. Of Kipilo’s eight grandchildren, two are engineers and a third is an engineering student.

Services were held in several locations, including Naperville, Ill.; Johnstown, Pa.; and Folsom, Calif. — Eds., with thanks to Janet Henke

Sources: SWE archives, Janet Henke
Meet the Leaders in the Recruitment and Retention of Women Engineers

Meet the SWE Corporate Partnership Council (CPC)—a strategic alliance among the Society’s most prominent supporters. The financial and talent resources that the CPC brings to SWE are invaluable in the pursuit of our mission. In return, CPC members and their constituents receive benefits, too. Among these is access to the most promising practices and latest research on the recruitment and retention of women in engineering. And we all benefit when women continue to strive for, and succeed in an engineering career.

To join the CPC visit SWE.org/Partner

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- Stryker
- Texas Instruments
- Toyota
- Turner
- URS Corporation
- US Navy
- United Technologies Corporation
- Verizon
In the Society’s new strategic plan, advocacy has a very prominent position. Specifically, the strategic plan states that SWE will advocate for the inclusion and success of women, present and prospective, in engineering and technology. The importance we are placing on advocacy also provides some insight on my recent travels. Over the past two months, I have attended several SWE region conferences, met with many of SWE’s Corporate Partnership Council (CPC) members, and represented the Society at award ceremonies.

Reflecting on these experiences, I am struck by how many organizations serve as our partners in advocacy. As an association, we know that our mission is advanced when employers recognize the value that women engineers bring to their companies and institutions. When these same employers embrace diversity and inclusion, they create a culture where all can thrive and succeed. At the February CPC meeting, for example, research-based presentations from both fellow CPC members and subject matter experts on ways to advance women in the workplace resulted in lively discussions. Participants were eager to take these best practices back to their respective organizations and implement them.

We also know that to actualize a truly inclusive workplace, leadership’s commitment is essential. I saw this in action on Introduce a Girl to Engineering Day, when I participated on a panel with Dow Chemical leaders to discuss the value of diversity and inclusion. Talking before a packed room of employees and local media, it was clear that the leaders at Dow understand the importance of not only having a diverse work force, but of making sure that their organization’s environment is inclusive of all.

When top employers vocalize their commitment to retaining and advancing women, it sends a message. The commitment of our CPC members to creating cultures that help retain and advance women is evident. This, in turn, creates a virtuous circle. As more organizations see how the inclusion of women is vital to innovation, the CPC membership grows. And through that growth, we are able to impact inclusion within the profession — not only for those currently in the field, but for those considering an engineering career as well.

I witnessed similar commitments from the many employers supporting SWE’s region conferences. Through participation in career fairs, conducting workshops, and sponsoring the attendance of their employees, these employers also support the inclusion and success of women in engineering.

We at SWE know what works. Our job is to get the best practices into organizations that employ women engineers. I encourage all of our SWE leaders to reach out to local employers. Invite them to SWE programs, talk with them about the value SWE provides. Position our organization as a “go-to” resource for help with recruiting and retaining women in engineering. Build partnerships in advocacy.

Expanding our universe

In a different twist on partners in advocacy, I was honored to attend the STEP Awards on Feb. 6, an event that recognizes the accomplishments of women in manufacturing. I applaud The Manufacturing Institute, sponsor of these awards, for highlighting the contributions women make to manufacturing and for supporting diversity and inclusion. Thirteen SWE members were part of this year’s cohort — for details, please turn to the “People” department on page 60.

As we consider the advocacy goal from our strategic plan, let’s expand our universe of potential partners. Encourage your local community, or other professional organizations you are part of, to leverage SWE as a diversity partner. We have a great deal to offer, from diversity and inclusion training to outreach resources aimed at reaching girls from diverse communities.

We know there still is a long way to go on our journey, and that we can’t change the climate for women in engineering alone. But I am convinced that, together with our partners in advocacy, we are making a difference.

Karen Horting, CAE
SWE Executive Director & CEO
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Growing Board, Growing Pains

Approved in 1951, SWE’s first set of bylaws established the board of directors as the Society’s governing body, composed of six officers, the immediate past president, six directors-at-large, and one director from each professional section. That structure worked when SWE had just a few sections, but by 1954, the Society had nine professional sections and a 21-person board that had difficulty certifying a quorum at meetings.

Vice President Dot Merrill summarized the growing problem in a July 15 letter to the board: “Now look what happens to us next year, when all the new sections have been chartered. We will have 6 Officers, 6 Directors at Large and 18 Section Directors. ... This makes a Board of 30, and one so unwieldy it would be almost impossible to operate efficiently.”

In the 1958 bylaws revision, the board of directors was replaced with a nine-person executive committee, which served as the Society’s governing body from 1959 until 1985. The new bylaws also established the council of section representatives, predecessor to today’s senate.

– Troy Eller English, SWE archivist
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